

Section II: Water Availability

The Polaris Institute is an Ottawa-based non-governmental organization that has been in existence since 1997. Our main goal is to enable citizen movements to develop new methods, strategies and tools in order to bring about democratic social change. As a result, most of our past educational work has focused on helping students to develop the critical thinking and leadership skills necessary to bring about on-the-ground action.

Full resource accessible online at: www.polarisinstitute.org/education

Other water education resources available at this site:

- Investigating Local Water (*Gr.9 Science: Biology—Sustainable Ecosystems*)
- Water Perspectives: Conflict and Action (*Gr.10 Civics and Citizenship*)

Section II of II: Water Use & Availability

Gr.9 Issues in Canadian Geography, academic (2013) *CGC1D

Description: In *Section I: Water Use*, we created a picture of water in Canada and explored how the way we use water is influenced by how we view it. *Section II: Water Availability* provides the next step for looking at water resources in Canada and around the world. It examines the impact of human activity on the Great Lakes (and other surface water sources), as well as a further exploration of other factors affecting water availability in various countries, globally. This resource also includes a student research project for examining the impacts of climate change on water availability in Canada. This section has four main goals:

1. Describe the significance of the Great Lakes as a source of freshwater in Canada
2. Identify some common impacts of human activity on the Great Lakes
3. Develop an appreciation for the different factors affecting water availability, in Canada and around the world
4. Understand & describe the effect of climate change on water resources in Canada

IMPORTANT NOTE FOR TEACHERS: This section of the resource contains some information “backgrounders,” including: The Great Lakes (p.2), Water Availability Around the World (p.12), and Climate Change & Water Availability (p.24). Although designed to meet expectations from the *Gr.9: Issues in Canadian Geography*, Ontario secondary school curriculum, this resource may also provide useful activities for *Gr.12: Environment & Resource Management*. We encourage you to use this resource as you see fit—that is, to take the activities, ideas and information presented here and make them your own. Good luck!

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Students complete two matching activities. The first helps them to understand the significance of the Great Lakes as a source of fresh water in Canada. The second outlines some of the impacts of various human activities on the Great Lakes.

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An examination and comparison of factors affecting water availability in various countries around the world, including Canada

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An electronic media project that has students gather, examine and analyze evidence of how climate change is influencing water availability in Canada

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Background Information: The Great Lakes

The Great Lakes (sometimes referred to as the Laurentian Great Lakes) contain the largest supply of freshwater in the world—around 1/5th of globally available freshwater (and more than 4/5th of the North American supply). They are made up of a series of five large, interconnected lakes, one small lake (Lake St. Clair), four connecting channels and the St. Lawrence Seaway.

	Ranking by Size (among Great Lakes)	Ranking by Size (worldwide)	Population in Lake Basin (Canada + U.S.)	Retention time (# of years required to get rid of pollutants)
Lake Ontario	Smallest	17 th largest	5.6 million	6
Lake Erie	4 th largest	13 th largest	12.4 million	~2.5
Lake Huron	2 nd largest	4 th largest	3 million	22
Lake Michigan	3 rd largest	5 th largest	12 million (U.S. only)	99
Lake Superior	Largest	2 nd largest	673,000	~170-200

During the last ice age, the Great Lakes were formed as a continental glacier retreated (~20,000 years ago). It was so heavy and powerful that the lake basins were gouged by the movement of the glacier over the Earth, which later filled up with meltwater from the retreating ice sheet. The Great Lakes attained their current water levels about 4,000 years ago.

The Great Lakes basin provides water for 40 million people in Canada (2 provinces) and the U.S. (8 states), as well as more than 200 billion litres of water per day for municipal, agricultural and industrial use. In fact, early settlers were drawn to the region around the Great Lakes for the agricultural land; today, the Great Lakes support 25% of Canada's farm production. Industrialization of the Great Lakes basin began in the early 20th century, including industries such as: steel, paper, chemicals, cars and other manufactured goods. The Great Lakes are still dealing with many harmful environmental impacts resulting from industry. Shipping is another important economy on the Great Lakes, with over 200 million tons of cargo (primarily iron ore, coal and grain) being shipped annually throughout the region.

Commercial and sport fishing are also important to the economy of the Great Lakes: each year, around 65 million pounds of fish are caught (the equivalent worth of one billion dollars!). However, challenges such as pollution, habitat destruction, over-fishing and the presence of invasive species have all contributed to a decline in the fisheries.

In the last century, the Great Lakes have been subjected to heavy pollution and increased withdrawals and diversions, often leading to adverse ecological and community impacts. The Great Lakes Water Quality Agreement was first signed in 1972 between Canada and the U.S. It is intended to work toward restoring and protecting water quality and ecosystem health in the Great Lakes. Through this agreement, both countries enforce marine environmental protection laws, observe water quality and monitor and protect wildlife and fish species in the Lakes. The agreement outlines strict protocols for dealing with accidental spills, as well as for dealing with the problem of invasive species through strict monitoring of ballast and other cargo discharges.

References...see p.37

Activity 1: Fresh Water in Canada—A Great Lakes Case Study

Learning Goals:

- Describe the significance of the Great Lakes as a source of freshwater in Canada
- Identify some common impacts of human activity on the Great Lakes

Curriculum Expectations (*Gr.9 Issues in Canadian Geography; academic, 2013, *CGC1D*):

<p>Strand A: Geographic Inquiry and Skill Development</p> <p>A1. Geographic Inquiry: use the geographic inquiry process and the concepts of geographic thinking when investigating issues relating to Canadian geography</p>	
<p>Strand B: Interactions in the Physical Environment</p> <p>B1: Analyse various interactions between physical processes, phenomena, and events and human activities in Canada</p> <p>B3: Describe various characteristics of the natural environment and the spatial distribution of physical features in Canada, and explain the role of physical processes, phenomena, and events in shaping them</p>	<p>B1.2 Analyse interrelationships between Canada’s physical characteristics and various human activities that they support</p> <p>B1.4 Explain how human activities can alter physical processes and contribute to occurrences of natural events and phenomena</p> <p>B3.2 Explain how geological, hydrological, and climatic processes formed and continue to shape Canada’s landscape</p>
<p>Strand C: Managing Canada’s Resources & Industries</p> <p>C2: Analyse issues related to the distribution, availability, and development of natural resources in Canada from a geographic perspective</p>	<p>C2.1 (1) Explain how the availability and spatial distribution of key natural resources in Canada are related to the physical geography of the country (including water), and (2) assess the significance of their availability and distribution, nationally</p>

Description: This two-part activity allows students to consider the significance of the Great Lakes as a major source of freshwater on the planet. Students will explore: (1) how they were formed & how much is available; (2) the impact of human activities on the Great Lakes.

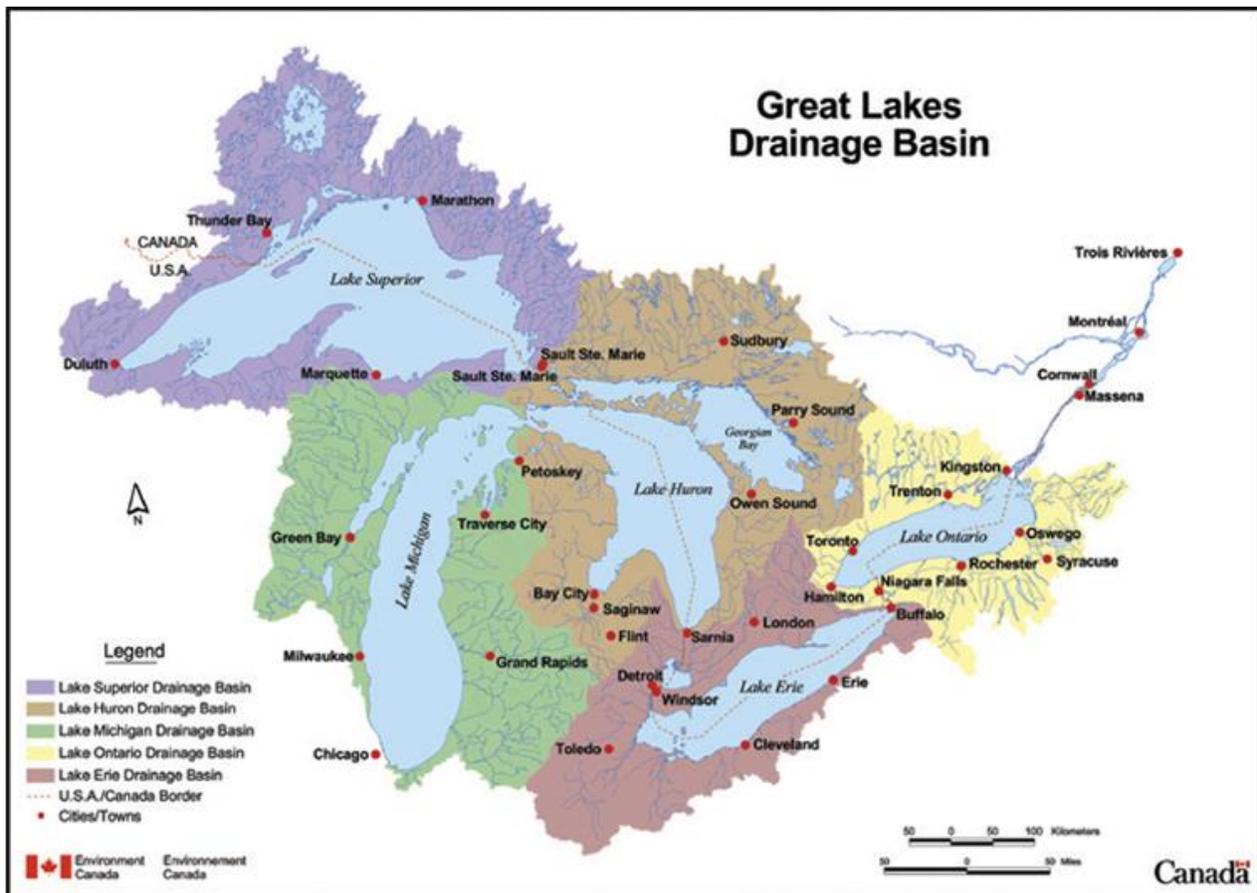
Time required: 1 class period (65-70 min)

Materials & Preparation:

- Map of the Great Lakes (classroom map and/or image for SMARTboard or projector)
- (*BLM 2.0*) Great Lakes Matching Activity—1 print-out per pair (p.6)
- (*BLM 2.1*) Human Activity & the Great Lakes—1 double-sided print-out per pair (p.10-11)

Engagement Strategy: [25-30 min]

- **Note:** *The purpose of this engagement activity is to help students learn more about the importance of the Great Lakes as a source of freshwater in Canada.*
- Show students a map of the Great Lakes
- Explain that, in pairs, students are going to complete a matching activity. Distribute (*BLM 2.0*) Great Lakes Matching Activity (p.6).
 - Students must match the statements (on the left) to the correct answers (on the right)
- Take-up the answers as a class. Use the **Background Information** on p.2 to discuss as needed.



Example Great Lakes Map [Source: <https://www.ec.gc.ca/grandslacs-greatlakes/>]

(BLM 2.0) Great Lakes Matching Activity

Teacher Key

Match the statement on the left with the correct answer on the right:

- | | |
|--|--|
| 1. The Great Lakes were formed by... | (4) 40 million ¹ |
| 2. The Great Lakes, as we now know them, are about _____ years old | (8) Sports fishing ² |
| 3. The amount of water found in the Great Lakes is equivalent to _____ cubic kilometres! | (5) Agriculture ³ |
| 4. The Great Lakes supply drinking water to _____ people in Canada and the U.S. | (9) Lake Ontario ⁴ |
| 5. Settlers were drawn to the Great Lakes region due to its potential for... | (3) 23,000 ⁵ |
| 6. About _____ Canadians live in Lake Ontario's watershed, representing >20% of the province's population. | (10) Lake Superior ⁶ |
| 7. In the early 20th century, the health of the Great Lakes was significantly impacted by _____. | (2) 4,000 ⁷ |
| 8. This industry, supported by the Great Lakes, is worth \$4 billion each year: | (1) Retreat of a continental ice sheet (glacier) during the last Ice Age. ⁸ |
| 9. More Canadians live in <i>this</i> Great Lakes watershed than any other watershed in Canada. | (6) 2.8 million ⁹ |
| 10. This Great Lake borders two Ontario cities and takes almost 200 years to rid itself of pollutants! | (7) Industry ¹⁰ |

¹ *Great Lakes Environmental Research Laboratory* (Michigan). National Oceanic and Atmospheric Administration, Department of Commerce (U.S.) <<http://www.glerl.noaa.gov/pr/ourlakes/facts.html>>

² <http://www.glerl.noaa.gov/pr/ourlakes/facts.html>

³ <http://www.glerl.noaa.gov/pr/ourlakes/economy.html>

⁴ *Lake Ontario Waterkeeper* (Toronto). <<http://www.waterkeeper.ca/lake-ontario/>>

⁵ <http://www.glerl.noaa.gov/pr/ourlakes/intro.html>

⁶ <http://www.glerl.noaa.gov/pr/ourlakes/facts.html>

⁷ <http://www.glerl.noaa.gov/pr/ourlakes/background.html>

⁸ <http://www.glerl.noaa.gov/pr/ourlakes/background.html>

⁹ <http://www.glerl.noaa.gov/pr/ourlakes/lakes.html>

¹⁰ <http://www.glerl.noaa.gov/pr/ourlakes/economy.html>

(BLM 2.0) Great Lakes Matching Activity

Student Activity Sheet

Match the statement in the *left* column with the correct answer in the *right* column (fill in the correct number in the blanks provided):

1. The Great Lakes were formed by... _____ 40 million
2. The Great Lakes, as we now know them, are about _____ years old _____ Sports fishing
3. The amount of water found in the Great Lakes is equivalent to _____ cubic kilometres! _____ Agriculture
4. The Great Lakes supply drinking water to _____ people in Canada and the U.S. _____ Lake Ontario
5. Settlers were drawn to the Great Lakes region due to its potential for... _____ 23,000
6. About _____ Canadians live in Lake Ontario's watershed, representing >20% of the province's population. _____ Lake Superior
7. In the early 20th century, the health of the Great Lakes was significantly impacted by _____ 4,000
_____.
8. This industry, supported by the Great Lakes, is worth \$4 billion each year: _____ Retreat of a continental ice sheet (glacier) during the last Ice Age
9. More Canadians live in *this* Great Lakes watershed than any other watershed in Canada. _____ 2.8 million
10. This Great Lake borders two Ontario cities and takes almost 200 years to rid itself of pollutants! _____ Industry

Teaching Strategy: [40 min]

- Students will complete a second activity, designed to help them learn about different impacts of human activity on the Great Lakes. The activity can be completed in pairs or as individuals.
- Distribute (*BLM 2.1*) Human Activity & the Great Lakes, p.10-11
- Read the instructions for the activity aloud to students
 - There are four impacts described (on p.1 of the activity sheet). Each represents a harmful impact to the Great Lakes as a result of human activity.
 - Students should read these four descriptions carefully, before moving on to examine the tables (p.2 of the activity sheet).
 - Each table represents one of the impacts described. Using the information provided (and critical thinking skills), students must match the information provided in the tables (on p.2) to the correct impact (on p.1).
 - Collect student activity sheets [after 20-25 min]
 - Go over each table with the class as a large group

Assessment

- Students complete the **Engagement Strategy** activity to assess their understanding of the importance of the Great Lakes as a source of fresh water. A class discussion at the end provides students with feedback and further context for the information presented in the activity.
- Collect the **Teaching Strategy** activity sheet. Review the correct answers for the tables with students, ensuring that they understand the linkages between human activities and their impacts on the Great Lakes. Discuss approaches and solutions for mitigating against these impacts. What can we do as individuals? As a society?

Differentiated Instruction:

- Have students complete both activities in pairs, matching students with stronger literacy skills with those who need additional assistance.
- Be sure to leave ample time to discuss the activities and answers aloud as a class.

Extension:

- Have students research and write a short, one-paragraph reflection on another human activity that impacts the Great Lakes. Have students describe: (a) the activity; (b) its impacts (both direct and indirect); and (c) possible solutions (to mitigate against the impact)
- Students could follow the same format as in (*BLM 2.1*) Human Activity & the Great Lakes (shown below)

Possible human activities responsible	“Ripple” effects	Solutions

(BLM 2.1) Human Activity & the Great Lakes (p.1 of 2)

Teacher Key

Instructions:

- Each table on page 2 represents a negative impact to the Great Lakes, resulting from human activity
- Read the Description of Impacts below
- Using the clues provided, **match each of the impacts below with the appropriate table on p.2**

Did you Know?
Many cities along the Great Lakes make use of them for both sourcing their drinking water and disposing of their wastewater...
Now, if this doesn't make us think differently about what we put down the drain, I don't know what will!

Description of Impacts:

High bacteria levels: If bacteria counts are high enough that there is a risk of causing human illness, this will result in beach closings and/or advisories. The most common bacterial pollution is E. coli, which indicates the presence of human or animal waste in the water.

Harmful Algal Bloom: Algal blooms occur when algae (a microscopic plant) grows to a point where a microscope is no longer needed to see it. Blue-green algae, known as cyanobacteria, cause algal blooms that are known to produce toxins (these are called "Harmful Algal Blooms"). These blooms are typically caused by high levels of nutrients (nitrogen and phosphorus), which may come from sources such as fertilizers or sewage.

Invasive Species: These are non-native species introduced from another body of water. They can outcompete native species for resources (such as food and habitat). Historically, a common way invasive species were introduced to the Great Lakes was in the ballast water of ships (used by large vessels for stability).

Low water levels: Since 1997-98, the Great Lakes basin has experienced the longest extended period of low water levels since tracking began in 1918. Although there are natural influences that impact this phenomenon, there are also several human activities that contribute to it. Read the tables on p.2 to determine which human activities might contribute to low water levels.

Table (answer key):

#1 = Invasive species; #2 = Harmful Algal Bloom;
#3 = High bacteria levels; #4 = Low water levels

YOUR TASK:

On page 2, write the appropriate impact (below) in the space provided for each table. Use the descriptions above to help you!

- High bacteria levels
- Harmful Algal Bloom
- Invasive Species
- Low water levels

(BLM 2.1) Human Activity & the Great Lakes (p.2 of 2)

Impact #1: Invasive species		
Possible human activities responsible	"Ripple" effects	Solutions
<ul style="list-style-type: none"> - Recreational boating - Commercial shipping - Aquaculture (fish-raising operations) 	<ul style="list-style-type: none"> - Loss of other plant or fish species - Impacts to the fishery and economy 	<ul style="list-style-type: none"> - Follow boating and shipping regulations in the Great Lakes - Continue to uphold the terms of the U.S-Canada Great Lakes Water Quality Agreement

Impact #2: Harmful Algal Bloom		
Possible human activities responsible	"Ripple" effects	Solutions
<ul style="list-style-type: none"> - Improper septic maintenance - Runoff from lawns, gardens, and farms - Overflow from wastewater management systems during high rainfall events (storm sewers, treatment plants) - Use of soaps & detergents that have phosphates 	<ul style="list-style-type: none"> - Decrease in dissolved oxygen levels due to excessive plant growth can lead to fishkills - Unsuitable water for human activity (e.g., swimming, drinking) - Toxic to humans and animals - Earthy or musty smell 	<ul style="list-style-type: none"> - Proper septic maintenance - Implement on-site water management practices (to reduce stormwater runoff) - Reduction in use of fertilizers and soaps/detergents with phosphates

Impact # 3: High bacteria levels		
Possible human activities responsible	"Ripple" effects	Solutions
<ul style="list-style-type: none"> - Improper septic maintenance - Runoff from manure piles - Overflow from wastewater management systems during high rainfall events (storm sewers, treatment plants) 	<ul style="list-style-type: none"> - Unsuitable water for human activity (e.g., swimming, drinking) - Human health effects 	<ul style="list-style-type: none"> - Proper septic maintenance - Implement on-site water management practices (to reduce stormwater runoff), particularly on farms - Effective waste treatment plants

Impact # 4: Low water levels		
Possible human activities responsible	"Ripple" effects	Solutions
<ul style="list-style-type: none"> - Dredging/ diversions - Water withdrawals - Climate change 	<ul style="list-style-type: none"> - Economic impacts (fishing, commercial shipping, recreational boating, hydroelectric generation, etc.) 	<ul style="list-style-type: none"> - Regulation - Conservation (energy and water)

(BLM 2.1) Human Activity & the Great Lakes (p.1 of 2)

Student Activity Sheet

Instructions:

- Each table on page 2 represents a negative impact to the Great Lakes, resulting from human activity
- Read the Description of Impacts below
- Using the clues provided, ***match each of the impacts below with the appropriate table on p.2***

Did you Know?

Many cities along the Great Lakes make use of them for both sourcing their drinking water and disposing of their wastewater...

Now, if this doesn't make us think differently about what we put down the drain, I don't know *what* will!

Description of Impacts:

High bacteria levels: If bacteria counts are high enough that there is a risk of causing human illness, this will result in beach closings and/or advisories. The most common bacterial pollution is E. coli, which indicates the presence of human or animal waste in the water.

Harmful Algal Bloom: Algal blooms occur when algae (a microscopic plant) grows to a point where a microscope is no longer needed to see it. Blue-green algae, known as cyanobacteria, cause algal blooms that are known to produce toxins (these are called "Harmful Algal Blooms"). These blooms are typically caused by high levels of nutrients (nitrogen and phosphorus), which may come from sources such as fertilizers or sewage.

Invasive Species: These are non-native species introduced from another body of water. They can outcompete native species for resources (such as food and habitat). Historically, a common way invasive species were introduced to the Great Lakes was in the ballast water of ships (used by large vessels for stability).

Low water levels: Since 1997-98, the Great Lakes basin has experienced the longest extended period of low water levels since tracking began in 1918. Although there are natural influences that impact this phenomenon, there are also several human activities that contribute to it. Read the tables on p.2 to determine which human activities might contribute to low water levels.

YOUR TASK:

On page 2, write the appropriate impact (below) in the space provided for each table. Use the descriptions above to help you!

- High bacteria levels
- Harmful Algal Bloom
- Invasive Species
- Low water levels

(BLM 2.1) Human Activity & the Great Lakes (p.2 of 2)

Impact #1: _____		
Possible human activities responsible	“Ripple” effects	Solutions
<ul style="list-style-type: none"> - Recreational boating - Commercial shipping - Aquaculture (fish-raising operations) 	<ul style="list-style-type: none"> - Loss of other plant or fish species - Impacts to the fishery and economy 	<ul style="list-style-type: none"> - Follow boating and shipping regulations in the Great Lakes - Continue to uphold the terms of the U.S-Canada Great Lakes Water Quality Agreement

Impact #2: _____		
Possible human activities responsible	“Ripple” effects	Solutions
<ul style="list-style-type: none"> - Improper septic maintenance - Runoff from lawns, gardens, and farms - Overflow from wastewater management systems during high rainfall events (storm sewers, treatment plants) - Use of soaps & detergents that have phosphates 	<ul style="list-style-type: none"> - Decrease in dissolved oxygen levels due to excessive plant growth can lead to fishkills - Unsuitable water for human activity (e.g., swimming, drinking) - Toxic to humans and animals - Earthy or musty smell 	<ul style="list-style-type: none"> - Proper septic maintenance - Implement on-site water management practices (to reduce stormwater runoff) - Reduction in use of fertilizers and soaps/detergents with phosphates

Impact # 3: _____		
Possible human activities responsible	“Ripple” effects	Solutions
<ul style="list-style-type: none"> - Improper septic maintenance - Runoff from manure piles - Overflow from wastewater management systems during high rainfall events (storm sewers, treatment plants) 	<ul style="list-style-type: none"> - Unsuitable water for human activity (e.g., swimming, drinking) - Human health effects 	<ul style="list-style-type: none"> - Proper septic maintenance - Implement on-site water management practices (to reduce stormwater runoff), particularly on farms - Effective waste treatment plants

Impact # 4: _____		
Possible human activities responsible	“Ripple” effects	Solutions
<ul style="list-style-type: none"> - Dredging/ diversions - Water withdrawals - Climate change 	<ul style="list-style-type: none"> - Economic impacts (fishing, commercial shipping, recreational boating, hydroelectric generation, etc.) 	<ul style="list-style-type: none"> - Regulation - Conservation (energy and water)

Background Information: Water Availability Around the World

“Water scarcity is an abstract concept to many and a stark reality for others. It is the result of myriad environmental, political, economic and social forces.”

By 2025, an estimated 1.8 billion people will live in water scarce areas. Two-thirds of the world’s people will be living in water-stressed regions as a result of overuse of resources, population growth and climate change. Other factors which will influence water availability include technology & engineering, as well as the presence of regulations to monitor the use and abuse of water systems.

Water availability must be assessed by virtue of both water *quality* and *quantity*.

Quality: Water must be considered safe to drink in order to be “available.” According to the World Health Organization, safe drinking water is treated surface water, and treated or untreated groundwater (such as from protected springs, boreholes and wells).

Quantity: Definitions of water availability must also include the *ability to access a certain quantity of safe drinking water, within a certain distance from the household*. In July 2010, the UN General Assembly voted in favour of a non-legally binding resolution recognizing the **right to water and sanitation**. The Assembly recognized the right of every human to have access to sufficient water for personal and domestic uses (50-100 litres of water/person/day), which must be safe, acceptable and affordable (not exceeding 3% of household income), and physically accessible (within 1 km of the home, with a collection time not exceeding 30 minutes).” The reality is that almost half of the world’s population does not have access to water in their homes; they must rely on wells, communal spigots, water trucks, lakes and/or rivers to collect their water. On average, women in developing countries walk 6km/ day to collect water for the household. In addition, about 300 million people worldwide depend on desalination technology to provide them with freshwater.

Currently, 1 in 8 people worldwide (900 million) lack access to clean water, and we are adding 83 million people to the world annually. In developing countries, the lack of basic waste disposal infrastructure poses a huge threat to water availability. More than 40% of the world’s population lives without hygienic toilets. Water-bourne diseases such as cholera, leptospirosis and botulism cause 4,800 deaths per day and cause suffering to 2.3 billion people per year. Most of these diseases cause diarrheal illness, which is the number one killer of children under age five in the world.

Not only is safe, accessible drinking water important for keeping us healthy as humans, water is also essential to producing our sustenance. Farming and ranching account for 64% of water use worldwide. Water irrigation grows 40% of the world’s food and makes it possible to feed the people on this planet!

References:

¹ National Geographic. *Freshwater Crisis*.

<<http://environment.nationalgeographic.com/environment/freshwater/freshwater-crisis/>>

² UN Water: Water for Life Decade. (2010). *Human right to water*.

<http://www.un.org/waterforlifedecade/human_right_to_water.shtml>

³ Water 1st International (Washington, US). *Global Water and Sanitation Awareness Curriculum*. (2012).

<http://www.water1st.org/wp-content/uploads/2012/10/Water1st_Curriculum.pdf>

⁴ Food and Water Watch. *Water: World Water*. <<https://www.foodandwaterwatch.org/water/world-water/>>

⁵ Sierra Club BC. *Water: Going Global Lesson Plans and Activities*. <<http://www.sierraclub.bc.ca/education/resources-tools>>

⁶ Global Education. *The Safe Water Challenge* <<http://www.globaleducation.edu.au/teaching-activity/the-safe-water-challenge-7-8.html>>

Activity 2: Water Availability Around the World

Learning Goal:

- Develop an appreciation for the different factors affecting water availability, in Canada and around the world

Curriculum Expectations (*Gr.9 Issues in Canadian Geography; academic, 2013, *CGC1D*):

Strand A: Geographic Inquiry and Skill Development

A1. Geographic Inquiry: use the geographic inquiry process and the concepts of geographic thinking when investigating issues relating to Canadian geography

Strand E:

Liveable Communities

E1: Analyse issues relating to the sustainability of human systems in Canada

E2: Analyse impacts of urban growth in Canada

E1.5 Propose courses of action that would make a community more sustainable

E2.1 Assess the impact of urban growth on natural systems and capacity (*e.g., water availability*)

E2.2 Analyse how various economic, social, and political impacts of urban growth distribution affect the community

Description: Students are presented with fictional “water profiles” from two characters living in different countries. The profiles highlight what might constitute a typical water reality for a person living in that country. The activity asks students to read the profiles, and fill in a Venn diagram comparing and contrasting the two different water availability scenarios. The follow-up assignment (see **Assessment**) asks students to investigate and answer questions related to water availability in Canada.

Time Required:

- Activity: 1 class period [65-70 min]
- Assessment: 2-3 class periods [OPTIONAL]

Materials & Preparation:

Activity

- (*BLM 2.2*) Water Availability Profiles (p.16)
 - 3 copies (x 4 pgs) = < 24 students
 - 4 copies (x 4 pgs) = < 32 students
- (*BLM 2.3*) Water Availability Around the World – 1 per pair (p.21)
 - **Note:* There are two Venn Diagrams per page. If, for example, there are 12 groups of 2 working on the activity, you need only print 6 copies of (*BLM 2.3*). Alternatively, have students draw their own Venn diagram on a sheet of paper.
- Chalkboard/ whiteboard/ SMARTboard *or* chart paper

Assessment [OPTIONAL]

- At least 2 class periods in the computer lab

Engagement Strategy: [10-15 min]

- Start a discussion with students on the different factors which influence people’s ability to have access to safe, clean water. Write the words “Quality” and “Quantity” on the board. Explain to students that both of these factors have the ability to influence **water availability** (that is to say, access to safe, clean water).
- With students, brainstorm different factors which might influence water “quality” and water “quantity.” For further information, refer to **Background Information: Water Availability (p.12)**. See also table below.
- **Note: You do not need to discuss each of the points below with students; simply enough to get an understanding of the breadth of factors which contribute to water availability. Many of these factors will be examined in context during the main activity (see Teaching Strategy).*

Quality

- **Pollution** (biological, chemical, physical)
 - **Lack of sanitation infrastructure** (influences ability to provide clean water sources)
 - **Deforestation** (siltation of water sources due to erosion)
 - **Salination** (freshwater contaminated with seawater sources)
 - **Others:** lack of waste disposal systems, presence of industry, littering, road run-off, *etc.*
- **Lack of water treatment** (facilities or in-home devices)
 - Due to cost and/or availability of technology

Quantity

- **Geography** (distance from source to home; related to this are *transportation* and *family unit*—what/who is available to help collect/carry water?)
- **Climate** (lack of water due to regional weather trends; related to this is the exacerbating effects of *climate change* on water availability)
- **Lack of water infrastructure** (to pump water from source)
- **Population** (# of people relying on source)
- **Water withdrawals** (for agriculture, industry, *etc.*)
- **Cost** (often the cost of accessing safe, clean water is too high for the income level of those seeking access; a related issue is *water privatization*)

Teaching Strategy: [60-min]

Description

- You should have 3-4 copies (12 to 16 pages) of (*BLM 2.2*) Water Availability Profiles. Each page lists two profiles which students will read and compare using a Venn diagram (*BLM 2.3*).
 - There are 8 Water Availability Profiles in total (four pages)
 - **Note:* In one class, there will be 3-4 different student pairs working on the same profiles at the same time.
- Each water availability profile* represents a fictional character living in a different country from around the world. The profiles highlight what might constitute a typical water reality for a person living in that country.
- **Note: Please emphasize to students that these profiles are meant to provide examples, and by no means represent the living conditions or “water realities” faced by all people in these countries. We want to be careful to avoid stereotypes, and concentrate on identifying some of the key threats to accessing safe water, worldwide.*

Activity [40 min]

- Have students work in pairs
- Distribute one page of the water profiles (*BLM 2.2*) to each pair, along with one copy of (*BLM 2.3*) Water Availability Around the World (Venn Diagram, p.21)
- Working together, ask students to read the profiles and fill in the Venn diagram by comparing the two different profiles with regards to *what factors* affect water availability in each
 - See **ANSWER KEY (p.20)**
- Debrief the activity as a class, either at the end if time permits, or during the next class. If you are going to take-up the activity during the next class, collect the Venn Diagrams from students before they leave. Be sure to have students put their names on their work.

Debrief [10-15 min]

- Write the country “pairings” from the water availability profiles on the chalkboard/ whiteboard/ SMARTboard
 - Haiti/ Bangladesh
 - Bolivia/ India
 - Afghanistan/ Ethiopia
 - Australia/ United States
- One at a time (under the appropriate heading), have each student pair write down one of the factors affecting water availability in both countries they worked with (*i.e.*, from the centre of their Venn diagram)
- Once there is a good list compiled, compare across the four lists—what appears to be the most common factor affecting water availability, worldwide?
 - *Possible answers*—Access to sanitation, poverty
 - *Ask*—Are these issues likely to cause problems for water availability in Canada? Why/ why not?
- In the follow-up assignment for this activity (see **Assessment**), students will examine more closely the Canadian context of water availability, as well as Canada’s role in addressing the world water crisis.

Assessment: [2-3 class periods]

- Using the information gathered from the activity, as well as some independent research, students will complete an assignment from a list of pre-determined options. This type of assignment is known as RAFT (Role, Audience, Form, Topic). See (*BLM 2.4*) RAFT Assignment, p.22.
- The assignment will be formally assessed—see (*BLM 2.5*) RAFT Rubric, p.23.
- Have students submit their research notes and/or rough draft as these will be part of the grading rubric.

Differentiated Instruction:

- Provide students with a list of factors that impact water availability (see table on p.14) for the main activity. Pair up students with stronger literacy skills with those needing additional assistance.

(BLM 2.2) Water Availability Profiles

p.1 of 4

[Student Copy]

Using your Venn Diagram, compare and contrast the following two water profiles. Concentrate on the factors that affect water availability in each country.

Haiti

Emmanuel lives in Haiti, a Caribbean country. He and his family, along with almost 40% of Haitians, lack clean water. In his rural community, the water treatment facility does not function properly. Another problem is that in Haiti, one in four people do not have a sanitary toilet, which is both an urban and rural issue. This basic lack of sanitation services means that water quality is affected. Emmanuel and his country are considered poor, with about 80% of Haitian people living in poverty. While underground water resources may exist (especially in mountainous and coastal areas), Haiti is considered a water-stressed country because of a lack of money to provide infrastructure to access this water. On top of all this, rainfall patterns mean too much water is provided during certain parts of the year, while too little falls in the dry season. Soil erosion as a result of deforestation is also causing a decrease in water quality.

Bangladesh

Sadia lives in the capital city of Bangladesh, a country in South Asia. Her younger sister, Chandni, recently fell ill with a diarrheal disease from drinking poor quality water. About 100,000 children in Bangladesh die each year from drinking contaminated water. One of the main problems is that many living in poverty (about 30% of Bangladeshis) do not have access to a safe toilet—almost half of the population lacks access to sanitation services. In addition, the urban population continues to increase rapidly, causing the slums to become overcrowded and placing a strain on already scarce water resources. Sadia and her family used to live in rural, western Bangladesh. However, in the 1990s, the drilled well in their community was found to be high in arsenic, a toxic metal which can cause death (1 in 5 deaths in Bangladesh are attributed to arsenic in drinking water). These water sources were closed off, forcing people to return to contaminated surface sources (ponds and ditches), or walk great distances to get to safe wells. On top of all this, Bangladesh's climate means that the country experiences drought in the cooler seasons, placing even more stress on water resources.

(BLM 2.2) Water Availability Profiles

p.2 of 4

[Student Copy]

Using your Venn Diagram, compare and contrast the following two water profiles. Concentrate on the factors that affect water availability in each country.

Bolivia

Juan lives in the city of Cochabamba, Bolivia (South America). In the spring of 2000, he and many others embarked in a high-profile struggle against water privatization, which came to be known as the “Water Wars.” The movement was based on the idea that access to water should be a basic human right; however, in a district known for its poverty, water prices were making access to water possible only for the wealthy.

Despite political improvements after the “Water Wars,” Juan knows that Bolivia still suffers from limited access to water and sanitation. Over 70% of the country lacks access to proper sanitation, and in Cochabamba, at least 40% of residents still lack piped water. Those without it are forced to pay more (for trucking in water), and even users on the piped system still experience periods with no water service.

Existing water infrastructure is old, and precious water resources are slipping through the cracks—quite literally! As a mountainous country, Bolivia also experiences geographic barriers to providing a centralized water service. Over the past number of years, Juan has been reading articles on climate change, which is quickening the pace of glacial melt (a primary source of water in Bolivia).

Seasonal droughts, exacerbated by a changing climate, also play into his country’s struggle to meet their water needs.

India

Mahesh lives in India, a South Asian country. It is the 7th largest country by area and 2nd largest by population—a fact which is placing a strain on the country’s water resources. One of the challenges is the level of poverty in India—over half of the population is considered poor. Lack of sanitation remains one of the main problems with water availability. Agricultural runoff into surface waters is a close second. Industrial waste also poses a chemical threat to water quality. Mahesh lives in rural India, where water problems are considered worse. Although India has made improvements over the past decades in providing quality drinking water through centralized systems, the result has been over-privatization of water resources—drawing into question the affordability of water.

India is also a major grain producer—the combined agriculture and population needs are causing groundwater to be used at a rate faster than it can be replaced. Fortunately, many parts of India are blessed with a wet climate, even in dry regions—one of the keys to addressing water scarcity is to work on catching and storing this rainwater for future use.

(BLM 2.2) Water Availability Profiles

p.3 of 4

[Student Copy]

Using your Venn Diagram, compare and contrast the following two water profiles. Concentrate on the factors that affect water availability in each country.

Afghanistan

Fahran is from rural Afghanistan. In a country where only a little over 10% of people have immediate access to clean drinking water, she is not one of the lucky ones. Although some areas of Afghanistan are water scarce due to climate and geography, most people don't have access to clean water because of: (1) a lack of water infrastructure; and (2) contaminated water from lack of sanitation—only 1% of people in rural areas of the country have access to sanitation. In a country with a long history of conflict, natural water supplies and existing infrastructures have been badly damaged or destroyed. Investing in clean water hasn't exactly been made a priority for the country, either. Fahran's family are farmers; although agriculture is an important economic activity in the country, international aid money has not gone toward developing water infrastructure. Fahran also knows that there have been increasing tensions between Afghanistan and its neighbours, Iran and Pakistan. Near the border, she and her family see water from mountain rivers (Afghanistan's main source) flow across the border, without being able to use it on their fields. Water tensions seem likely to cause yet more danger and violence for her and her people.

Ethiopia

Winta is from the African country of Ethiopia. She and her three young daughters must gather water for their family, while her husband and sons work in the fields. They are luckier than some—it only takes them 2-hours roundtrip to gather the water they need for the day, but if Winta were on her own, she would have to make three trips. Even so, their water source doesn't always provide them with clean drinking water—the same pond is shared with cattle and other animals. Last year, Winta lost her infant child to diarrheal disease. Sanitation is only accessible to about 20% of the population in Ethiopia (estimated at over 90 million), and contributes significantly to the lack of clean water sources. Winta's country is also plagued by recurring drought, which sometimes causes local ponds, lakes, and shallow wells to dry up. Climate change is causing the rainy season to become shorter, which means water (for people and agriculture) is a scarcer resource. Farmers are fighting for the water they need to grow their crops—in the horn of Africa, where Somalia borders Ethiopia, tribal conflicts over water occur. Winta worries for the safety of her and her daughters as they make the trek to gather water each morning.

(BLM 2.2) Water Availability Profiles

p.4 of 4

[Student Copy]

Using your Venn Diagram, compare and contrast the following two water profiles. Concentrate on the factors that affect water availability in each country.

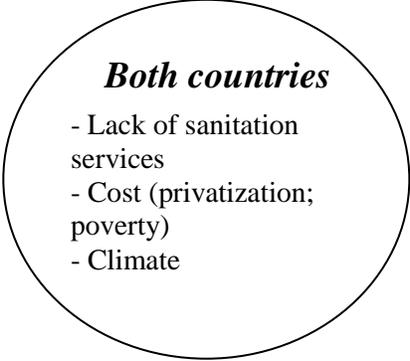
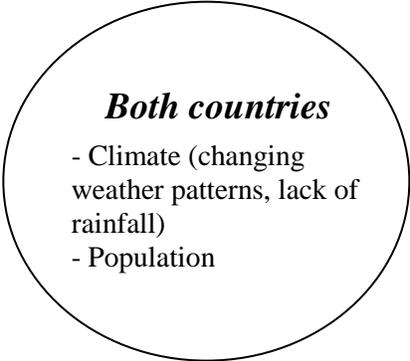
Australia

Tracy is from Perth, Australia. Australia is a developed country, and ranks in the top 15 wealthiest on the planet. Nevertheless, water scarcity is a growing concern, especially in Western Australia. Perth's climate is hot and dry, and climate change is believed to be causing a shift in weather patterns. Perth used to get a lot of winter storms, but these seem to be moving further south. Over the past three decades, the result has been much less surface water runoff to recharge the water reservoirs. Of the nearly 2 million people in Perth, most now draw their water from the ground; with a growing population, this water future is not sustainable. The groundwater will eventually run out, and the rains won't come to bring more. Luckily, Perth is able to plan ahead—they are building desalination plants (that turn seawater into freshwater) to deal with current and future water needs. However, the coal-powered desalination plants are contributing MORE to the problem by releasing large amounts of greenhouse gases into the atmosphere (which in turn contribute to climate change).

United States

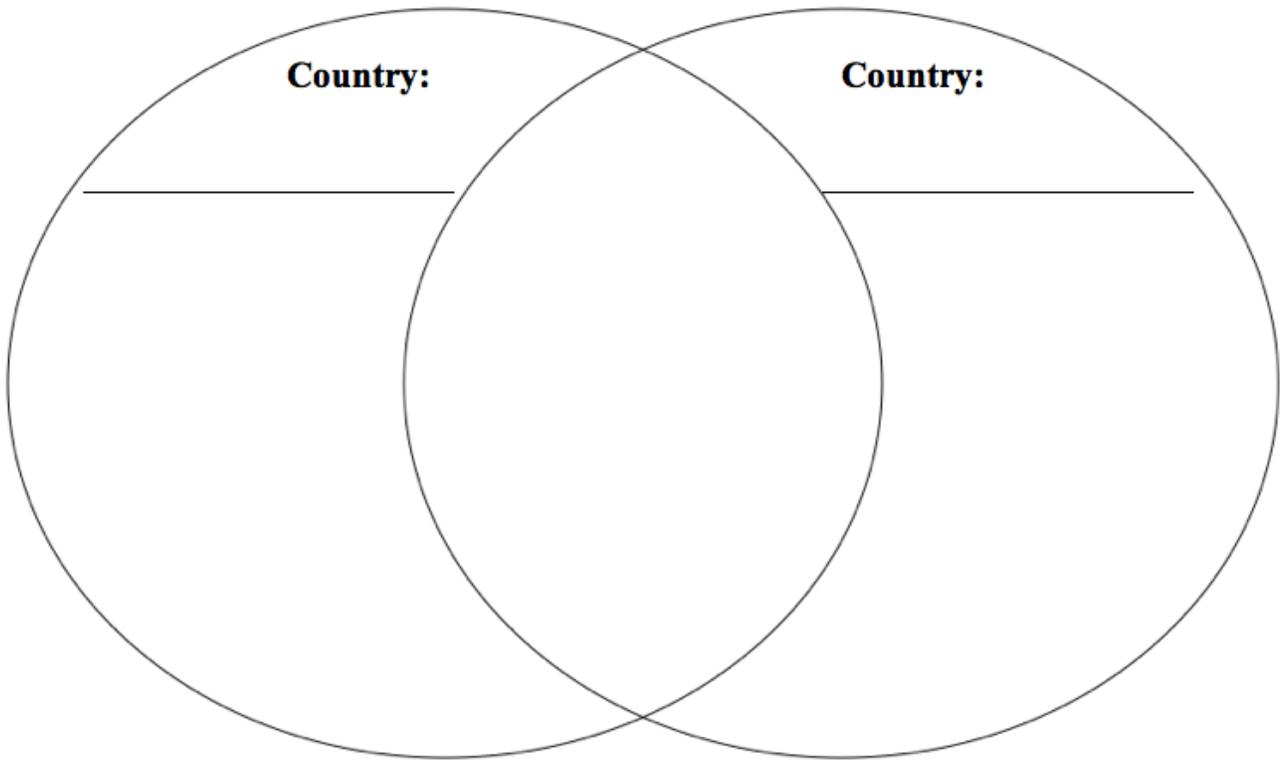
John lives in San Diego, California. He is working in with a team of experts to develop a 50-year water strategy for the city. In the Western U.S., surface water sources such as lakes, rivers, and reservoirs are diminishing due to an ongoing drought, which is believed to be a result of climate change. Important agricultural lands are going out of production because there isn't enough water to produce crops. Large cities such as San Diego have been forced to rely almost solely on groundwater, and the future of this is unsustainable. The average domestic water use per person in the United States is over 4 times that of India, and almost 8 times that of Bangladesh. With close to 1.5 million people in San Diego (a similar number to Perth), population and lifestyle choices (*i.e.*, how water is used, and in what quantities) will continue to affect California's water shortages. John's team knows that water restrictions, with enforcement and fines for violation, may be the only way forward in dealing with the city's water crisis.

ANSWER KEY (Venn Diagram):

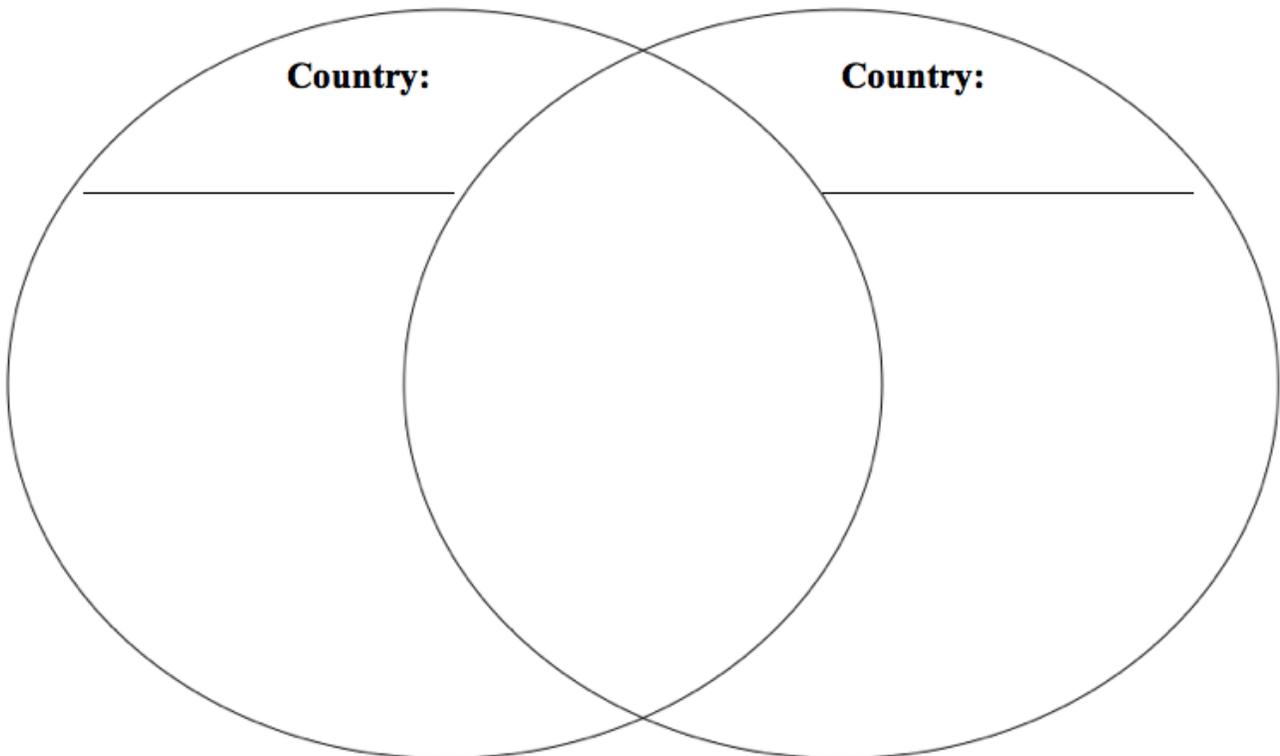
<p style="text-align: center;">Haiti</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of functioning water treatment facility - Lack of sanitation services - Deforestation (soil erosion) <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Lack of infrastructure to access water resources (related to country's poverty level) - Climate (rainfall patterns) 	 <p style="text-align: center;"><i>Both countries</i></p> <ul style="list-style-type: none"> - Lack of sanitation services - Poverty - Climate 	<p style="text-align: center;">Bangladesh</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of sanitation services (leading to contaminated surface water sources) - Groundwater toxic metal contamination (geographic, arsenic) - Urban overcrowding <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Climate (drought in cooler seasons)
<p style="text-align: center;">Bolivia</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of sanitation services <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Cost (privatization, but historically, poverty) - Aging infrastructure (water loss) - Geography (mountains) - Climate (glacial melt, drought) 	 <p style="text-align: center;"><i>Both countries</i></p> <ul style="list-style-type: none"> - Lack of sanitation services - Cost (privatization; poverty) - Climate 	<p style="text-align: center;">India</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of sanitation services - Poverty (lack of infrastructure) - Agricultural & industrial pollution <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Overpopulation - Cost (privatization; poverty) - Agricultural withdrawals - Climate (rainfall & catchment systems)
<p style="text-align: center;">Afghanistan</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of sanitation services <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Lack of water infrastructure (due to conflict) - Lack of investment in water supply - Geography (water supply that crosses country borders) - Climate (earlier snowmelt from mountains) 	 <p style="text-align: center;"><i>Both countries</i></p> <ul style="list-style-type: none"> - Lack of sanitation services - Climate - Conflict 	<p style="text-align: center;">Ethiopia</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Lack of sanitation services - Contamination from animals <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Distance to source - # of family members to gather water - Climate (drought) - Conflict (over water resources)
<p style="text-align: center;">Australia</p> <p><u>Quality</u></p> <ul style="list-style-type: none"> - Desalination technologies <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Climate (changing weather patterns, lack of rainfall) - Population 	 <p style="text-align: center;"><i>Both countries</i></p> <ul style="list-style-type: none"> - Climate (changing weather patterns, lack of rainfall) - Population 	<p style="text-align: center;">United States</p> <p><u>Quantity</u></p> <ul style="list-style-type: none"> - Climate (changing weather patterns, lack of rainfall) - Population - Lifestyle/ water use habits - Water restrictions

(BLM 2.3) Water Availability Around the World

In the space below, write down the factors affecting water availability in each of your two scenarios.
In the centre, list those factors that were common to both characters.



In the space below, write down the factors affecting water availability in each of your two scenarios.
In the centre, list those factors that were common to both characters.



(BLM 2.4) RAFT Assignment

Choose **one** of the following assignments

You will be assessed on how well you: (1) Answer the **Key Questions** outlined for your assignment; (2) Gather information and ideas relevant to the assignment; (3) Express and organize your ideas; (4) Form a concluding statement; (5) Communicate to your assigned audience (*Ask*: What do they know? What do you *want* them to know?)

Assignment #1

Role	Audience	Form	Topic
Water campaigner for the Council of Canadians <www.canadians.org>	Canadian public	Letter to the editor (<i>i.e.</i> , opinion piece in the newspaper)	Improving water availability for indigenous people in Canada
<p>Key Questions: What is the state of water availability for indigenous people in Canada? How could the <u>sustainability</u> of water resources be improved for indigenous communities?</p> <p>Note: It may be easier to use a <i>case study</i> (<i>i.e.</i>, discuss water availability in a specific community)</p>			

Assignment #2

Role	Audience	Form	Topic
Member of the United Nations Water Security Taskforce	United Nations delegates	Speech (political address)	The impact of population growth on water availability
<p>Key Questions: What is the current and future world population? How will an increasing world population affect future water availability? As water resources become scarcer worldwide, what will be some of the economic, social and/or political impacts? Will these be felt in Canada? How?</p>			

Assignment #3

Role	Audience	Form	Topic
Water utility expert	Urban municipality	Video teleconference	Preparing to meet increasing water demands in urban Canada
<p>Key Questions: How might urbanization (the move of people out of rural areas into urban ones) impact the availability of water? How will water infrastructure hold up to increasing demands? Who will pay for upgrades? Consider the privatization of water utilities—what happens when the cost of providing water services goes up? (<i>hint</i>: refer to recent example of Detroit, Michigan)</p>			

(BLM 2.5) RAFT Rubric

CRITERIA	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<i>Addresses the assignment topic (including Key Questions)</i>	Demonstrates <u>limited</u> understanding of assignment topic	Demonstrates <u>some</u> understanding of assignment topic	Demonstrates <u>considerable</u> understanding of assignment topic	Demonstrates <u>thorough</u> understanding of assignment topic
<i>Planning skills (e.g., gathers research evidence & information effectively)</i>	Uses planning skills with <u>limited</u> effectiveness*	Uses planning skills with <u>some</u> effectiveness	Uses planning skills with <u>considerable</u> effectiveness	Uses planning skills with <u>a high degree of</u> effectiveness
<i>Expressing & organization of ideas and information (e.g., clear expression, logical organization)</i>	Expresses and organizes ideas & information with <u>limited</u> effectiveness	Expresses and organizes ideas & information with <u>some</u> effectiveness	Expresses and organizes ideas & information with <u>considerable</u> effectiveness	Expresses and organizes ideas & information with <u>a high degree of</u> effectiveness
<i>Processing skills (e.g., interprets information & formulates concluding statement)</i>	Uses processing skills with <u>limited</u> effectiveness	Uses processing skills with <u>some</u> effectiveness	Uses processing skills with <u>considerable</u> effectiveness	Uses processing skills with <u>a high degree of</u> effectiveness
<i>Communication for different audiences or purposes (e.g., inform, persuade)</i>	Communicates for different audiences or purposes with <u>limited</u> effectiveness	Communicates for different audiences or purposes with <u>some</u> effectiveness	Communicates for different audiences or purposes with <u>considerable</u> effectiveness	Communicates for different audiences or purposes with <u>a high degree of</u> effectiveness

*Where “effectiveness” may represent: appropriateness, clarity, accuracy, precision, logic, relevance, significance, fluency, flexibility, depth, and/or breadth.

Notes for Student:

Background Information: Climate Change & Water Availability

Climate Change is one of the greatest challenges facing our planet. What is causing it? Greenhouse gases are released by burning fossil fuels for energy. Fossil fuels include: coal, oil and natural gas. We call these gases “greenhouse gases” (GHGs) because of their ability to trap heat from the sun. Although alternative sources of energy exist (such as sun, wind and hydro), the world still relies heavily on these ancient “fossil” fuel stores as our main power source. Although GHGs are needed to trap enough heat on our planet for life to exist, too many GHGs are building up in the atmosphere. This has led to an increase in the earth’s average global temperature, at a rate unlike anything seen before in our planet’s history. This change has led to a number of large-scale impacts, one of which has been to the availability of water in parts of the world.

Water Availability is being influenced by climate change in the following ways:

(1) Changing weather patterns: Climate refers to the long-term weather patterns of an area. People (and other animals) build their lives around the climate they live in. For example, a **change in rainfall patterns could lead to different extremes—drought or flooding**. Drought influences water availability in terms of *quantity* (how much is available), whereas flooding can actually affect the *quality* of surface water sources (through contamination).

(2) Global warming trends: The average global temperature is now ~1-1.5°C warmer than it was a century ago. Although this doesn’t seem like much, remember that this average is calculated from warming across the *entire planet!* This has had an impact on freshwater that is stored in ice—that is to say, **glacier and snow melt**. Many areas of the world rely on these sources to provide them with a steady source of freshwater supplies throughout the year.

Activity 3: Climate Change & Water Availability

Learning Goals:

- Understand the effect of climate change on water resources in Canada.
- Describe the connection between climate change and water availability in Canada in terms of the environment, economy, society and politics.

Curriculum Expectations (*Gr.9 Issues in Canadian Geography; academic, 2013*):

Strand A: Geographic Inquiry and Skill Development	
A1. Geographic Inquiry: use the geographic inquiry process and the concepts of geographic thinking when investigating issues relating to Canadian geography	
Strand B: Interactions in the Physical Environment B1: Analyse various interactions between physical processes, phenomena, and events and human activities in Canada B2: Analyse characteristics of various physical processes, phenomena, and events affecting Canada and their interrelationship with global physical systems	B1.3 Assess environmental, economic, social, and/or political consequences for Canada of changes in some of the Earth’s physical processes B1.4 Explain how human activities can alter physical processes and contribute to occurrences of natural events and phenomena B2.2 Describe patterns and trends in the occurrence of a variety of natural phenomena and events in Canada (<i>e.g.</i> , mapping areas of drought, precipitation trends)

Description: An electronic media project that has students gather, examine and analyze evidence of how climate change is influencing water availability in Canada.

Time Required: 2-4 class periods (spread over 1-2 weeks)

Materials & Preparation:

- Chalkboard/ whiteboard/ SMARTboard *or* chart paper
- One copy per student—(*BLM 2.6*) E-Portfolio Project (3-pgs), p.28-30
 - Alternatively, print only p.29 & have students complete the questions from the table (p.29-30) on the computer and submit them electronically with the e-portfolio.
- (*BLM 2.7*) Example E-Portfolio Project (2 pages), p.31-32
 - Digital copy to post online as example for students (or paper copy to post in classroom for reference)
- [Optional] (*BLM 2.8*) E-portfolio Assessment Rubric, p.33
- 2 classes booked in the computer lab

Engagement Strategy: [15-20 min]

- Explain to students that for this assignment, they will be exploring some of the ways that climate change influences water availability
 - **Note:** If you have completed **Activity 2: Water Availability Around the World** with your class, students will have already been introduced to a few climate-related factors affecting water availability
- Using the knowledge already existing in the class, discuss some of the foundational information about climate change**:
 - What/who is causing it?
 - What are some of the impacts? How do these influence water availability?
 - Given what you know about climate change, do you think it is influencing water resources in Canada? Why/ why not?

****Note:** Refer to the **Background Information** on **p.24** for more information on climate change and water availability to help lead this short discussion.

Teacher's Choice: Many online teaching tools and lessons exist to introduce climate change to students of all ages. If you feel it more appropriate to spend additional time on this introduction, refer to the wealth of media that exists on this subject. Try <www.r4r.ca> (Resources for Rethinking) for a start.

Teaching Strategy:

- Students will be conducting their own research by putting together a portfolio of media evidence that creates a portrait of the impact of climate change on water availability in Canada.
- For the electronic portfolio, or “e-portfolio,” evidence* may take the form of:
 - Articles from reputed newspapers or magazines
 - Excerpts or case studies from books or blogs written by experts
 - Videos or film clips made by expert bodies (*e.g.*, National Geographic, National Film Board of Canada)
 - Photos, images, slides, maps, cartoons, *etc.*

***Note:** To help students decide if a piece of media evidence is appropriate, they will consult **Determining Credible Sources** in (*BLM 2.6*) E-Portfolio Project

- Students must find at least **four credible pieces of evidence** on the internet, depicting each of the following:
 - (1) the impact of human activity on climate change in Canada
 - *E.g.*, Image of factory with smokestack; article on the Alberta Tar Sands; *etc.*
 - (2) an impact of climate change on glaciers (or the Arctic) in Canada
 - *E.g.*, Article on trends of summer ice break-up in the Arctic; picture showing “then and now” of the reach of the Athabasca glacier; *etc.*
 - (3 & 4) a current or projected impact of climate change on water availability in Canada
 - *E.g.*, chart showing average temperature rise in Canada over last century; article on crop failures in prairies due to drought; recent extreme flooding events in Alberta and Ontario; map of expected areas of drought; *etc.*

- See (*BLM 2.6*) E-Portfolio Project (p.28) for instructions and information for students to complete this assignment. It also includes example wording for internet searches and guiding questions for determining source credibility.
- For each piece of evidence, students will also need to fill out a section of the table in (*BLM 2.6*) E-Portfolio Project (p.29-30). The purpose of this is to demonstrate that students have reflected on their reasons for including a particular piece of media in the portfolio, and can explain how each piece fits with the descriptions, above (for evidence to be gathered).
- [OPTIONAL] Go through the example e-portfolio table answers in (*BLM 2.7*), p.31-32

Assessment:

- Collect the e-portfolio assignment. This includes two parts:
 - (1) E-portfolio evidence—4 pieces
 - This may be collected: via USB key, email (attachments and/or hyperlinks), or an online classroom learning environment (see: <[GreenLearning's Cool 2.0](#)>)
 - (2) Table from (*BLM 2.6*) E-Portfolio Project (p.29-30)
- Use the rubric in (*BLM 2.8*) to grade the assignment (p.33)

Differentiated Instruction:

- To shorten this project, have students choose one of the four topic areas listed and find 2-3 pieces of evidence for that topic area. Then have students complete one table from (*BLM 2.6*), p.29-30, using all of the pieces of evidence gathered.

(BLM 2.6) E-Portfolio Project p.1 of 3

Instructions:

(A) For this assignment, you must gather pieces of evidence from the internet demonstrating each of the following:

- (1) The impact of human activity on climate change in Canada
- (2) An impact of climate change on glaciers (or the Arctic) in Canada
- (3 & 4) A current or projected impact of climate change on water availability in Canada

(B) Complete the attached table describing each of your four pieces of evidence. You must hand in this table, along with a copy of your e-portfolio (which you may submit digitally).

(C) Remember, your evidence must be credible! Look for the following: articles from reputed newspapers or magazines; excerpts or case studies from books or blogs written by experts; videos or film clips made by expert bodies; photos, images, slides, maps, cartoons, *etc.*

(D) Refer to the information below for further help with this assignment. Good luck!

Determining Source Credibility:

- Who is the author/ creator? What are their credentials—*e.g.*, are they considered an expert in their field?
 - Consider: University professors, researchers, science writers, journalists with well-known publications, *etc.*
 - For non peer-reviewed* sources, consider whether the content seems balanced and objective, or only one-sided. Does the author/ creator have any vested interest in portraying a certain story? (*e.g.*, money, reputation, avoiding a public response to the issue, *etc.*)
- Does it have more than one author/ contributor? If so, do they work for the same or different organizations?
 - **Note*: The same evidence coming from two or more different sources adds to its credibility.
- Is the source current? (What is the date that it was written/ created? Is it within the last 5 years?)

****What does peer-reviewed mean?***

Peer-reviewed means an article has been evaluated by other researchers or subject specialists in an academic community, prior to being published.

Example Internet Searches:

Some search parameters will not yield the results you are looking for. The trick is to find a balance between being specific enough, and not overly specific. The following search terms can get you started:

- Glacier melt + climate change + Canada
- Drought + climate change + Canada
- Flooding + climate change + Canada

1) Impact of human activity on climate change in Canada

Describe the evidence & why you chose it: _____

How did you decide it is credible? _____

Describe the impact (*i.e.*, what does the evidence *show*?): _____

Describe a social, political, or economic consequence of this impact: _____

2) Impact of climate change on glaciers (or the Arctic) in Canada

Describe the evidence & why you chose it: _____

How did you decide it is credible? _____

Describe the impact (*i.e.*, what does the evidence *show*?): _____

Describe a social, political, or economic consequence of this impact: _____

3) Current or projected impact of climate change on water availability in Canada

Describe the evidence & why you chose it: _____

How did you decide it is credible? _____

Describe the impact (*i.e.*, what does the evidence *show*?): _____

Describe a social, political, or economic consequence of this impact: _____

4) Current or projected impact of climate change on water availability in Canada

Describe the evidence & why you chose it: _____

How did you decide it is credible? _____

Describe the impact (*i.e.*, what does the evidence *show*?): _____

Describe a social, political, or economic consequence of this impact: _____

(BLM 2.7) Example E-Portfolio Project

Example E-Portfolio for Students—to post online or in the classroom for reference

1) Impact of human activity on climate change in Canada

Describe the evidence & why you chose it: This is an article on the impact of the Alberta tar sands on the Athabasca River. It includes an image of smokestacks next to the river. I chose it because as Canadians, we are contributing to climate change through our dependence on oil, which is a fossil fuel.

<<http://www.nature.com/news/2010/100831/full/news.2010.439.html>>

How did you decide it is credible? The source is in an international weekly journal of science. It lists two references at the end, both of which are peer-reviewed journal articles from a science journal.

Describe the impact (i.e., what does the evidence show?): The article describes how Canada's oil-mining operations are releasing toxic heavy metals into the Athabasca river.

Describe a social, political, or economic consequence of this impact: Seven pollutants were found at high enough concentrations to pose risk to aquatic life. The findings of the study were also a concern to human health.

2) Impact of climate change on glaciers (or the Arctic) in Canada

Describe the evidence & why you chose it: News article entitled: "Athabasca Glacier melting at 'astonishing' rate." I chose it because it is a recent article from May 2014 about a shrinking glacier in Canada.

<<http://www.macleans.ca/news/canada/athabasca-glacier-melting-at-astonishing-rate/>>

How did you decide it is credible? Maclean's magazine is a popular Canadian magazine and the article was by the Canadian Press.

Describe the impact (i.e., what does the evidence show?): The article talks about how the glacier will likely be gone within a generation, and that it has been shrinking over the last 150 years. It says glacial melt is a major climate change issue, and that this phenomenon will impact: hydro-power production, ocean circulation patterns, fisheries, and global sea-level rise.

Describe a social, political, or economic consequence of this impact: The Athabasca glacier is a popular tourist destination in Jasper National Park in the Rocky Mountains. Visits to the glacier bring in a lot of money, and the tourism attraction creates jobs in Jasper.

3) Current or projected impact of climate change on water availability in Canada

Describe the evidence & why you chose it: News article from 2009 entitled: “Climate change in the land of great drought.” I chose it because it talks about how climate change will make drought in the prairies more commonplace.

<<http://www.theglobeandmail.com/globe-debate/climate-change-in-the-land-of-great-drought/article4278159/>>

How did you decide it is credible? I decided it is credible because it is a fairly recent article in a well-respected Canadian newspaper (the Globe and Mail). The author, Barry Smit, is the Canada Research Chair in Global Environmental Change at the University of Guelph and co-editor of a publication called “Farming in a Changing Climate.”

Describe the impact (i.e., what does the evidence show?): The article describes how frequency and severity of drought has been increasing in the prairies, and how people and governments need to start preparing for impacts to farms as a result of water shortages.

Describe a social, political, or economic consequence of this impact: This will impact the agricultural sector’s economy, as well as insurance companies and governments who provide support to farmers. It could become a hugely political issue as well, given that farming is a key economy in the Canadian prairies.

4) Current or projected impact of climate change on water availability in Canada

Describe the evidence & why you chose it: Webpage post from July 2013 by Environmental Defence entitled: “Making Canada Resilient to Climate Change.”

<<http://environmentaldefence.ca/blog/making-canada-resilient-climate-change>>

How did you decide it is credible? Environmental Defence is an NGO that has been around for 30 years and their aim is to protect the environment and human health. It is a recent posting.

Describe the impact (i.e., what does the evidence show?): The page discusses the need for Canada, and especially Canadian cities, to adapt to the increase and severity of flooding events because they will only become more common. It talks about Canada’s aging infrastructure as one of the key challenges.

Describe a social, political, or economic consequence of this impact: Being unprepared for flooding can impact water quality because freshwater sources can become contaminated during flooding events (the water picks up debris and pollutants and carries them into the surface water sources).

(BLM 2.8) E-Portfolio Assessment Rubric

CRITERIA	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<i>Knowledge & Understanding</i> (justification of media evidence selected)	Provides <u>no</u> justification of evidence selected	Provides <u>limited</u> justification of evidence selected	Provides <u>appropriate</u> justification of evidence selected	Provides <u>considerable</u> justification of evidence selected
<i>Planning skills</i> (gathers appropriate evidence effectively)	Gathers inappropriate evidence	Gathers appropriate evidence, with <u>some</u> exceptions	Gathers appropriate evidence with <u>no</u> exceptions	Gathers appropriate evidence with a <u>high degree of</u> effectiveness*
<i>Processing skills</i> (detecting bias in research sources)	Unable to detect bias in research sources	Detects bias in <u>some</u> research sources	Detects bias in <u>most</u> research sources	Detects bias in research sources with a <u>high degree of</u> effectiveness
<i>Communication</i> (clearly synthesizes and expresses ideas)	Communicates with <u>limited</u> effectiveness	Communicates with <u>some</u> effectiveness	Communicates with <u>considerable</u> effectiveness	Communicates with a <u>high degree of</u> effectiveness
<i>Application</i> (makes connections and applies critical thinking skills)	Makes connections and applies critical thinking skills with <u>limited</u> effectiveness	Makes connections and applies critical thinking skills with <u>some</u> effectiveness	Makes connections and applies critical thinking skills with <u>considerable</u> effectiveness	Makes connections and applies critical thinking skills with a <u>high degree of</u> effectiveness

*Where “effectiveness” may represent: **appropriateness, clarity, accuracy, precision, logic, relevance, significance, fluency, flexibility, depth, or breadth.**

Notes for Student:

Acknowledgements

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We welcome any and all feedback on this educational resource.

Appendix A: Curriculum Expectations

Issues in Canadian Geography (Gr.9), CGC1D – academic

<p>Strand A: Geographic Inquiry and Skill Development</p> <p>A1. Geographic Inquiry: use the geographic inquiry process and the concepts of geographic thinking when investigating issues relating to Canadian geography</p>	
<p>Strand B: Interactions in the Physical Environment</p> <p>B1: Analyse various interactions between physical processes, phenomena, and events and human activities in Canada</p> <p>B2: Analyse characteristics of various physical processes, phenomena, and events affecting Canada and their interrelationship with global physical systems</p> <p>B3: Describe various characteristics of the natural environment and the spatial distribution of physical features in Canada, and explain the role of physical processes, phenomena, and events in shaping them</p>	<p>B1.2 Analyse interrelationships between Canada’s physical characteristics and various human activities that they support</p> <p>B1.3 Assess environmental, economic, social, and/or political consequences for Canada of changes in some of the Earth’s physical processes</p> <p>B1.4 Explain how human activities can alter physical processes and contribute to occurrences of natural events and phenomena</p> <p>B2.2 Describe patterns and trends in the occurrence of a variety of natural phenomena and events in Canada (<i>e.g.</i>, mapping areas of drought, precipitation trends)</p> <p>B3.2 Explain how geological, hydrological, and climatic processes formed and continue to shape Canada’s landscape</p>
<p>Strand C: Managing Canada’s Resources & Industries</p> <p>C2: Analyse issues related to the distribution, availability, and development of natural resources in Canada from a geographic perspective</p>	<p>C2.1 (1) Explain how the availability and spatial distribution of key natural resources in Canada are related to the physical geography of the country (including water), and (2) assess the significance of their availability and distribution, nationally</p>
<p>Strand E: Liveable Communities</p> <p>E1: Analyse issues relating to the sustainability of human systems in Canada</p> <p>E2: Analyse impacts of urban growth in Canada</p>	<p>E1.5 Propose courses of action that would make a community more sustainable</p> <p>E2.1 Assess the impact of urban growth on natural systems and capacity (<i>e.g.</i>, <i>water availability</i>)</p> <p>E2.2 Analyse how various economic, social, and political impacts of urban growth distribution affect the community</p>

Note: Although designed to meet expectations from the **Gr.9: Issues in Canadian Geography**, Ontario secondary school curriculum, this resource may also provide useful activities for **Gr.12: Environment & Resource Management**.

Appendix B: Engaging Students in Action Projects

There are several good reasons for engaging your students in action projects. For example:

- They cater to different learning styles (because they are experiential in nature)
- They offer relevant and meaningful learning opportunities (which is motivating for students)
- These projects allow students to relate to the trans-disciplinary nature of real-world issues, and encourage holistic thinking and problem-solving¹

Learning for a Sustainable Future (LSF) has created a guide for educators entitled: “Engaging Students in Sustainable Action Projects.” It can be accessed via LSF’s *Resources for Rethinking* website: <<http://resources4rethinking.ca/en/professional-development/resources>>. The document outlines 12 steps for facilitating the creation of meaningful action projects with your students.

One of these steps outlines how to **facilitate choosing a project idea** with students. The guide also makes available a 9-page **Project Planning Template**, which takes students through a step-by-step thought process for designing the most effective action project (using their initial project idea). Another step in the guide addresses **building motivation** for student engagement in the project. It involves exercises for exploring the diverse reasons for students to care about something, as well as activities for exploring the difference between emotional and rational responses to an issue.

There are various types of action projects students can engage in. Some examples include:

- Projects to **educate and inform** (often with the intent to **persuade others** to initiate change)
- Projects for **political or civic action** (and/or to **influence policy**)
- Projects that **support the needs of organizations** (already working for change)

Common Types of Action Projects

Educate/ inform/ persuade

- Awareness campaigns (*e.g.*, posters/ pamphlets, videos, public service announcements, advertisements, school fairs, *etc.*)
- Community education programs (*e.g.*, workshops, presentations, special events, *etc.*)
- Written communication (*e.g.*, newspaper articles, letters to the editor, short stories, poems, *etc.*)
- Oral communication (*e.g.*, plays, street theatre, public debates, mock town halls, *etc.*)

Political/ civic action & public policy

- Meeting with elected officials
- Speaking at public meetings or hearings (*e.g.*, making presentations to city hall or town council)
- Circulating petitions
- Supporting political candidates (*e.g.*, volunteering with a campaign)
- Engaging in peaceful dissent (*e.g.*, parades with protest signs, gatherings in public places [with a permit], *etc.*)

Supporting “change-maker” organizations

- Assisting with community clean-ups
- Engaging in citizen science monitoring projects
- Beautification projects (*e.g.*, tree plantings, public space naturalizations)

¹ Burgess, Terry. (2003). *Engaging Students in Sustainable Action Projects*. Learning for a Sustainable Future <<http://resources4rethinking.ca/en/professional-development/resources>>

Appendix C: References

Background Information: The Great Lakes (p.2)

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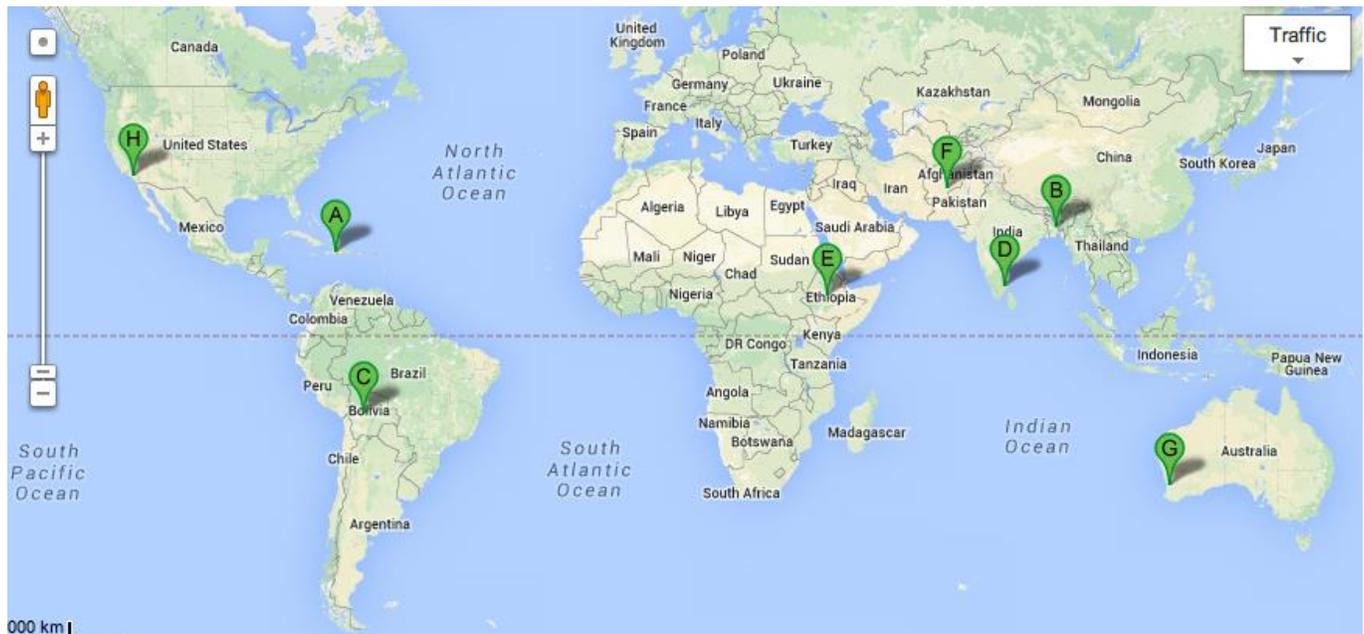
The Great Lakes: A Water Management Challenge. Great Lakes Water Management Forum (U.S.) <<http://www.greatlakes-seaway.com/en/pdf/waterwaymanagement.pdf>>

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Water Availability Profiles (p.16-19)

The following countries are featured in the Water Availability Profiles:

- | | |
|---------------------------|-------------------------------|
| A. Haiti (Port-au-Prince) | E. Ethiopia (Addis Ababa) |
| B. Bangladesh (Dhaka) | F. Afghanistan (Kandahar) |
| C. Bolivia (Cochabamba) | G. Australia (Perth) |
| D. India (Tamil Nadu) | H. United States (California) |



Map of Countries in Water Availability Profiles [Source: Google maps]

Afghanistan

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Haiti

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India

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United States

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