Innovations for Sustaining Rural Drinking Water Services

RPLC Rural Water Infrastructure Webinar

Sarah-Patricia Breen

March 22, 2018

RPLC
RURAL POLICY LEARNING COMMONS
CAPR
COMMUNAUTÉ D'APPRENTISSAGE DES POLITIQUES RURALES

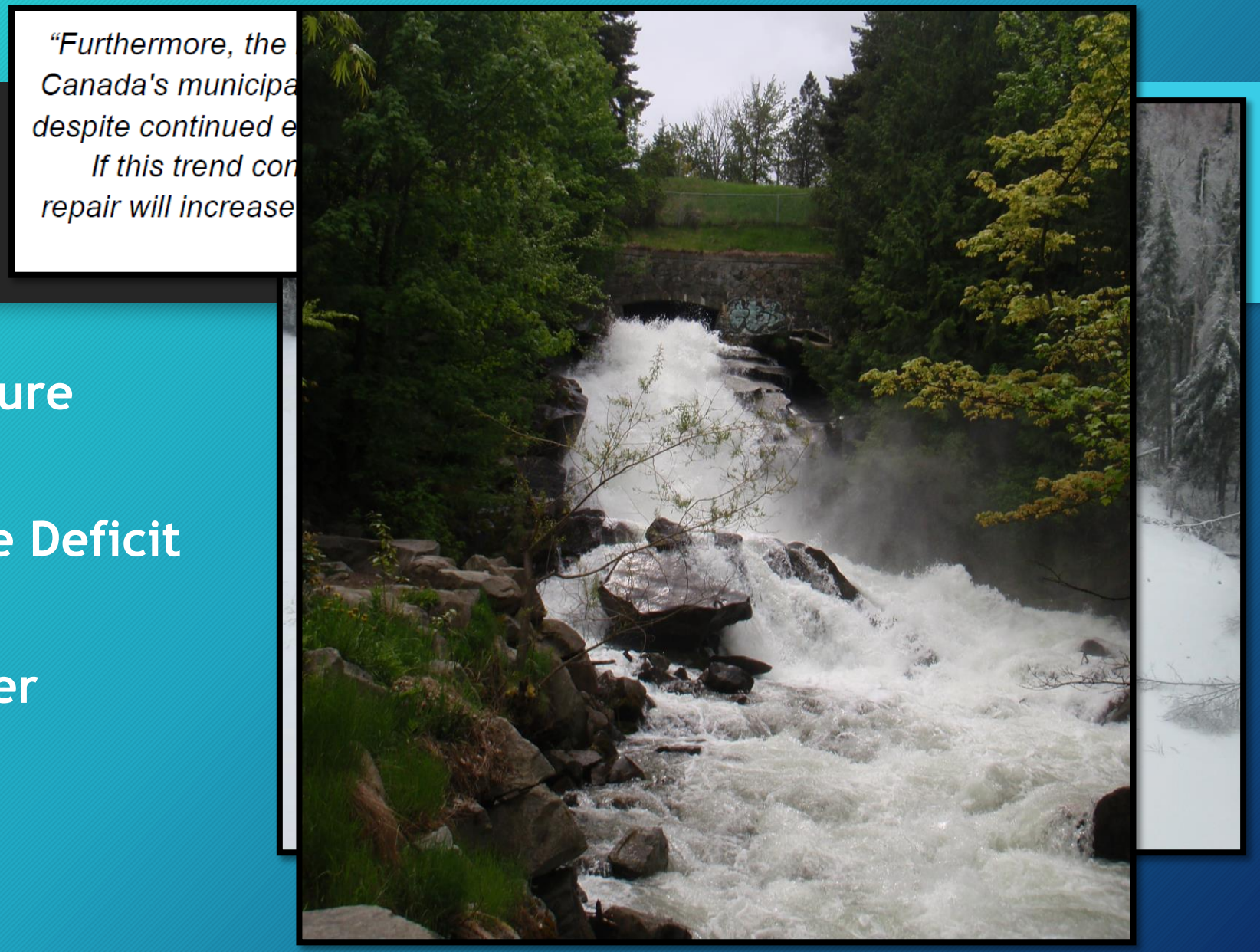
UNIVERSITY OF SASKATCHEWAN
School of Environment and Sustainability
SENS.USASK.CA


Problem
Context
Asset Management
Human Capacity Building
Lessons

Outline

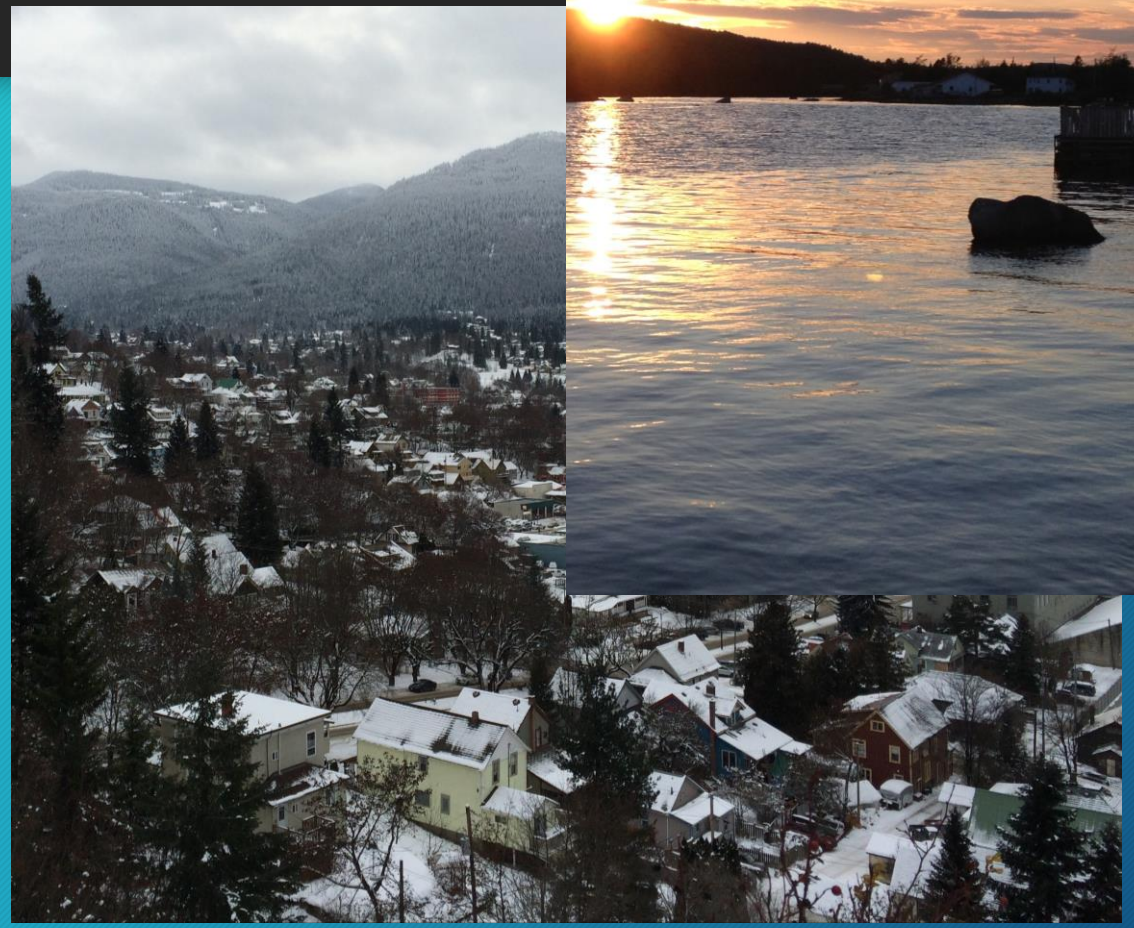
The Problem

- The role of infrastructure
- General: Infrastructure Deficit
- Specific: Drinking Water



The Context

- Demographics
- Scale
- Isolation
- Capacity
  - Human
  - Financial
- Public acceptability



New Technology

"Our primary concern was to digitize our valuable records, as a means of preserving them. Another key objective was to make it very easy for the maintenance staff, to help them identify where water lines are in the ground, rather than having to go through boxes of files, which could take hours on end, to look for [the] record of lines that had been buried in the ground over 30 years ago" (Daniels 2014, pp. 1-2).

New Collaborations

"Our water utility personnel have a lot of existing expertise and informal learning is happening every day. Until now, that expertise hadn't been tapped as a way to build formal knowledge and earn Environmental Operators Certification Program (EOCP) Continuing Education Units." (Joe McGowan, Director of Public Works City of Cranbrook)

"We have a lot of new employees so we train every day on our job site—it is just not formally structured or documented. When the P2P pilot project came up, it was a good opportunity to get a structure in place to help me teach and to document the training. Getting the CEUs was a bonus." (Gino Elia, City of Fernie)

Lessons Learned

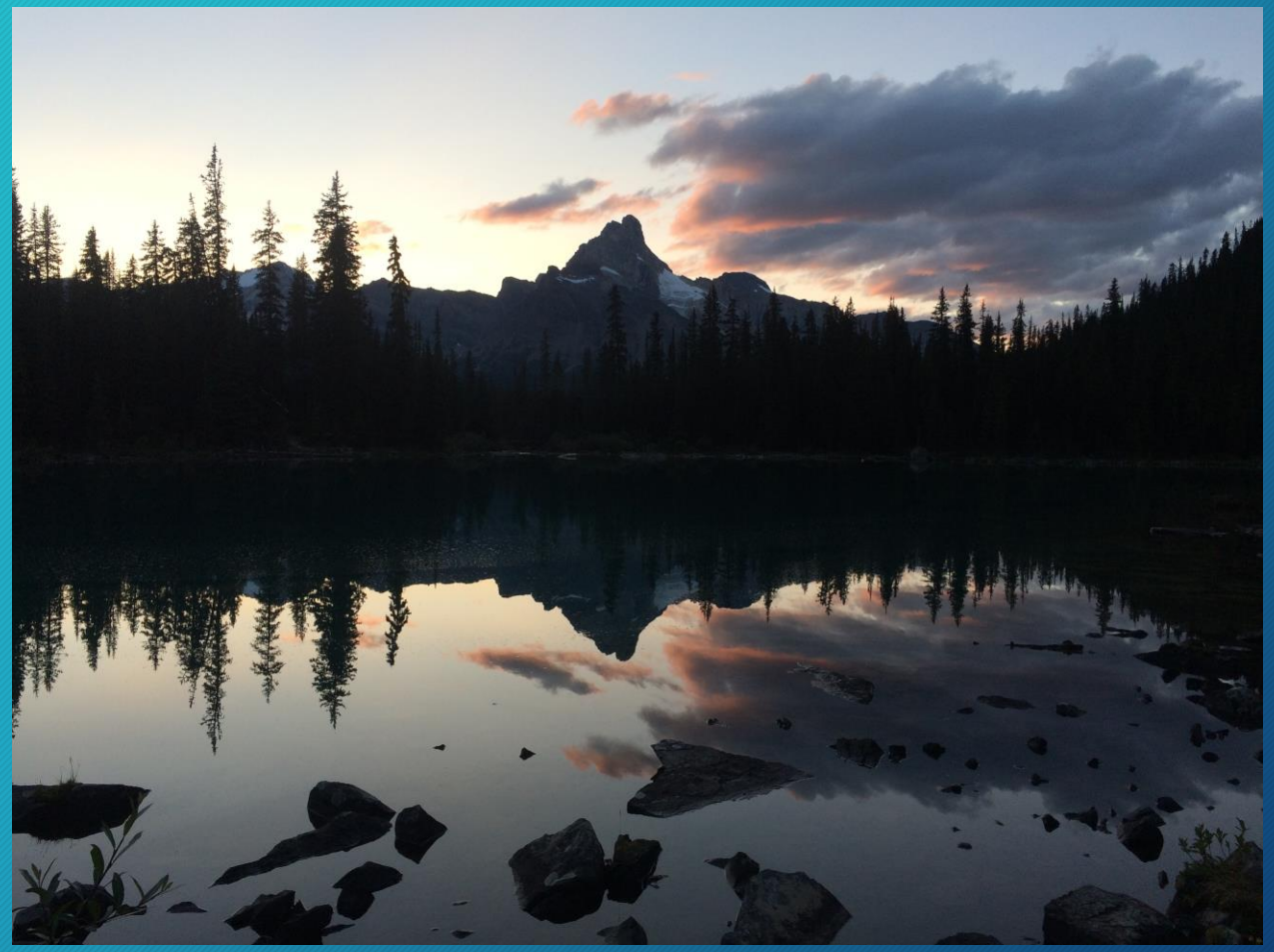
Critical Components

- Innovation
  - Product
  - Process
- Place-based
- Collaboration

Challenges

- Financial capacity
- Support from third party organizations
- Changing the status quo

Thank you!



Sarah-Patricia Breen

Sarah.Breen@usask.ca

RPLC
RURAL POLICY LEARNING COMMONS
CAPR
COMMUNAUTÉ D'APPRENTISSAGE DES POLITIQUES RURALES

UNIVERSITY OF SASKATCHEWAN
School of Environment and Sustainability
SENS.USASK.CA

Newfoundland Labrador

Water Resources Management Division

Department of Municipal Affairs and Environment

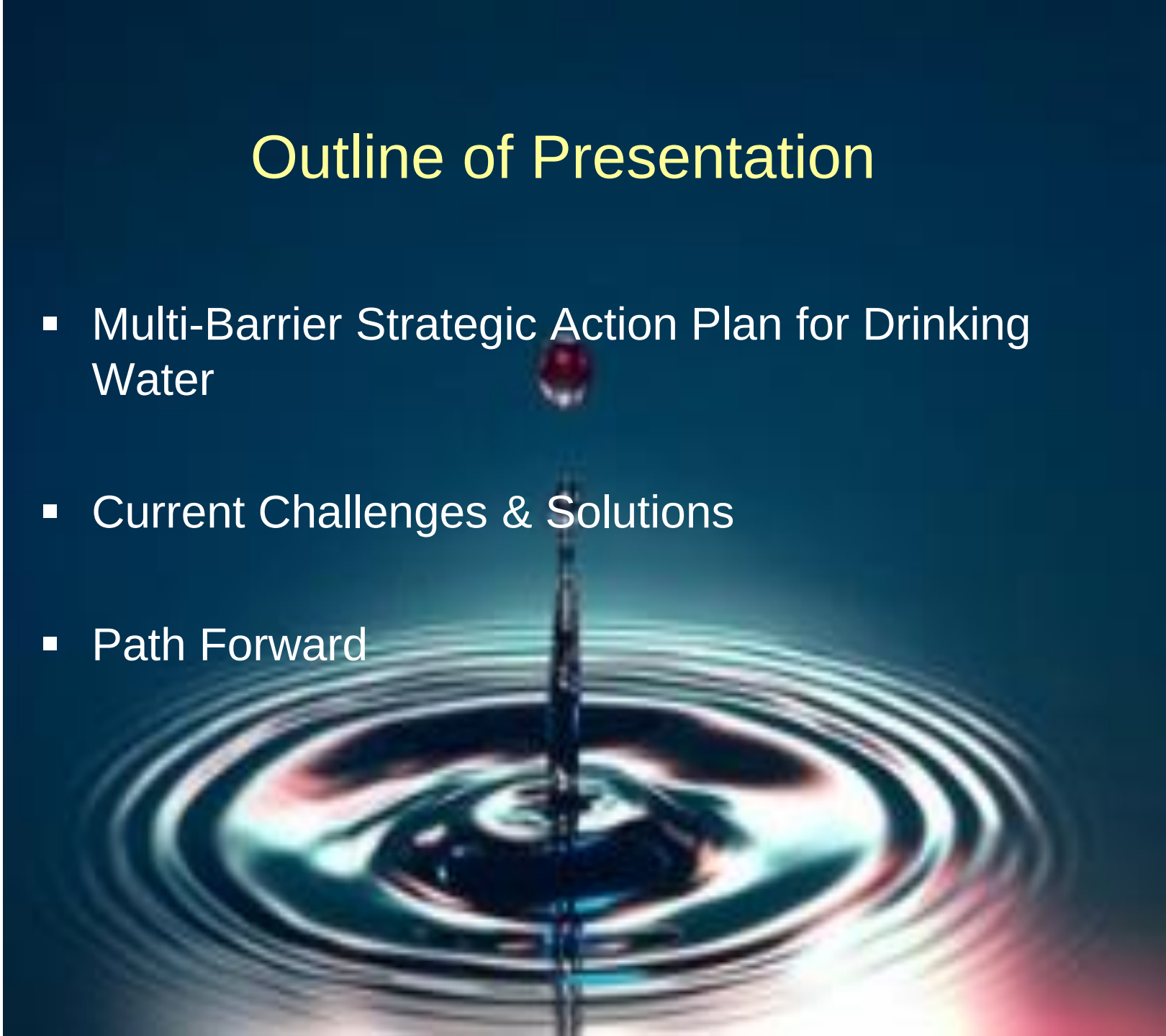
Rural Water Infrastructure in Newfoundland and Labrador

Gerry Lahey
Environmental Scientist
Water Resources Management Division

Newfoundland Labrador

Outline of Presentation

- Multi-Barrier Strategic Action Plan for Drinking Water
- Current Challenges & Solutions
- Path Forward



Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Multi-Barrier Approach

The Multi-Barrier Approach is…

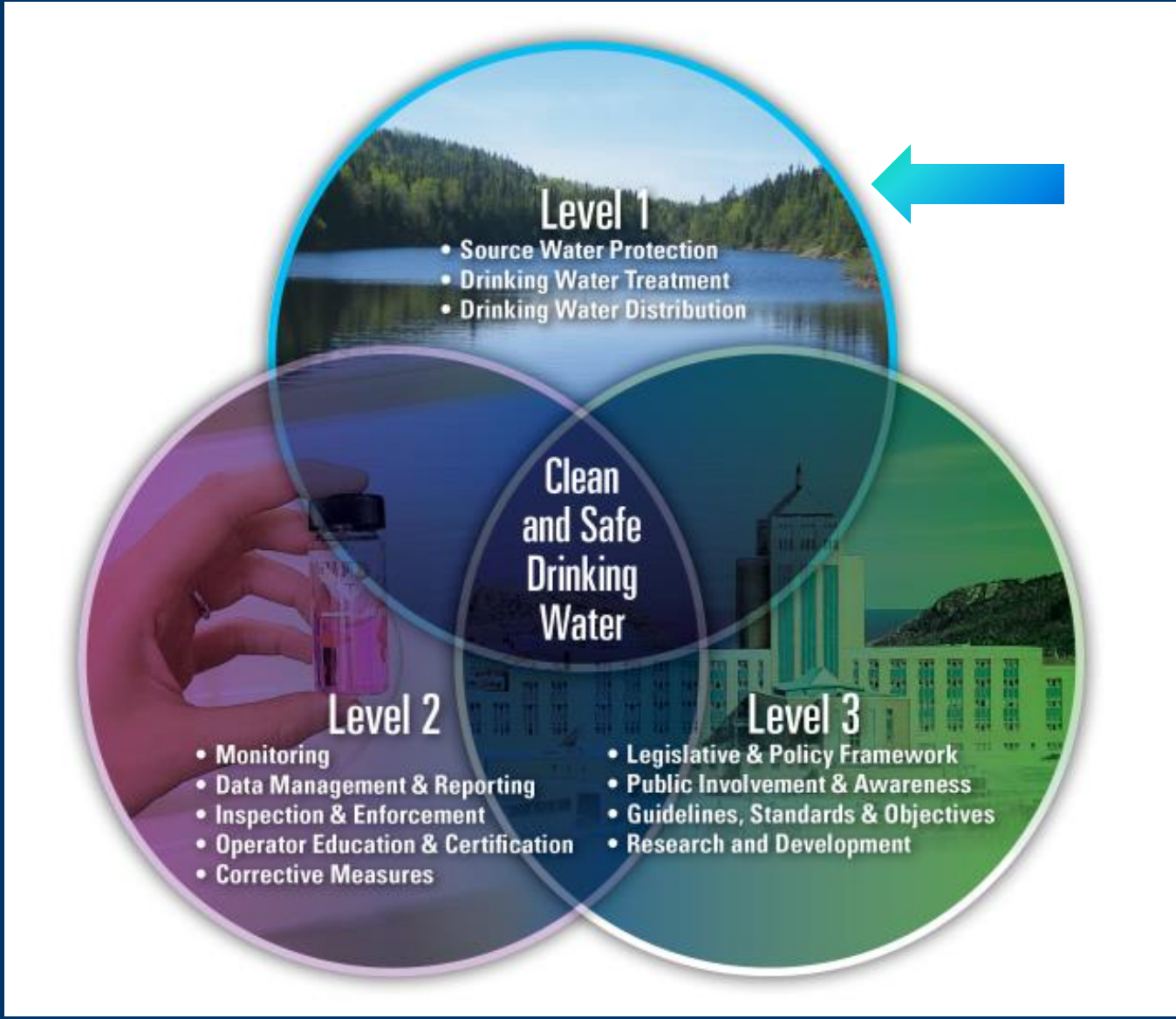
.. an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap in order to reduce risks to the public

Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Multi-Barrier Strategic Action Plan for Drinking Water Safety in NL



Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Level I of MBSAP

Source Protection

Drinking Water Treatment

Drinking Water Distribution

Water Resources Management Division

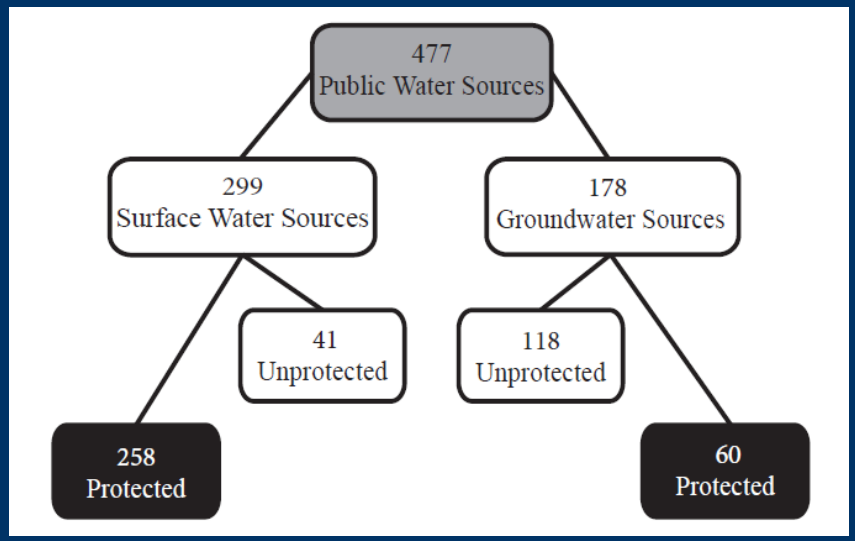
Department of Municipal Affairs and Environment

Level I
Source Protection

- Section 39 (SW) & 61 (GW) of the Water Resources Act.

- Information on Protected Public Water Supplies are available online.

http://www.mae.gov.nl.ca/waterres/quality/drinkingwater/protectedareas.html



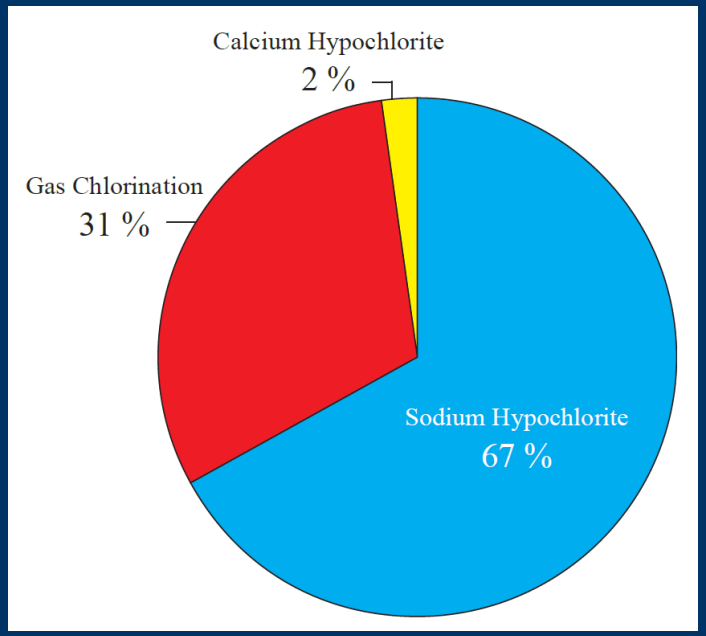
Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Level I
Drinking Water Treatment

Chlorination Systems used in NL



Disinfection Systems

Type of Disinfection System				
Chlorination	Ultraviolet Light	Mixed Oxidants	Ozone	Chloramines
443	33	8	4	1

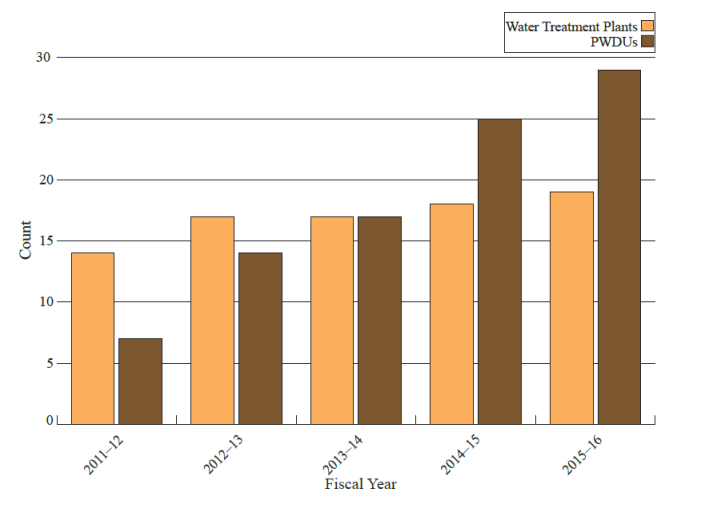
Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Level I Drinking Water Treatment

WTPs per Fiscal Year



Water Treatment Systems

Type of Drinking Water Treatment System						
pH adjustment	Micron/pressure filters	Infiltration galleries	Arsenic removal	Iron/Manganese removal	Lead removal	Strontium removal
53	34	22	10	5	1	1

Water Resources Management Division

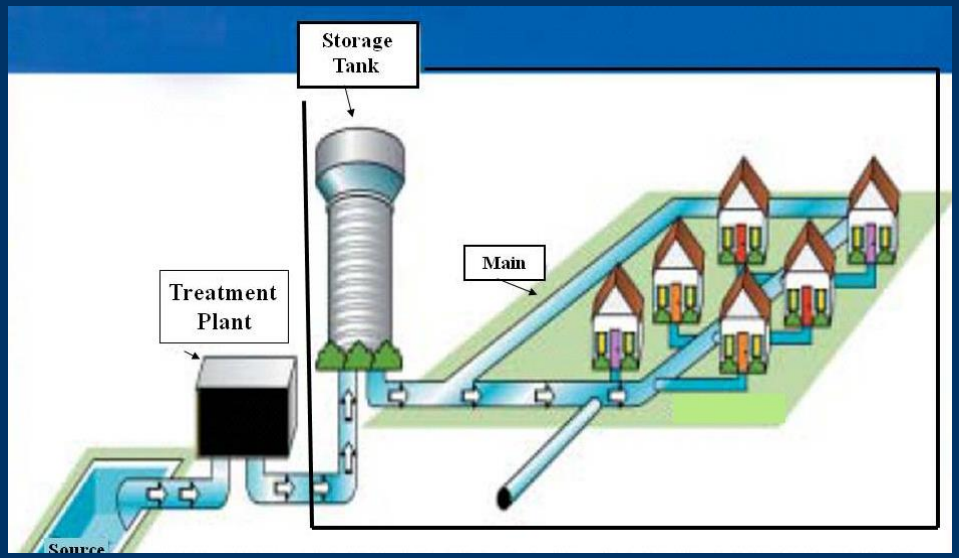
Department of Municipal Affairs and Environment

Level I
Drinking Water Distribution

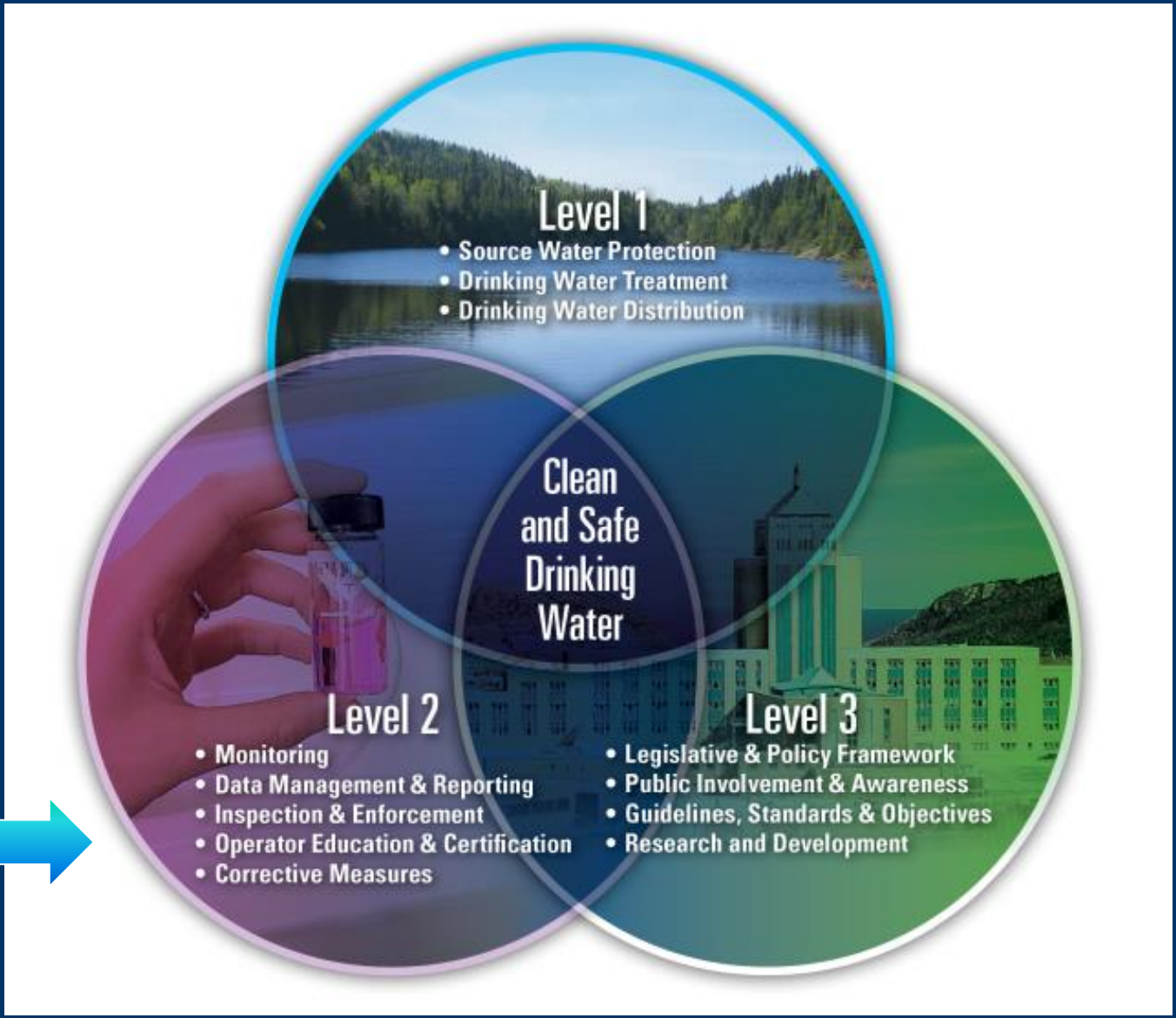
- Water distribution system classes

Size (population serviced)	> 50,000	15,001 - 50,000	1,501 - 15,000	501 - 1,500	≤ 500	Total
Count	1	5	36	80	386	508

76% have very small systems



Multi-Barrier Strategic Action Plan for Drinking Water Safety in NL



Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Level II

Operator Education, Training & Certification

Monitoring

Data Management and Reporting

Inspection and Enforcement

Corrective Measures

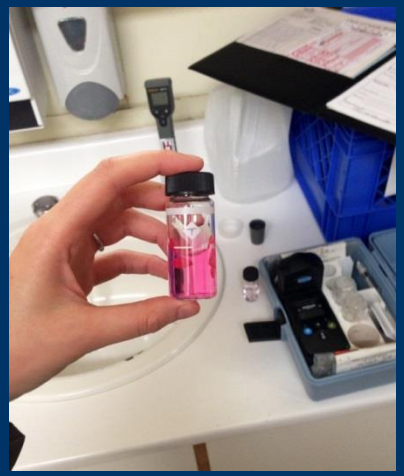
Water Resources Management Division

Department of Municipal Affairs and Environment

Level II Monitoring

Unique monitoring system within North America

- Provincial Government is responsible for regular monitoring:
  - Bacteriological (Service NL)
    - Total coliforms
    - E.Coli
  - Chemical (ECC)
    - Physical
    - Metals
    - Disinfection by-products



Water Resources Management Division

Department of Municipal Affairs and Environment

Level II Monitoring

Region	Source	Tap	THM	HAA	Total
Eastern	22	454	421	388	1,285
Western	24	300	266	273	863
Central	20	87	83	55	245
Labrador	10	74	100	105	289
Other (Special)	4	0	0	0	4
Total	80	915	870	821	2,686

Number of chemical water quality samples taken by WRMD for 2016-17

Region					
St. John's	Eastern	Central	Western	Northern	Total
7,610	973	3,963	4,330	1,693	18,569

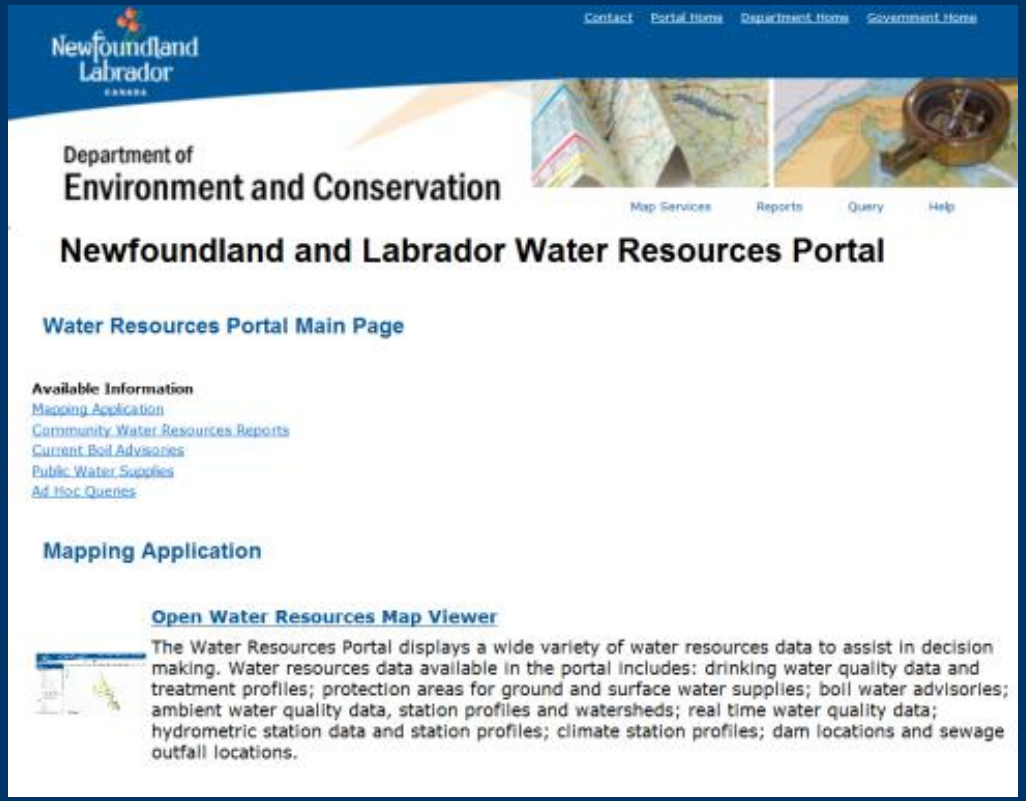
Number of bacteriological samples taken by Service NL for 2016-17

Water Resources Management Division

Department of Municipal Affairs and Environment

Level II
Data Management & Reporting

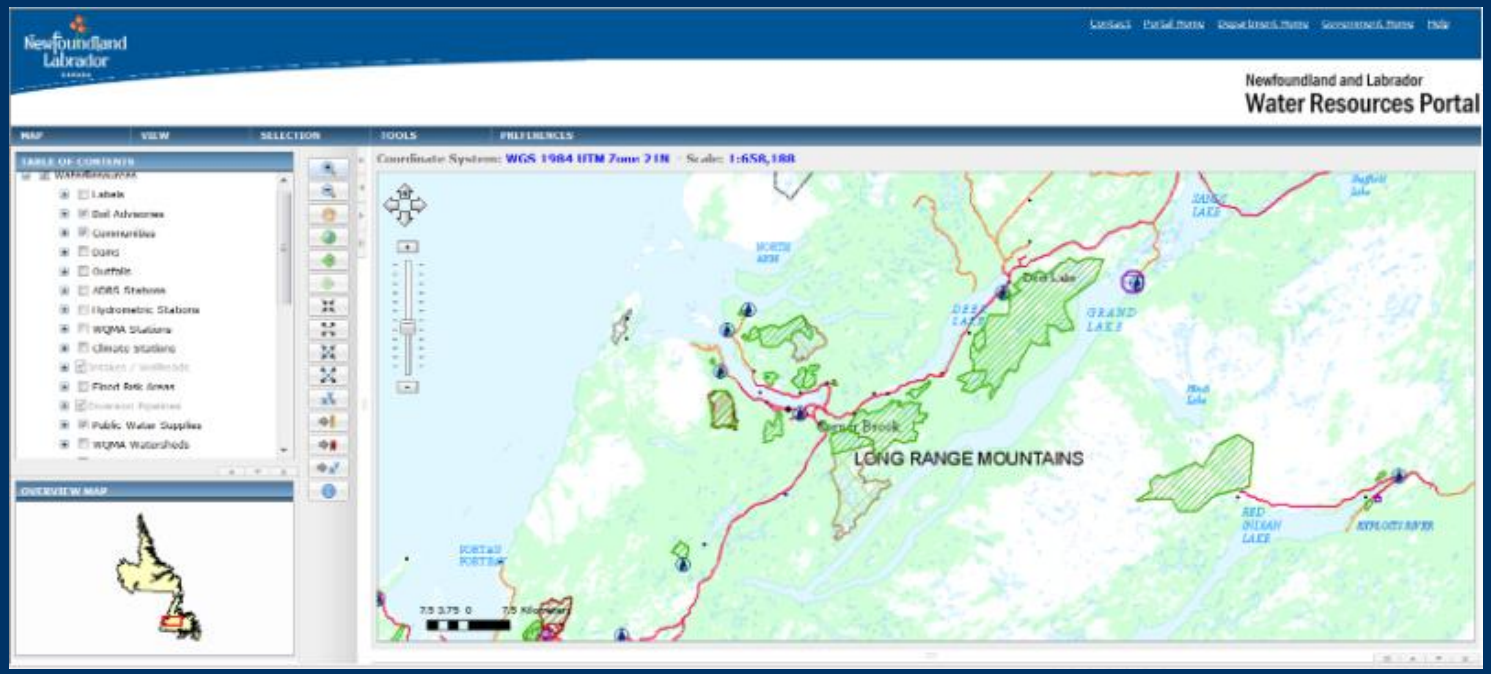
- Large volume of data requires a stringent QA/QC program to ensure quality of data.
- Data is available on Water Resources Portal:



http://maps.gov.nl.ca/water/

Level II
Data Management & Reporting

- Water Resources Portal Mapping:

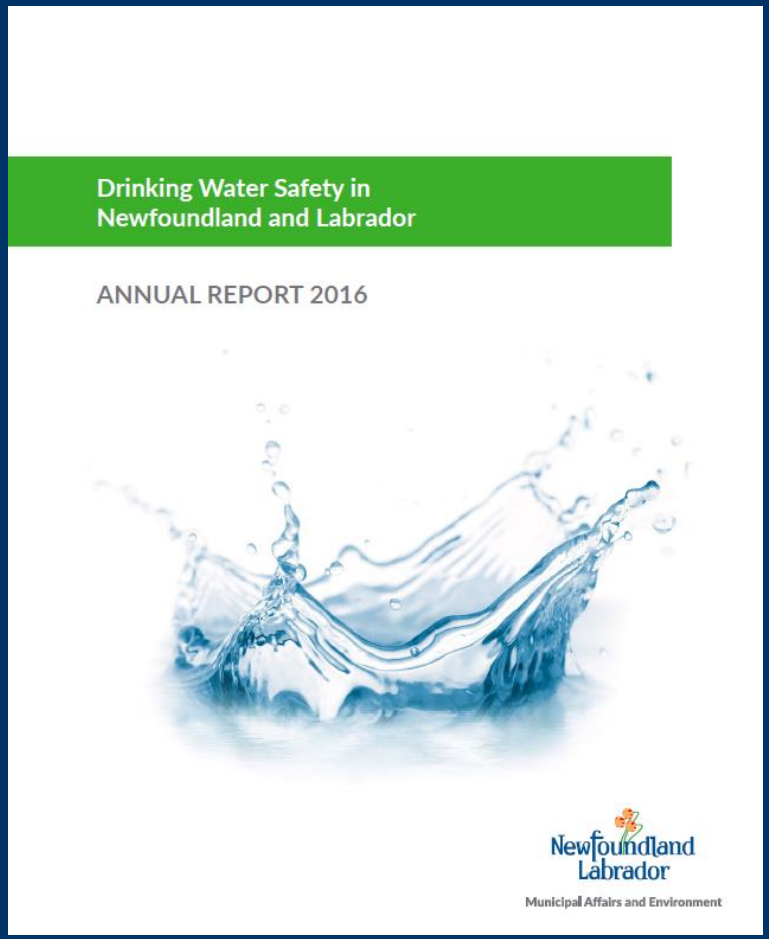


Water Resources Management Division

Department of Municipal Affairs and Environment

Level II
Data Management & Reporting

- Reports provided by WRMD:
  - Seasonal community drinking water quality email notifications
  - Exceedance reports
  - Annual Drinking Water Safety in NL reports
  - Web documents:
    - "What's New"



http://www.env.gov.nl.ca/env/waterres/whatsnew/index.html

Newfoundland Labrador

Level II Operator Education, Training & Certification

A UNIQUE APPROACH TO TRAINING

Theory: Classroom style seminars

Hands on: On-site training with Mobile Training Units

Certification: Local access to certification exams

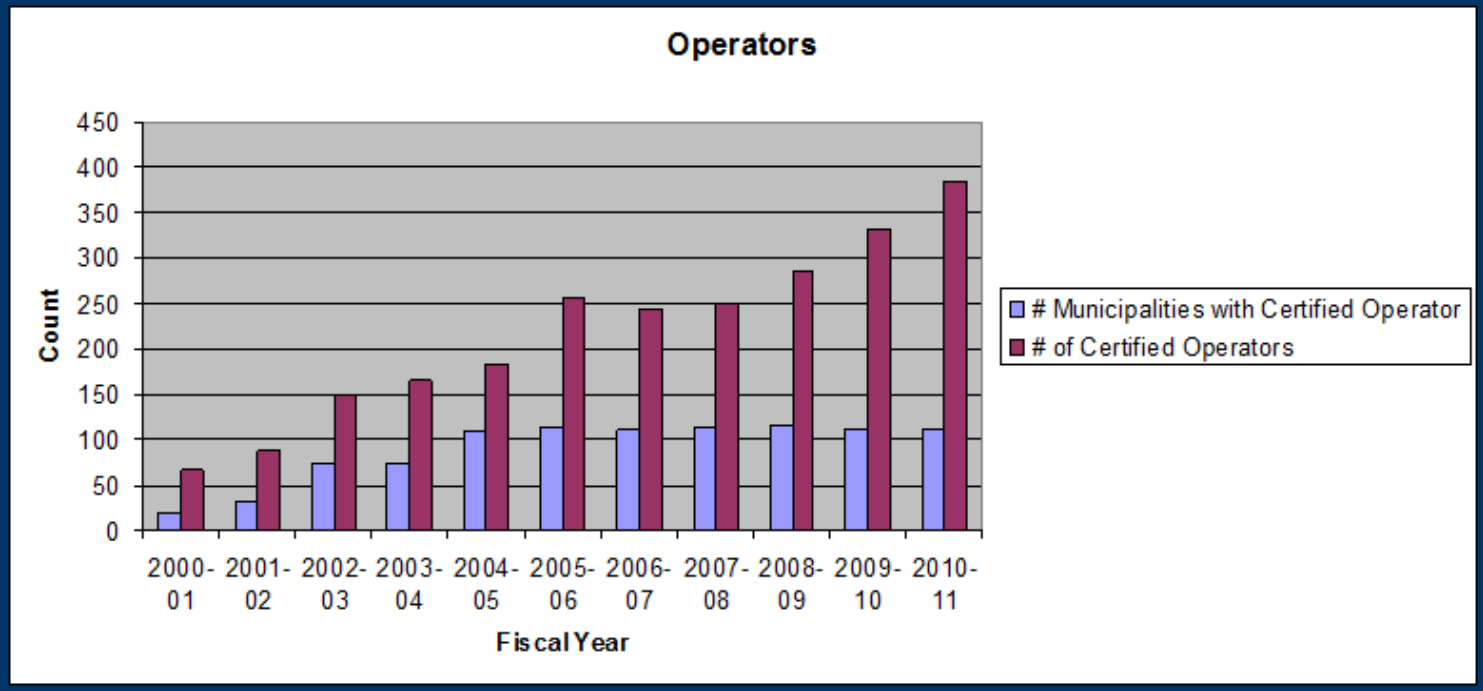
Certification became mandatory in 2012

Water Resources Management Division

Department of Municipal Affairs and Environment

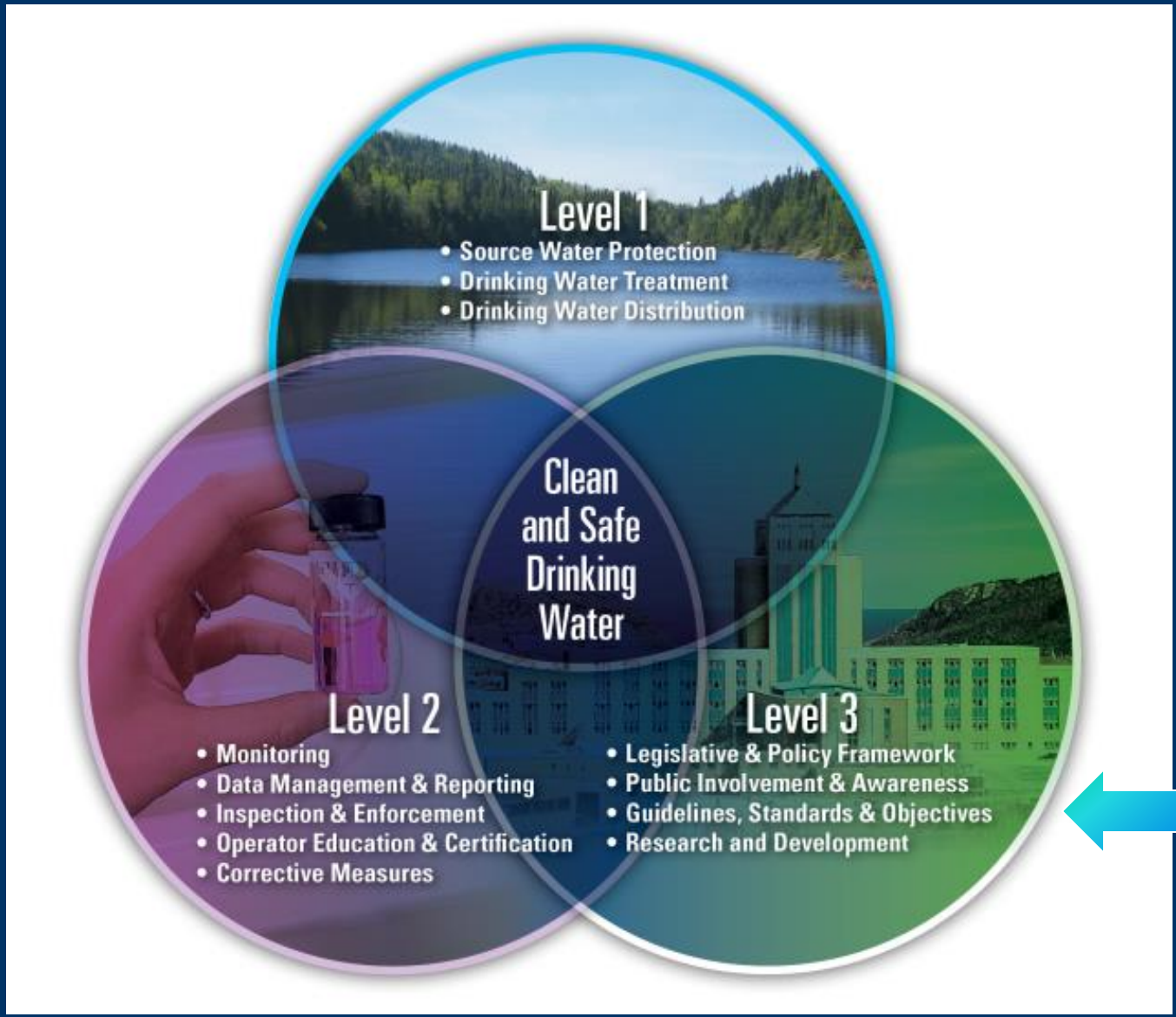
Newfoundland Labrador

Level II
Example: Corrective Measures



- High rate of improvement.
- Still holdout communities that will not participate in free training.
- Operators starting to retire.

Multi-Barrier Strategic Action Plan for Drinking Water Safety in NL

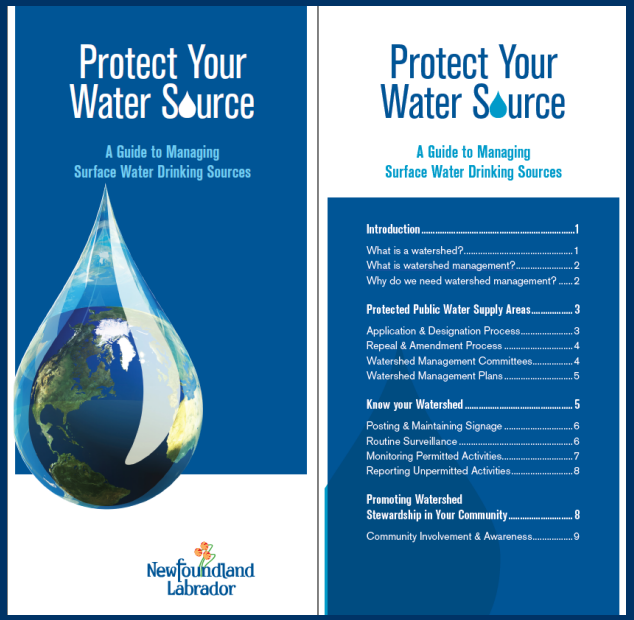


Water Resources Management Division

Department of Municipal Affairs and Environment

Level III

- Legislative and Policy Frameworks
- Public Involvement & Awareness
- Guidelines, Standards & Objectives
- Research & Development



Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Legislative & Policy Frameworks

- Water Resources Act regulates administration of:
  - water rights,
  - protection of PPWSAs, and
  - a range of construction and operating permits pertaining to drinking water systems.

- Municipal Affairs Act administers:
  - the management of waterworks.

- Municipalities Act grants powers to municipalities:
  - for the construction, operation, and maintenance of water systems and for the allocation of funds for this work.

Public Involvement & Awareness

- Water Resources Management webpage

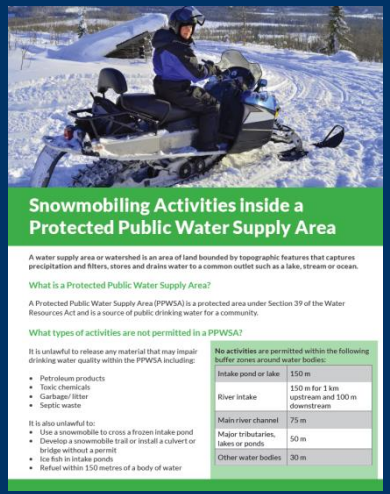
http://www.mae.gov.nl.ca/waterres/index.html

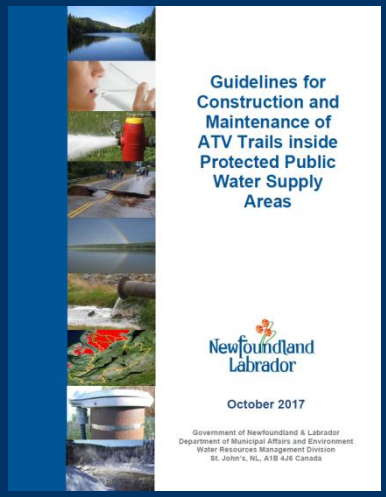
- New public outreach videos

http://www.youtube.com/NLWaterResources/

- New public outreach brochures

http://www.mae.gov.nl.ca/waterres/quality/drinkingwater/protectedareas.html





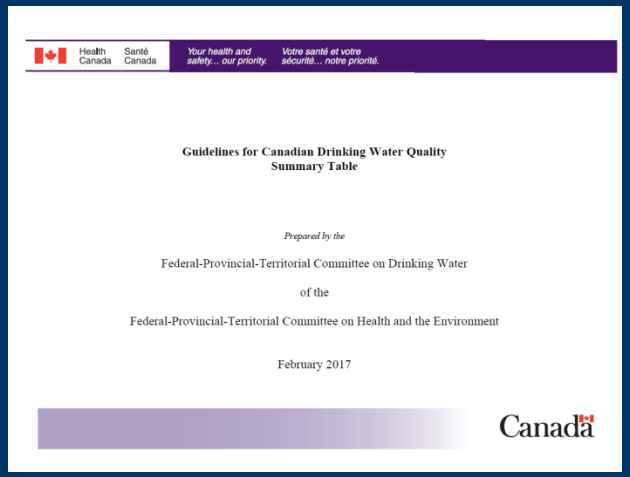
Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Guidelines, Standards & Objectives

- Water Quality Guidelines
  - Guidelines for Canadian Drinking Water Quality.



Health Canada / Santé Canada — Your health and safety... our priority. / Votre santé et votre sécurité... notre priorité.

Guidelines for Canadian Drinking Water Quality
Summary Table

Prepared by the

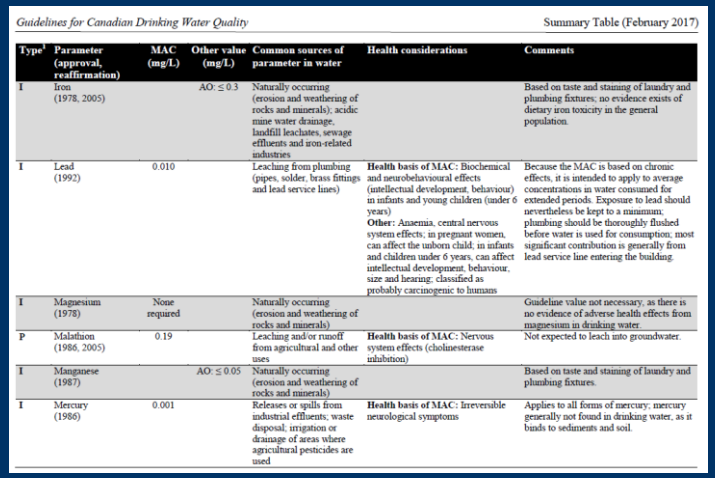
Federal-Provincial-Territorial Committee on Drinking Water

of the

Federal-Provincial-Territorial Committee on Health and the Environment

February 2017

Canada



Guidelines for Canadian Drinking Water Quality — Summary Table (February 2017)

Type[1]	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Iron (1978, 2005)		AO: ≤ 0.3	Naturally occurring (erosion and weathering of rocks and minerals); acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries		Based on taste and staining of laundry and plumbing fixtures; no evidence exists of dietary iron toxicity in the general population.
I	Lead (1992)	0.010		Leaching from plumbing (pipes, solder, brass fittings and lead service lines)	**Health basis of MAC:** Biochemical and neurobehavioural effects (intellectual development, behaviour) in infants and young children (under 6 years) **Other:** Anaemia, central nervous system effects; in pregnant women, can affect the unborn child; in infants and children under 6 years, can affect intellectual development, behaviour, size and hearing; classified as probably carcinogenic to humans	Because the MAC is based on chronic effects, it is intended to apply to average concentrations in water consumed for extended periods. Exposure to lead should nevertheless be kept to a minimum; plumbing should be thoroughly flushed before water is used for consumption; most significant contribution is generally from lead service line entering the building.
I	Magnesium (1978)	None required		Naturally occurring (erosion and weathering of rocks and minerals)		Guideline value not necessary, as there is no evidence of adverse health effects from magnesium in drinking water.
P	Malathion (1986, 2005)	0.19		Leaching and/or runoff from agricultural and other uses	**Health basis of MAC:** Nervous system effects (cholinesterase inhibition)	Not expected to leach into groundwater.
I	Manganese (1987)		AO: ≤ 0.05	Naturally occurring (erosion and weathering of rocks and minerals)		Based on taste and staining of laundry and plumbing fixtures.
I	Mercury (1986)	0.001		Releases or spills from industrial effluents; waste disposal; irrigation or drainage of areas where agricultural pesticides are used	**Health basis of MAC:** Irreversible neurological symptoms	Applies to all forms of mercury; mercury generally not found in drinking water, as it binds to sediments and soil.

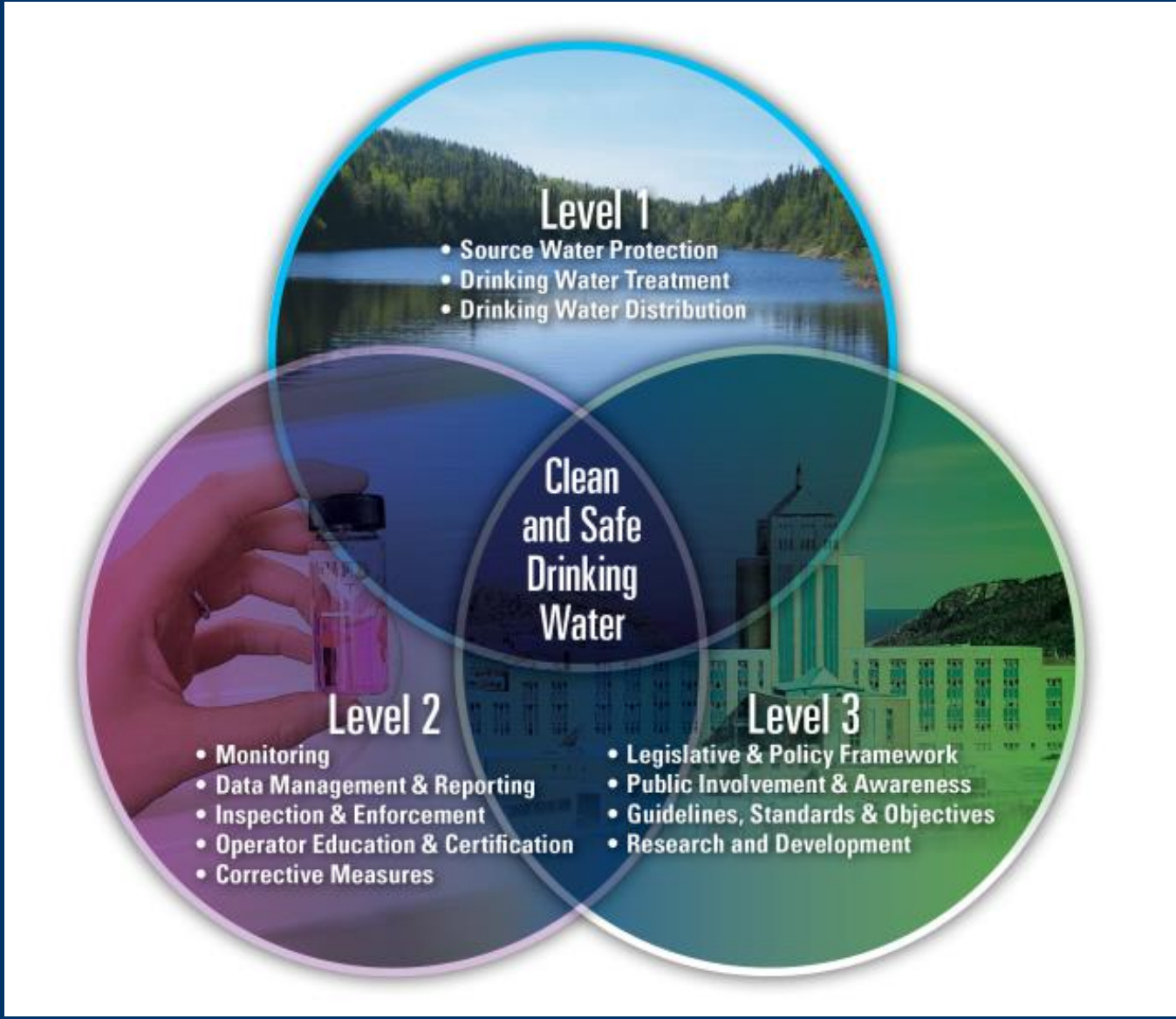
- Infrastructure Guidelines
  - Guidelines for the Design, Construction and Operation of Water and Sewerage Systems.
  - Chlorination Equipment Selection Guidelines.

Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Multi-Barrier Strategic Action Plan for Drinking Water Safety in NL



Water Resources Management Division

Department of Municipal Affairs and Environment

Current Challenges

Boil Water Advisories

Disinfection By-Products

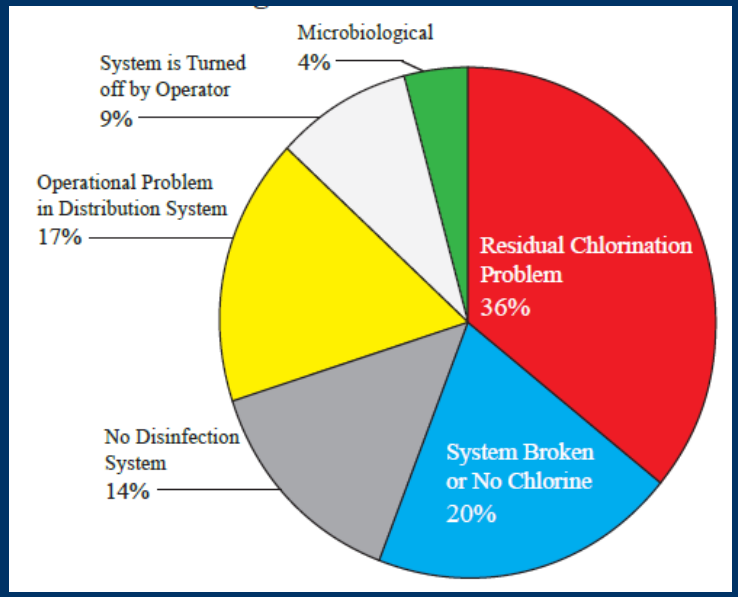
Department	Parameters		Exceedances 2011–12	2012–13	2013–14	2014–15	2015–16
Service NL	Bacteriological	*Escherichia coli*	196	133	132	211	92
		Total coliforms	844	930	962	932	970
Environment and Conservation	Chemical and Physical	Turbidity	98	103	78	170	83
		Arsenic	4	4	13	6	8
		Barium	2	1	2	1	0
		Fluoride	0	1	0	0	0
		Lead	8	4	2	4	6
	Disinfection By-Products	Trihalomethanes (THMs)	129	132	117	93	108
		Haloacetic Acids (HAAs)	165	147	153	117	134
		Colour	514	433	466	307	424
		pH	361	335	368	196	225
		Total Dissolved Solids	11	17	19	11	17

Current Challenges

Boil Water Advisories

As of February 22, 2018 there are 194 boil water advisories in place. There are about 146 communities affected by these boil water advisories, serving a population of about 35,545. The affected population is about 8.04% of the population serviced by Public Water Supplies.

Reasons used to issue BWA



>60% of BWA have been in effect for a period of five years or greater. These are classified as long-term BWAs.

Newfoundland Labrador

Addressing Current Challenges

Boil Water Advisories

- Standard operating procedures for removing boil water advisories:
  - BWA System Assessment Tool
  - Preventative Maintenance Checklists, Logs & Forms
  - Fact Sheets
  - Full Cost Accounting Assessment Tool

  http://www.mae.gov.nl.ca/waterres/quality/drinkingwater/sopbwa.html
- 90/10 funding split for small communities (pop <3000) on chlorination systems.
- Extensive on-site and classroom training for disinfection systems.

Addressing Current Challenges

Potable Water Dispensing Units

"Small scale water treatment system"

- Across Newfoundland and Labrador:
  - 29 Operating
- Water is treated on-site at a centralized location for manual collection by users.
- Mimics practice of collecting water from potential unsafe roadside springs, common in many rural communities.
- Intended to treat only drinking water portion of total water demand:
  - 0.5 to 3 L/person/day

Water Resources Management Division

Department of Municipal Affairs and Environment

Addressing Current Challenges

Potable Water Dispensing Units

- Uses many of the same treatment processes found in full scale WTPs.
- Common treatment components:
  - Multi-media filtration
  - Activated carbon filtration
  - Filter cartridges
  - Reverse osmosis
  - Ozone disinfection
  - UV disinfection
  - Chlorine disinfection
- Cost of PWDU affordable for small communities vs. full scale WTP.

Multi-media filters

Reverse Osmosis Unit

Newfoundland Labrador

What's Next? - Opportunities

- Continue to explore innovative approaches (PWDU, regional operator, regional system, etc.) for small systems.
- Continued coordination of MBSAP.
- Public engagement – social media.
- Promote risk-based management approach in drinking water systems.

Water Resources Management Division

Department of Municipal Affairs and Environment

Newfoundland Labrador

Thank You

Water Resources Management Division

Department of Municipal Affairs and Environment

UN WATER

22 MARCH
WORLD WATER DAY

Applying Nature/Natural Systems as Green Infrastructure (GI) in the Planning of Resilient Rural Communities

(with a Water Focus)

Paul Kraehling OPPI RPP

Rural Studies PhD Candidate

March 22, 2018
Webinar

University of Guelph

Ontario Agricultural College

School of Environmental Design and Rural Development

RPLC Rural Policy Learning Commons

CAPR Communauté d'apprentissage des politiques rurales

Outline

- Definition of Green Infrastructure (GI) & elements
- Rural area general issues/resilience challenges
- A resiliency response using GI:
  - Observations from Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) research
  - Other general comments
- Conclusion

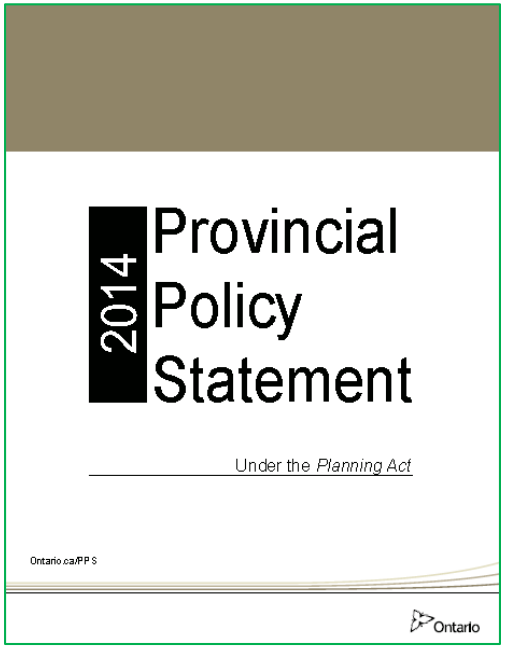
Kraehling, 2016

Definition of Green Infrastructure (GI)

- Natural elements (real and artificial) that provide multifunctional benefits to both human and natural communities.

  - Info taken from the PPS

    *…Green infrastructure: means natural and human-made elements that provide ecological and **hydrological functions and processes**. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.*

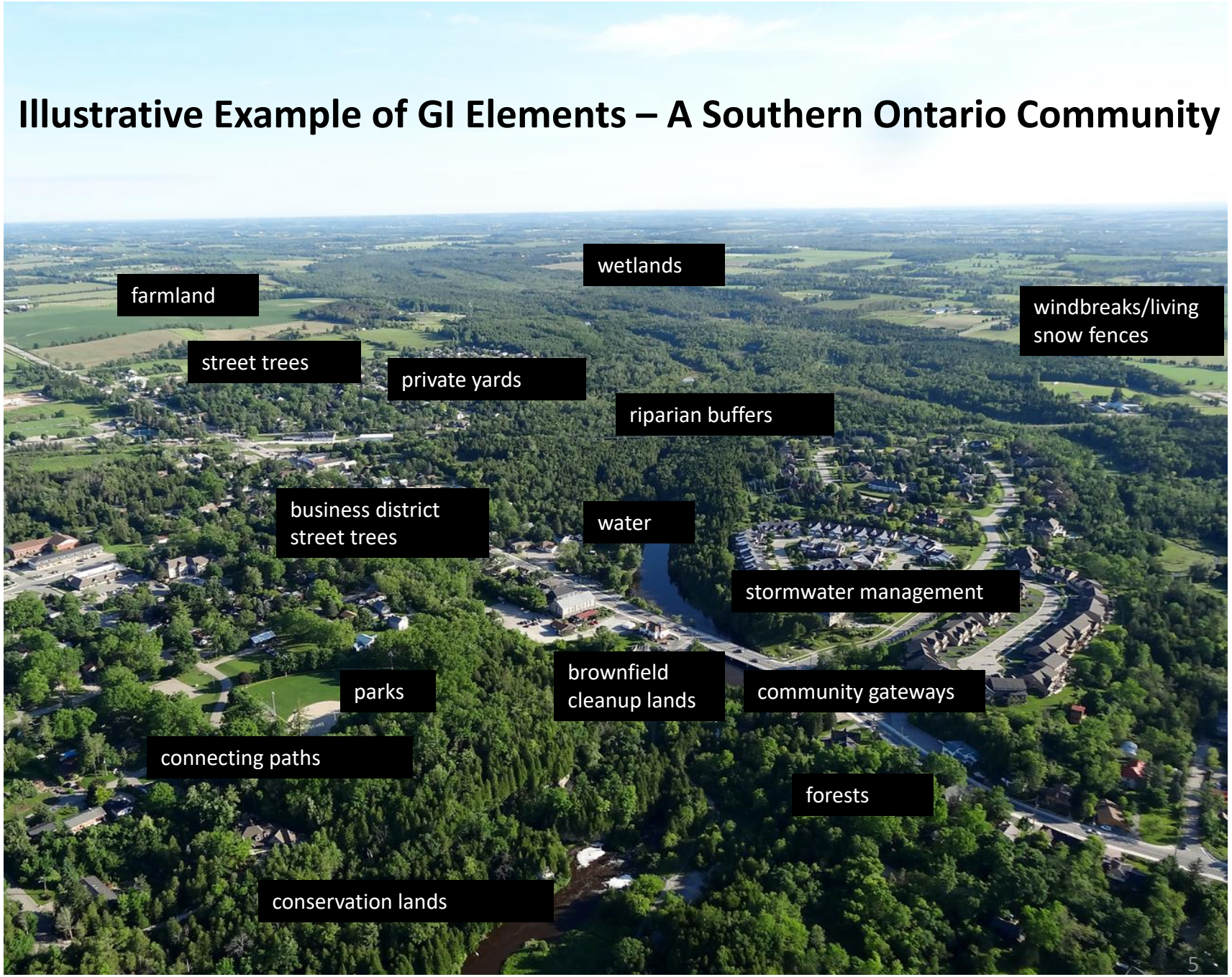


What are example elements contained within a GI planning framework?

Local & Neighbourhood Scale	Town & District Scale	Regional & Prov./National Scale
Street trees, verges and hedges	Business settings (corporate business parks)	Regional parks
Green roofs and walls	City/district parks	Rivers and floodplains
Pocket parks	Urban canals	Shorelines
Private gardens	Urban commons	Strategic and long-distance trails
Urban plazas	Forest parks	Forests, woodlands and community forests
Town and village greens and commons	Country parks	Reservoirs
Local rights of way	Continuous waterfronts	Road and railway networks
Pedestrian and cycle routes	Municipal plazas	Designated greenbelt and strategic gaps
Cemeteries and churchyards	Lakes	Agricultural land
Institutional open spaces	Major recreational spaces	National parks
Ponds and streams	Rivers and floodplains	National, regional or local landscape designations
Small woodlands	Brownfield land	Canals
Play areas	Community woodlands	Common lands
Local nature reserves	(Former) mineral extraction sites	Open countryside
School grounds	Agricultural land	
Sports pitches	Landfills	
Swales, ditches		
Allotments		
Vacant and derelict land		

Source: European Environment Agency (2011). Green Infrastructure and Territorial Cohesion: The Concept of Green Infrastructure and Its Integration into Policies Using Monitoring Systems. Copenhagen, Denmark, European Union.

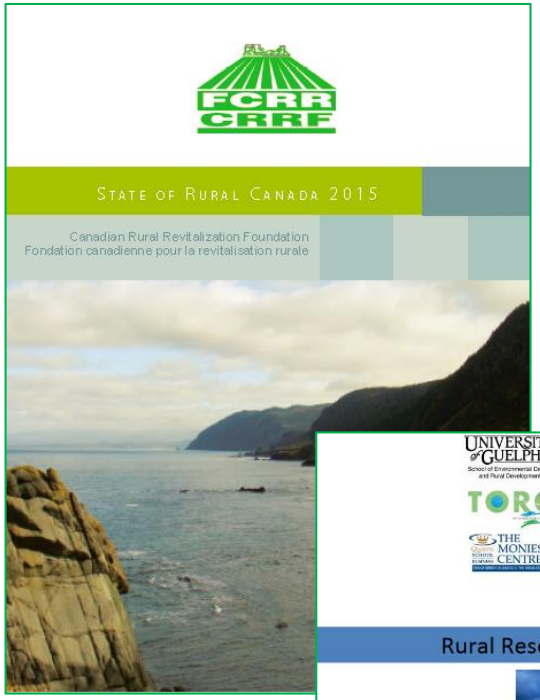
Illustrative Example of GI Elements – A Southern Ontario Community

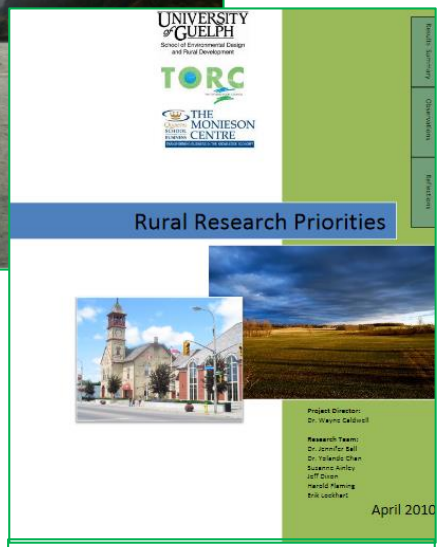


P Kraehling, 2016

Challenges to Rural Community Resilience

- Socio-economic issues, i.e. job creation, population retention & community age schisms
- ‘Hard’ infrastructure upkeep
- Paying for/retention of local municipal services
- Rural reduced municipal capacities



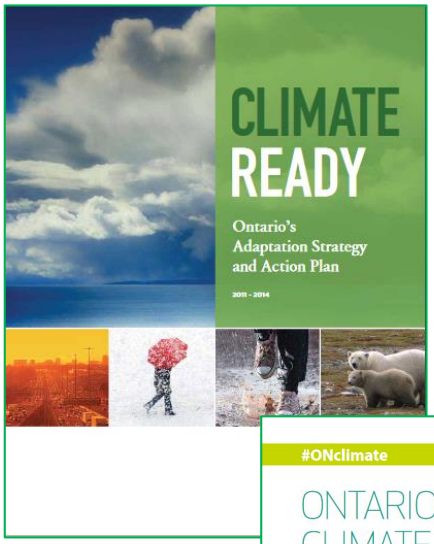


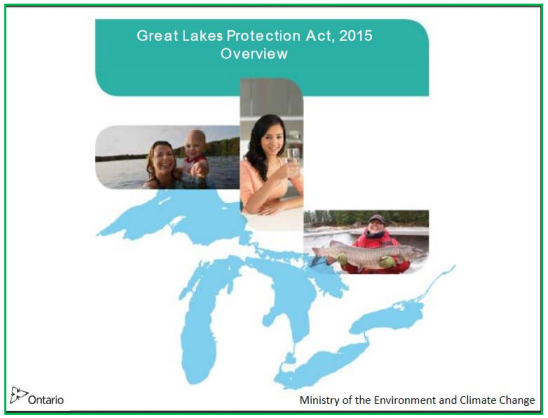
Rural Ontario Institute

Background info from: Cdn. Rural Revitalization Foundation and Rural Ontario Institute

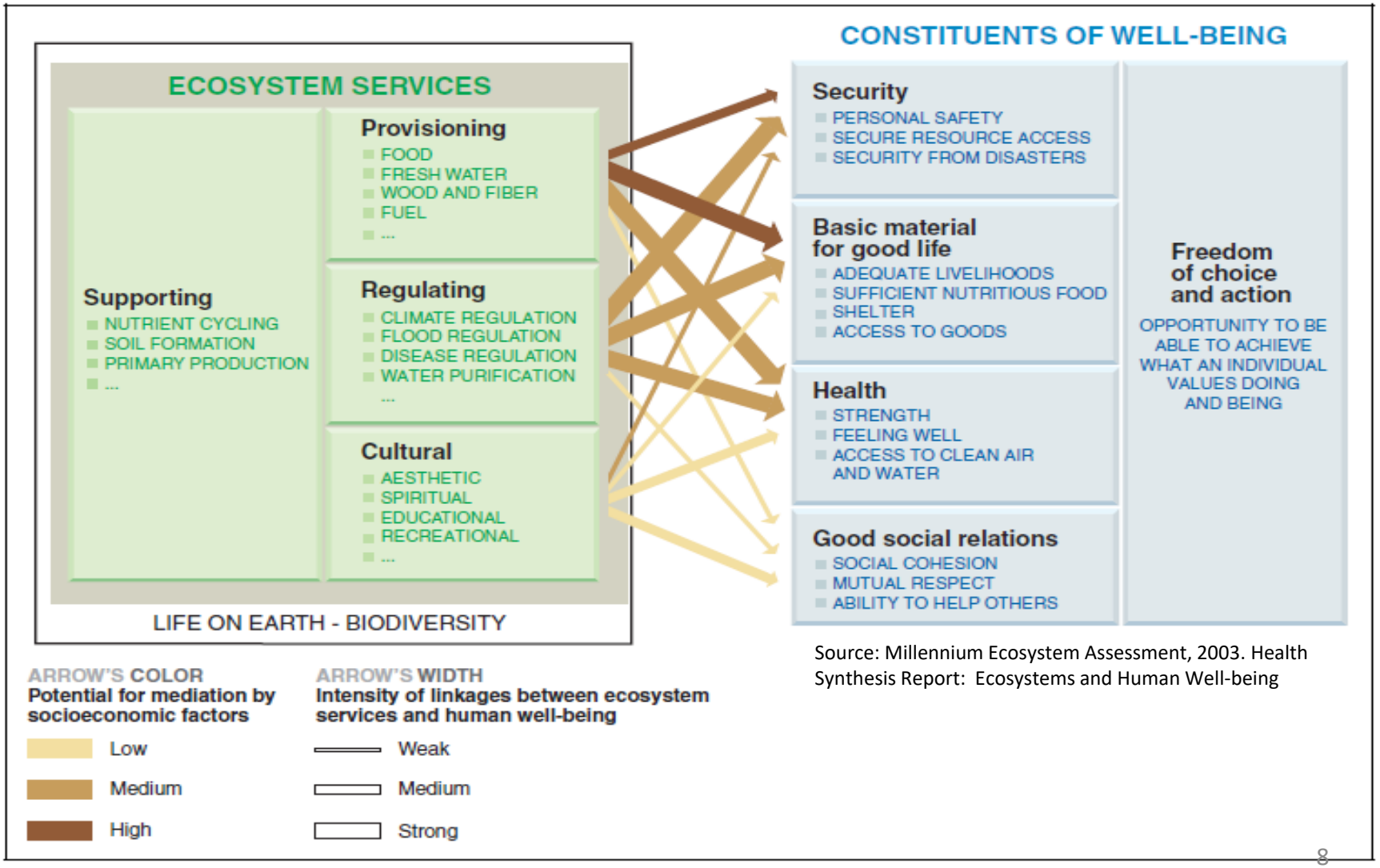
General Societal Aspirations Impacting Rural Places

- Climate change adaptation/mitigation
- General environmental stewardship
- Biodiversity protection





A Conceptual Framework for GI: The 'Goods + Services of Nature' Assisting Humankind



Source: Millennium Ecosystem Assessment, 2003. Health Synthesis Report: Ecosystems and Human Well-being

Recent OMAFRA – U of G Research:
GI for Ontario's Rural Communities: Using Nature for Economic Development and Community Resilience

- Literature review
- Survey rural community leaders
- Key informant interviews
- Case study write-up

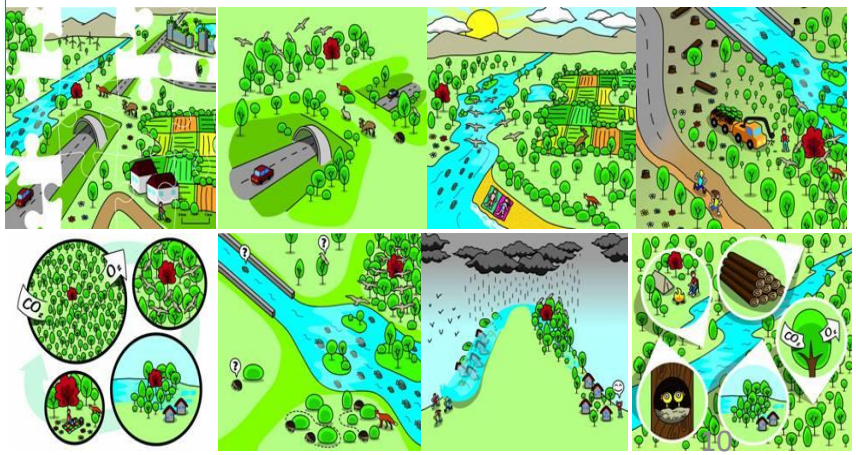
Innovative Use of GI Practices in Rural Ontario – Survey Results Summary

Agri-Food and Rural Link
A program of the OMAFRA – U of G Partnership
Mobilizing Agri-Food and Rural Research Knowledge

Lit Review - GI Planning in Europe

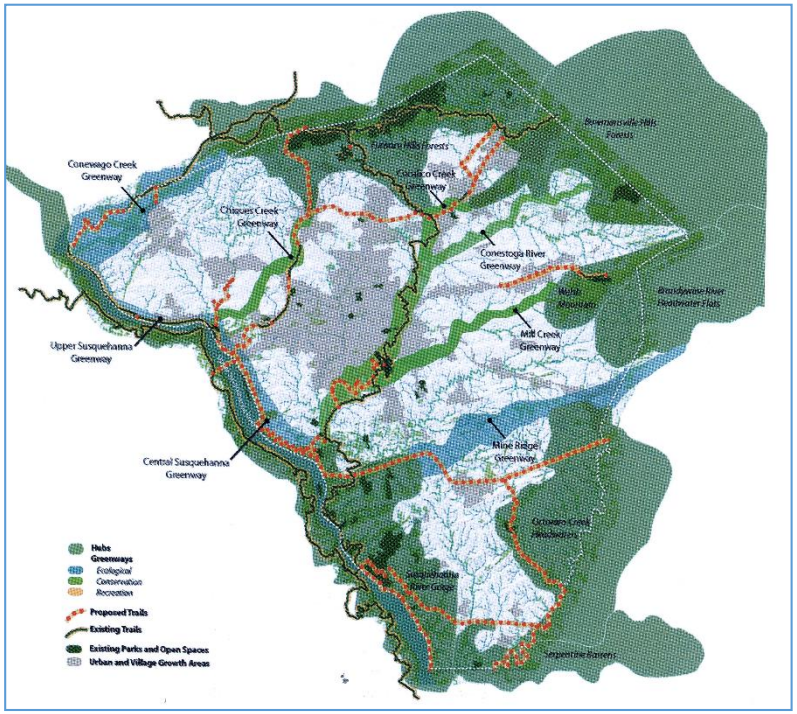
- Significant literature on the subject. . . Strong EU interest in addressing climate change impacts and protection of biodiversity

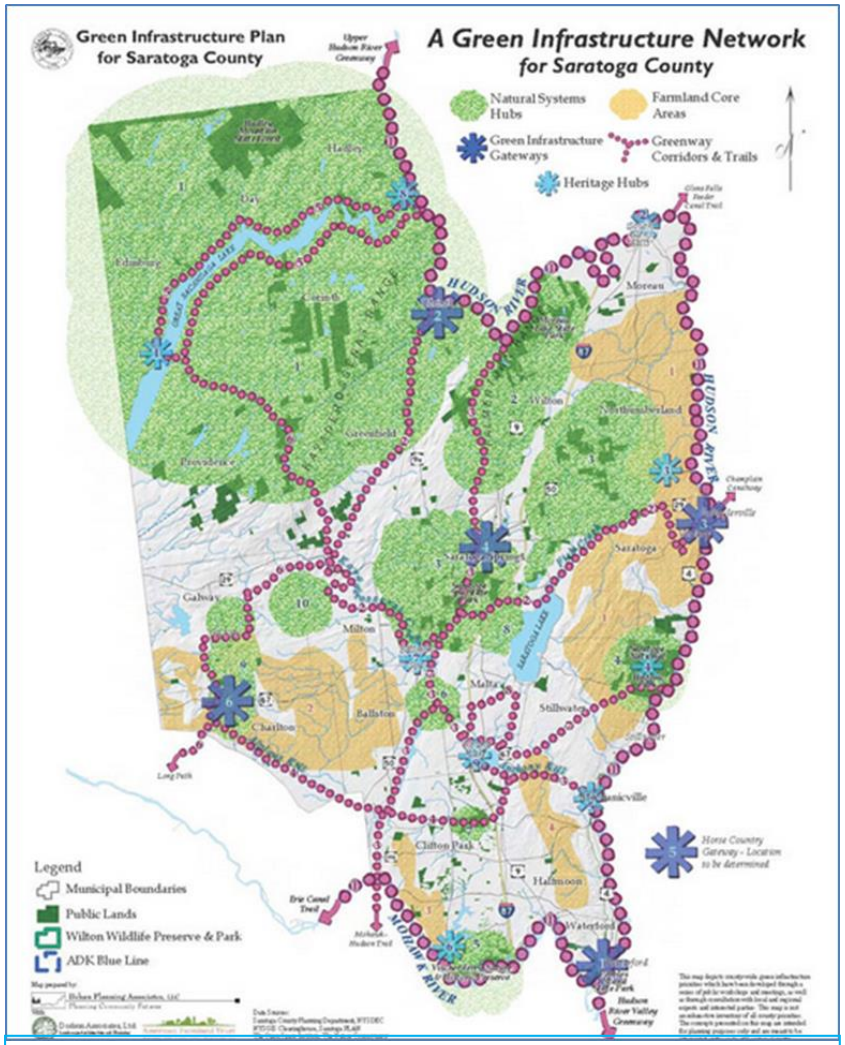
ec.europa.eu



Lit Review - GI Planning in USA

Lancaster County, PA Green Infrastructure Plan





Saratoga County, New York State

OMAFRA Survey - Innovative GI Elements

- Official Plans
- Sustainability planning
- Stewardship incentives
- Eco-cultural tourism
- Permaculture projects
- Local food
- Active transportation
- Parks, trails
- Soil erosion control
- Soil quality enhancement
- Woodlots
- Tree planting
- Rain gardens
- Natural habitat restoration
- Green linkages
- Prairie habitat
- Windbreaks, buffers
- Pollinator plantings
- Streetscapes
- Species at risk
- Watershed protection
- Source water protection
- Wetland protection
- Shoreline protection
- Climate change adaptation planning
- Sense of place cultural landscapes

Research shows varied approaches to integrating GI into rural municipalities.

OMAFRA Case Studies - Economic Benefits

- Growth of green industry: jobs in design, construction, maintenance
- Horticultural/landscaping jobs
- Less spending by municipalities
- Decreased energy costs
- Avoids cost of flooding, road repair
- Mitigates drought costs
- Attracting visitors – spending in local economy
- Eco-tourism
- Economic spinoffs
- Attracting young professionals
- Attracting & retaining residents
- Increased property value
- Timber sales
- Reduced healthcare costs – clean air & water, green space, increased physical activity
- Local food production
- Generates money from fees
- Creates niche markets – i.e. permaculture
- Environmental resilience
- Cost savings to farmers (inputs)
- Safeguarding soils
- Increase yields
- Education
- Preserves wildlife habitat
- Complements 'grey' infrastructure provision

GI provides multiple opportunities for stimulating economic activity, providing jobs, and offering cost benefits to rural municipalities.

GI Element Themed Categories

Community Livability (strategic planning)
Culture, Education, Recreation, Tourism
Local Food, Soil Quality Enhancement
Biodiversity, Habitat/Species Protection
Climate Change Adaptation & Mitigation
Water, Stormwater Management
Woodlands, Woodlots, Street Trees
Other (recycled land, brownfields)

Source: European Environment Agency, 2011

Source: Pollination Guelph

Source: Urban Toronto

Source: Tourism Windsor Essex

Case Study/GI Theme Matrix

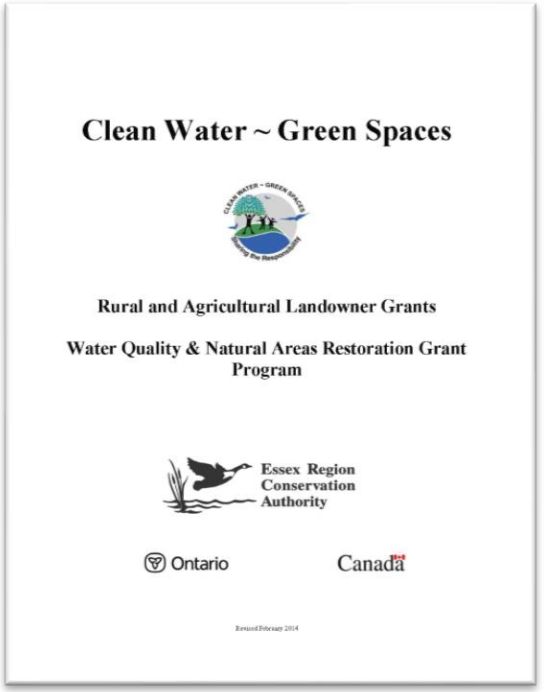
Themes / Case Studies	Community Liveability	Culture Educ. Rec. Tourism	Local Food, Soil Quality Enhancement	Biodiversity, Habitat & Species Protection	Climate Change Adaptation, Mitigation	Water, SW Mgmt.	Forests Trees Woodlots	Other (AT, brown-fields)
Take Action for a Sustainable Huron	X	X	X	X	X	X	X	X
Georgian Bay OP	X	X		X		X		X
Essex - CWATS	X	X						X
Clean Water ~ Green Spaces	X		X	X		X	X	X
Garvey Creek / Glenn Drain	X		X			X		
Maitland River video	X	X						
Rainscaping, Phosphorous Offsetting	X				X	X		
Mississippi Valley CA Climate Change model	X	X			X	X		
Transition Perth permaculture	X	X	X					
Simcoe Forests	X	X		X	X	X	X	X
Temagami Tourism	X	X		X				
Wingham Ecological Park	X	X		X		X		X
Green Legacy	X	X	X	X	X	X	X	X

Case Study –
Clean Water ~ Green Spaces

Essex Region Conservation Authority

- Incentive program for landowners that aims to improve regional water quality; increase & protect existing natural areas/biodiversity

- Funding directed at:
  - Natural area restoration
  - Buffer strips, windbreaks, tree planting, soil erosion controls
  - Wetland construction
  - Pollinator plantings

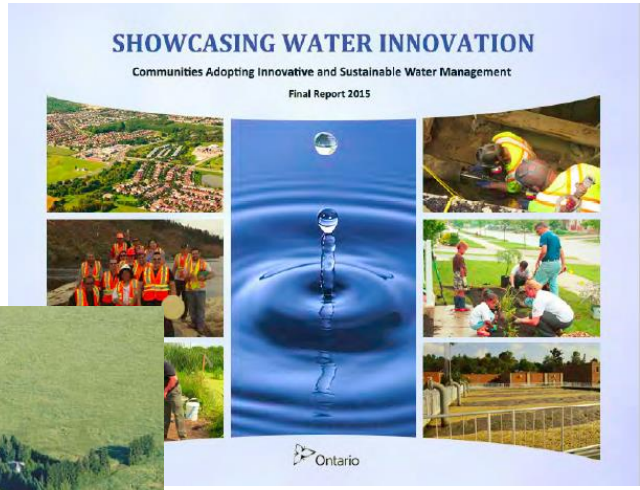


Background context – part of Great Lakes Water Quality Agreement, Great Lakes Protection Act, Detroit River Cleanup & Cdn. Heritage River

Case Study –
Garvey Creek-Glenn Drain Sub-Watershed

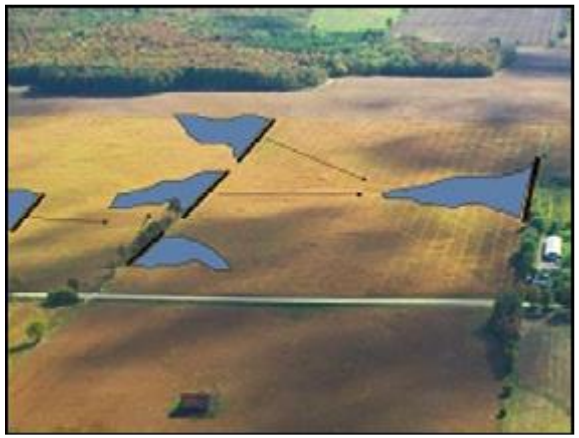
County of Huron

- One of 5 project watershed areas along southeast Lake Huron, investigating mechanisms to improve water quality & reduce soil erosion
- Pre & post monitoring rural stormwater run-off metrics, and stewardship efforts



Garvey-Glenn Watershed Stormwater Management Features

- Natural channels
- Constructed wetlands
- Erosion control berms/controlled outlets (WASCoB)
- Grassed swales



Other GI Elements: Constructed Wetlands for Wastewater Treatment (Rural Sewage Lagoons)

Cobalt, Ont. Constructed Wetland

Other GI Elements: Strategic Tree Placement for Living Snow Fences, Windbreaks, Shading

P Kraehling, 2016

Other GI Elements: Floodplain Riparian Buffers & Marginal Farmland Retirement

Grand River CA riparian buffer and creek setback

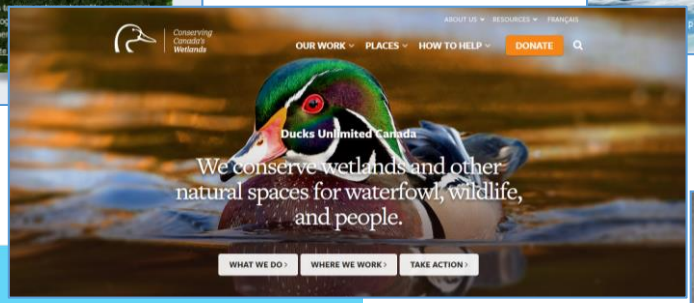
Maitland Valley CA Stormwater infiltration and remediation galleries

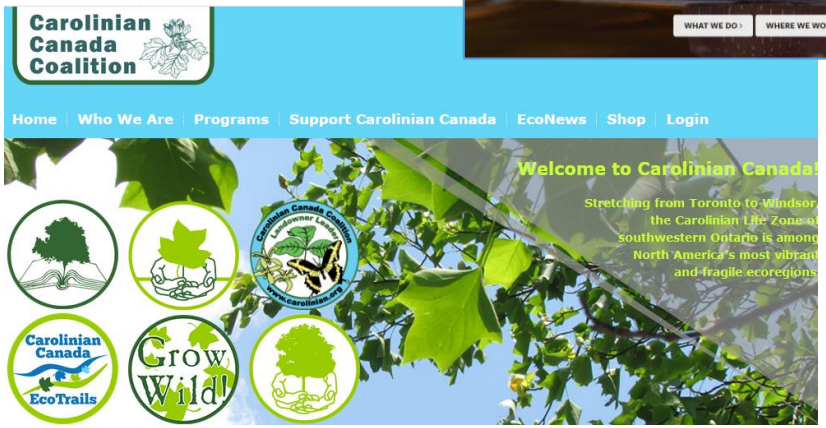
Other GI Elements:

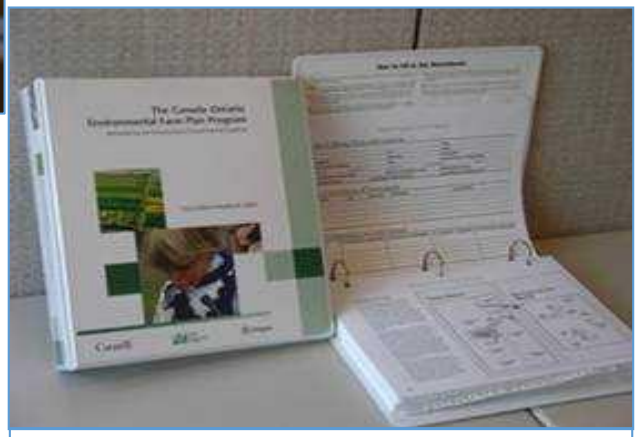
Recreation & Temporary Stormwater Storage

P Kraehling, 2016

Other GI Elements:
Leverage NGO and Senior Government Program $ to Assist Local Stewardship Efforts



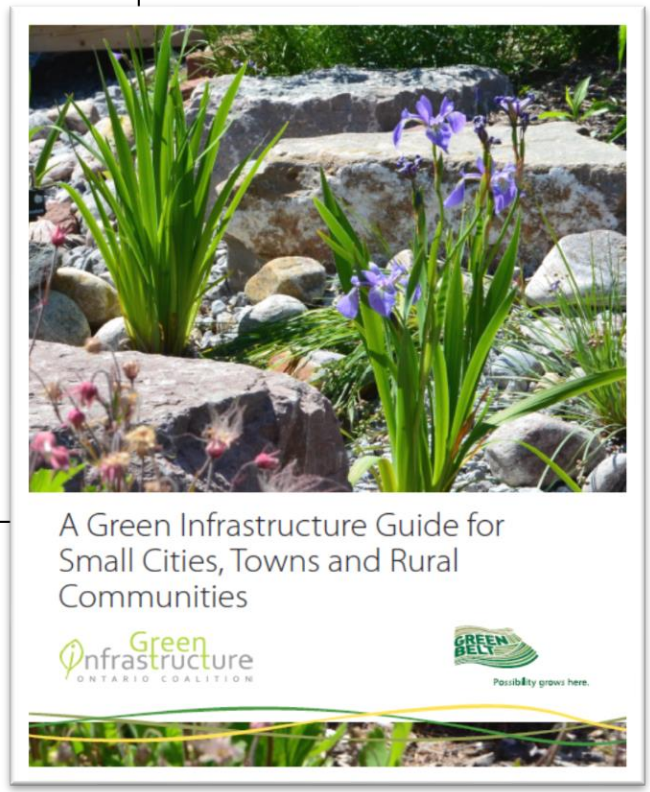




Source: OSCIA, Environmental Farm Plan & GLASI

Other GI Elements: Web info sources on GI

Ontario Green Infrastructure Coalition

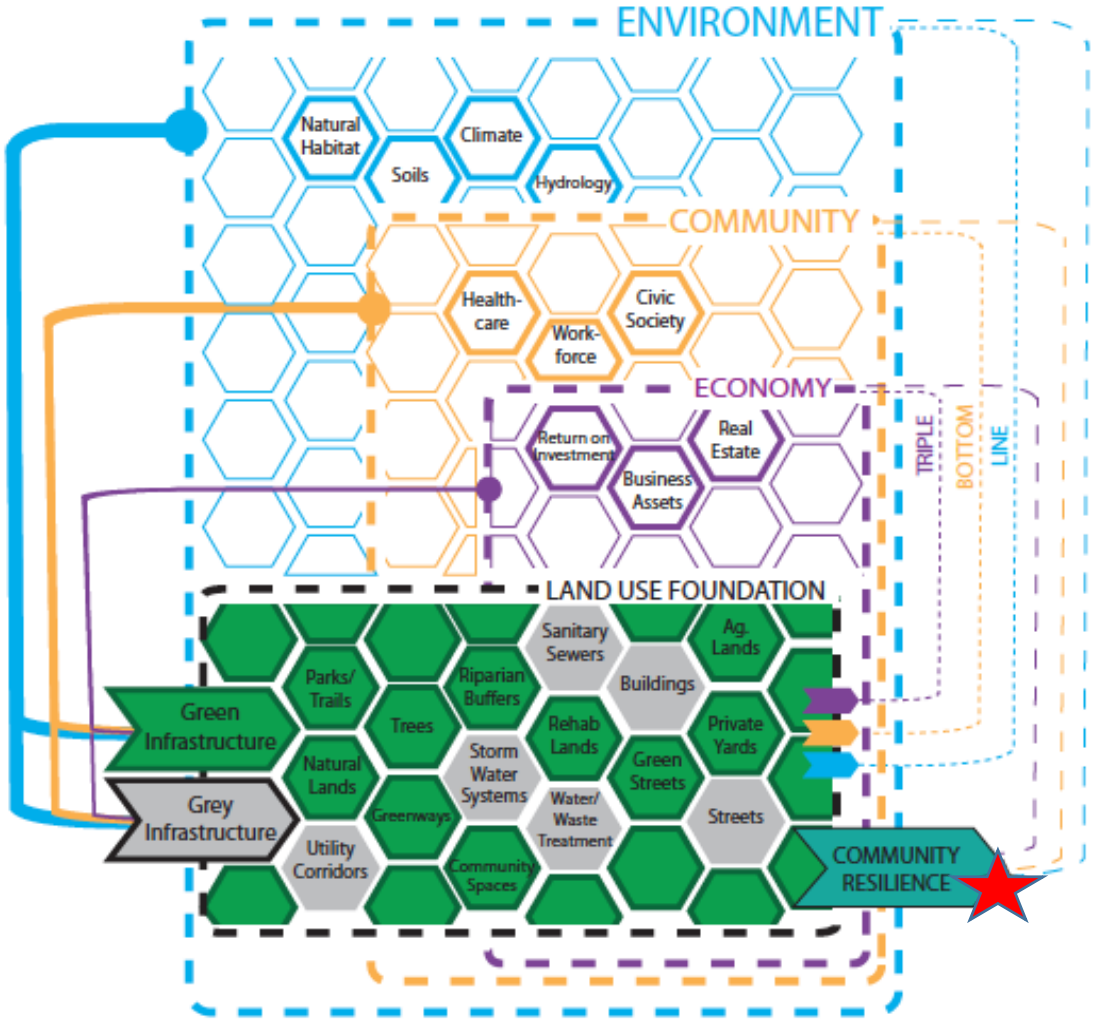


Greenbelt Foundation Guidebook

GI & Grey Infrastructure Working Together:

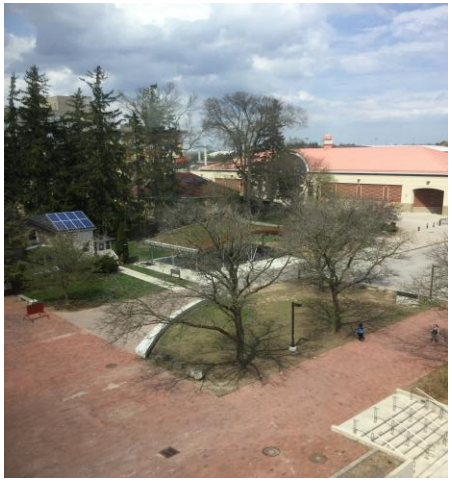
GI Strategic Community Planning Conceptual Framework

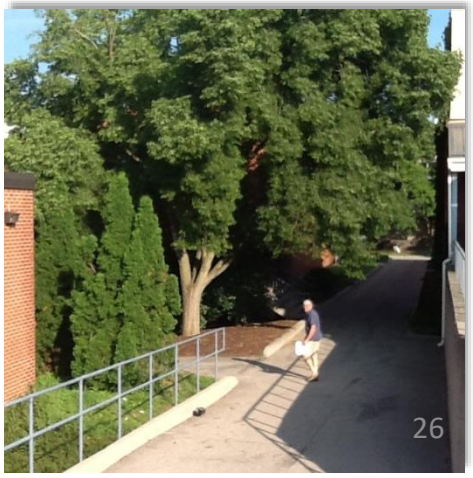
Adapted from Rouse & Bunster-Ossa, 2013



Conclusions

- Green infrastructure elements can be effective in addressing many challenges found in rural places
- Natural elements are cost effective and adaptable to many settings
- Land use planning using GI elements (with traditional ‘grey’ infrastructure) can be leveraged for community resiliency





Kraehling, 2016

UN WATER
22 MARCH
WORLD WATER DAY

Applying Nature/Natural Systems as Green Infrastructure (GI) in the Planning of Resilient Rural Communities (with a Water Focus)

Paul Kraehling OPPI RPP
Doctoral Candidate - Rural Studies
pkraehli@uoguelph.ca

GI OMAFRA/UofG Report @ http://waynecaldwell.ca/Projects/greeninfrastructure.html

UNIVERSITY of GUELPH
ONTARIO AGRICULTURAL COLLEGE
SCHOOL OF ENVIRONMENTAL DESIGN AND RURAL DEVELOPMENT

RPLC
RURAL POLICY LEARNING COMMONS
CAPR
COMMUNAUTÉ D'APPRENTISSAGE DES POLITIQUES RURALES