

Water and Sanitation Innovations for the Arctic

Canadian
Operation and Maintenance Approaches
and Sustainability

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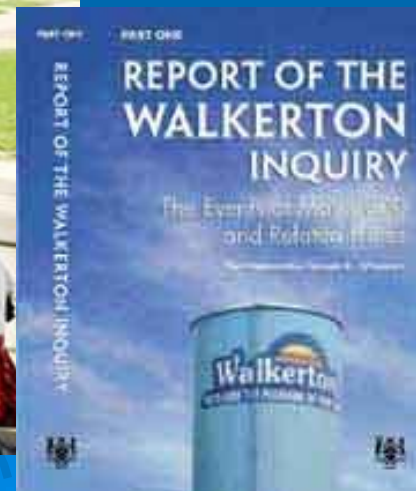
Canadian Perspective on Water and Sewer

Walkerton Legacy

Key recommendations of an inquiry touched on source water protection as part of a comprehensive multi-barrier approach, the training and certification of operators, a quality management system for water suppliers, and more competent enforcement.

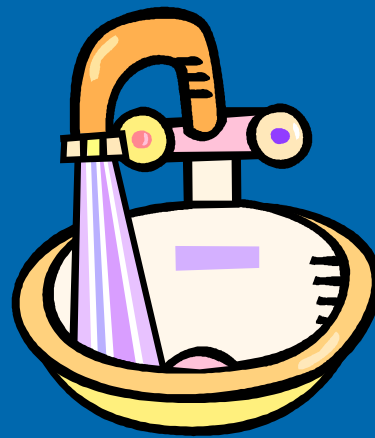


2,500 became ill in a town of 5000 and 6 died



The Northern Canadian Perspective on Water and Sewer

Most northerners in Canada travel to the south on a regular basis and have experienced “modern” water and sanitation facilities – these experiences have created expectations for communities in the north.



Waterline in Dawson City, YT in 1974



Truckfill station in Sachs Harbour NT in 2005

Geography and Logistics of Canadian North

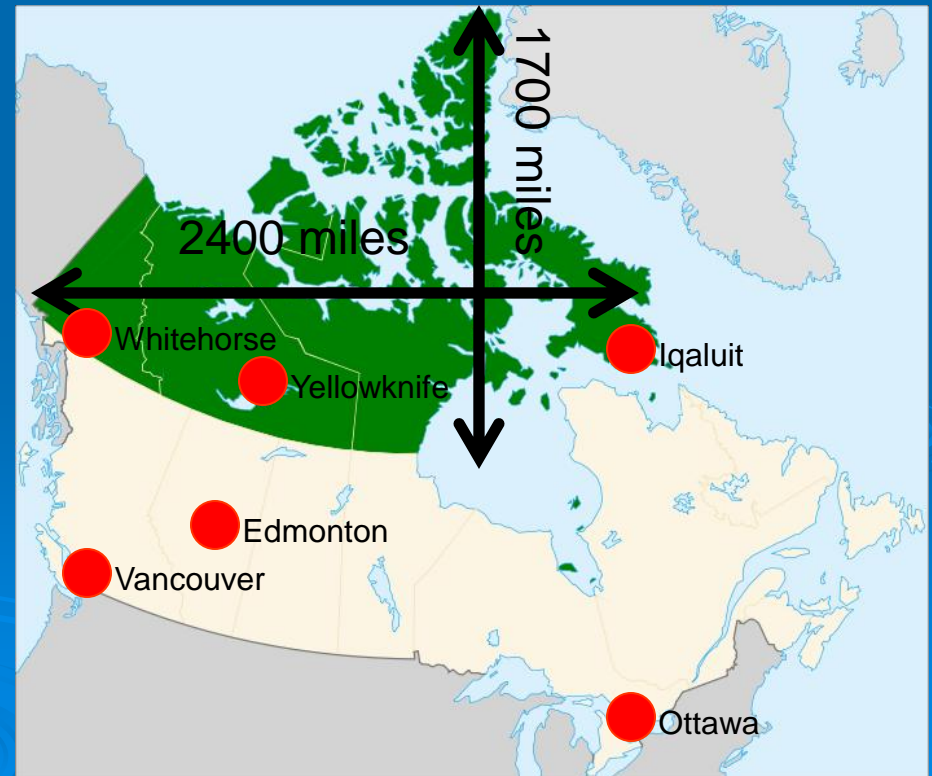
Four million square km; one and a half million square miles
40 % of Canada's land mass

Other northern regions of Nunavik (northern Quebec) and
Nunatsiavut (northern Labrador)

Getting around can be complicated and is
expensive - for example airfare from
Edmonton to Iqaluit is at least
\$2500



Water and sewer replacement in Iqaluit, NU in 1995.



Population and Infrastructure of Canadian North

85 communities in Yukon, Northwest Territories and Nunavut

YT	NT	NU	
24	32	28	Number of communities
7	6	3	Number of piped systems
30.1	41.4	31.9	Total population in thousands

Population in capital cities (population in thousands)
23.2 in Whitehorse; 19.8 in Yellowknife; 6.7 in Iqaluit



Water and sewer replacement in Yellowknife, NT in 2011.



Spare pipe in Dawson City YT.

Governance of Canadian North

- Federal Government
- Territorial Government
- Local Community Government
- First Nations Government (Community / Regional / Territorial / National)
- Metis Organizations (Community / Regional / Territorial / Land Claims)
- Inuit Government (Community / Regional / Territorial / Land Claims)

Example of layers of governance at the local level
Fort Resolution, NT ●

Potentially 7 levels of government

Federal

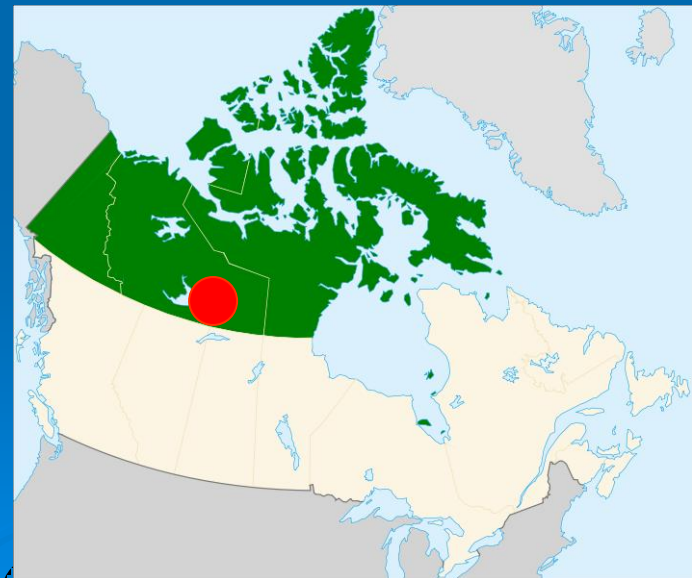
Territorial

Community

First Nations (Community / Regional)

Metis (Community / Regional)

There are issues associated with water and sanitation and the various levels of government in Fort Resolution



Governance of Canadian North

Practices of Territorial Status

Many northern communities are finding the demands of the Federal and Territorial governments to be well beyond their financial and administrative resources.



Cost of Water and Sewer in Canadian North

Grise Fiord, Nunavut - Operation and Maintenance

Year	Water \$	Sewer \$	Total
2001	234,391	100,200	334,591
2002	255,959	109,696	365,655

\$2240 per capita per year in 2002 or 6.4 cents per litre

Water use - 5,678,500 litres per year or 95 litres per capita per day

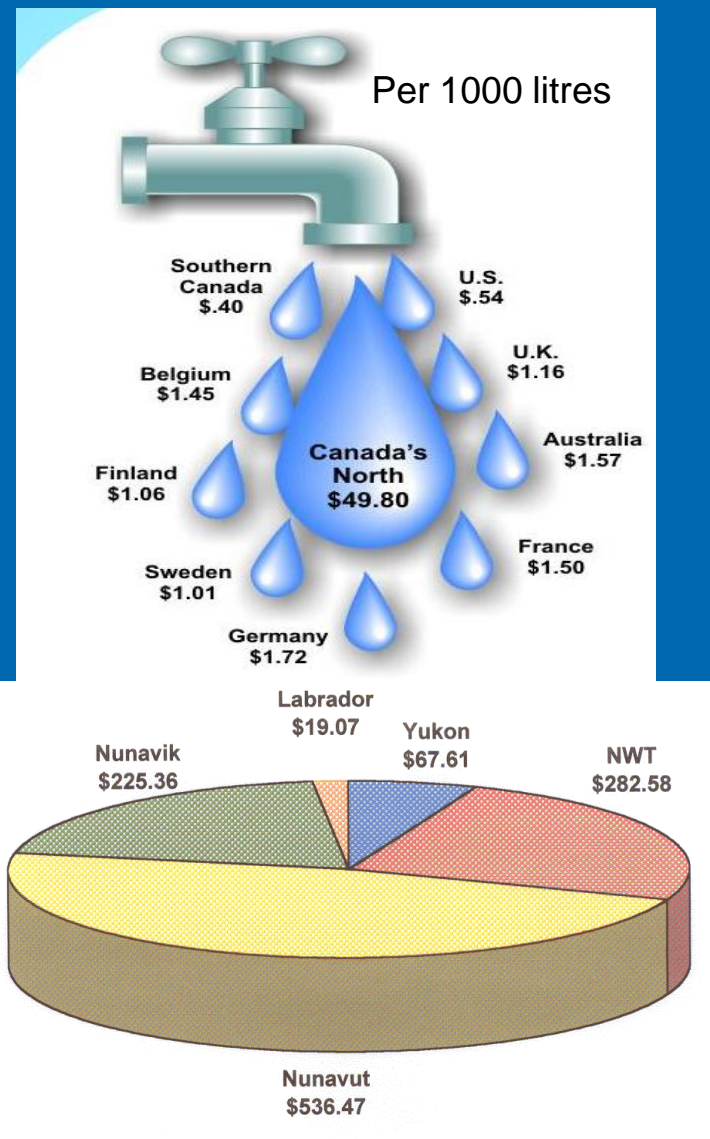
Whati, NT - Operation and Maintenance

Year	Water\$	Sewer \$	Total\$
2001	167,800	71,900	239,700
2002	184,600	79,100	263,700

\$580 per capita per year in 2002 or 2.3 cents per litre

Water use: 11.5 million litres per year or 70 litres per capita per day

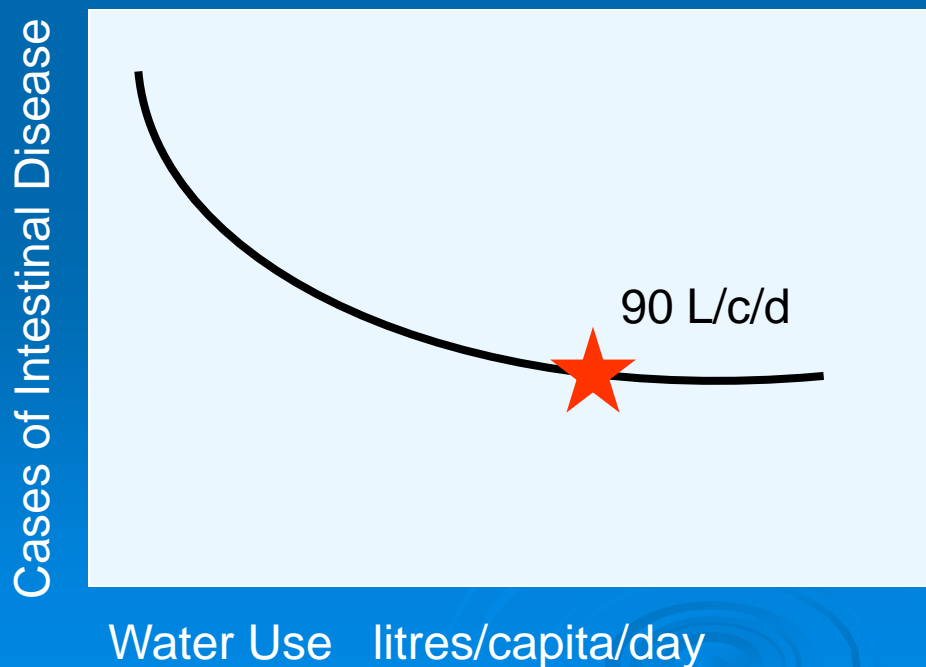
0.12 cents per litre in Edmonton. Alberta



Estimated regional monthly water and sewer costs for 10,000 litres of water

Driving forces for water and sanitation

Research completed in the 1980's suggested a link between cases of intestinal disease and water use. Based upon this research, a northern water and sewer policy was developed and implemented based upon public health influence of minimum water use of 90 litres/capita/day. This became the design standard for trucked water supply and all of the associated infrastructure.



Driving forces for water and sanitation

“Water proof 3” is Canada’s drinking water report card by “ecojustice”, who are comprised of lawyers and a few scientists headquartered in Vancouver with limited knowledge and experience in the Canadian north.

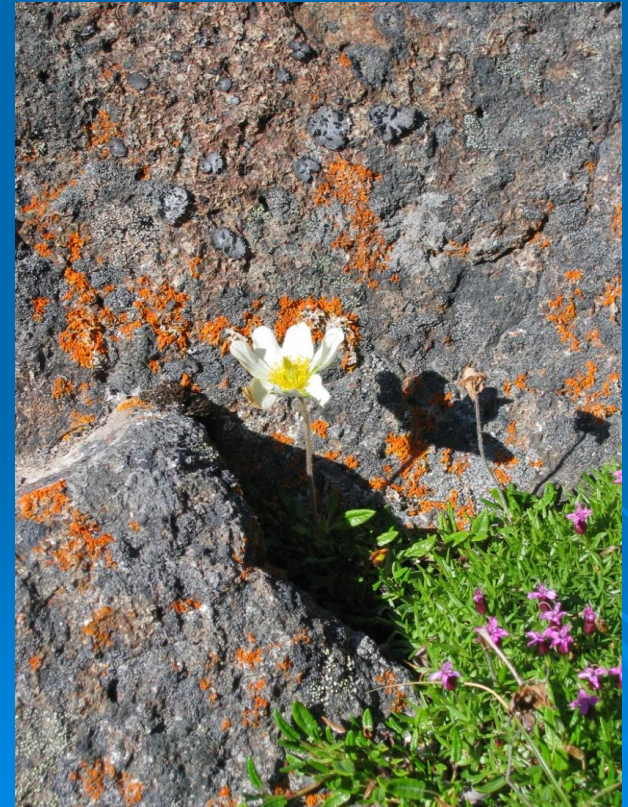


Driving forces for water and sanitation

Various existing and emerging regulations influence the water and sanitation infrastructure in the Canadian north; the legislation includes the Federal Fisheries Act (sewage), the Territorial Health Acts (water) and Territorial environmental legislation. Territorial water boards also influence the water and sanitation practices of communities.



Mackenzie River near Tsiigehtchic, NT.



Tundra flower near Ulukhaktok, NT

Operation and Maintenance Approaches in the Canadian North

- Regional territorial resources
- Community employed resources
- Outside resources

In support of these resources maintenance management systems have been developed, and there is ongoing community training and capacity building.



Operation and Maintenance Approaches in the Canadian North

“The School of Community Government provides an integrated approach to community government capacity building. The School coordinates a system of training and development, tools and resources for community governments, their staff and organizations that support community governments.”

“The Department of Public Works and Services is an essential partner in the achievement of government goals through the provision of high quality services, expert support and innovative leadership in community water systems.”



Water reservoir in Chesterfield Inlet, NU in 1998



Water treatment facility Tsiigehtchic, NT

Subsidizing northern water and sewer

The origins of the water and sewer subsidy go back more than 25 years with the baseline being the cost of water in Yellowknife which was 0.2 cents per litre – subsidies were provided for residential use in all communities for all operation and maintenance costs above the City of Yellowknife benchmark. The full economic was charge to non-residential users.



Piped water and sewer in Rankin Inlet NU



Trucked sewage collection in Repulse Bay, NU



Natural sewage lagoon in Tuktoyaktuk, NT

Subsidizing northern water and sewer

The subsidy has been “rebranded” to the general term of “formula funding” and the policy around this funding states “community governments should maximize their revenue, within the capacity of their residents”.

- Operations and Maintenance Funding – a grant to assist with the costs of providing community government programs and services
- Community Public Infrastructure Funding – a grant to assist with the capital costs of community public infrastructure
- Extraordinary Funding – a grant or loan to assist with extraordinary funding requirements.
- Water and Sewer Services Funding – a grant to assist with costs of providing water and sewer services



Truck sewage dump in Tuktoyaktuk, NT in 1994

Subsidizing northern water and sewer

- Water and Sewer Services Funding – a grant to assist with costs of providing water and sewer services
 - Kakisa population 52 granted \$167,000 in 2009-2010
 - Yellowknife population 20,000 granted no money in 2009-2010
 - GRANT TOTAL \$11.6 MILLION FOR 32 COMMUNITIES
- Operations and Maintenance Funding – a grant to assist with the costs of providing community government programs and services
 - Kakisa population 52 granted \$366,000 in 2010-2011
 - Yellowknife population 20,000 granted \$6.5 million in 2010-2011
 - GRANT TOTAL \$41.8 MILLION FOR 32 COMMUNITIES



Water intake construction in Carcross, YT in 1990

Subsidizing northern water and sewer

In 2007 the new deal implemented full authority on infrastructure for communities in NT

Alternate funding opportunities

- Infrastructure Stimulus Fund
- Municipal Rural Infrastructure Fund
- Canada Strategic Infrastructure Fund
- Infrastructure Canada Program



Water reservoir and treatment facility in Chesterfield Inlet, NU.

Innovations - Water treatment

Cartridge Filtration

Operation and maintenance consists of replacing ten, 1 micron filters twice a year, and replacing five, 10 micron filters once a year.

Replacement filters cost \$20 each, therefore the total cost of filters replacement is \$500.00 per year.

The water quality of Bennett Lake is extremely good, with very low turbidity.

Ultraviolet disinfection only has been accepted in some cases as the sole form of "treatment" to water supply.



Cartridge filtration system in Carcross YT

Innovations - Water treatment

The NT government is completing the phase 2 of a unique project delivery approach where water treatment facilities for communities were “bundled” into groups of 5 projects and tendered as design build – the program has delivered 10 water treatment facilities costing on average \$2.5 million each.



Water treatment facility in Edzo, NT



Water treatment facility for Ulukhaktok, NT – on route and in place

Innovations - Wastewater treatment

- Onsite wastewater recycling
- Aerated lagoon systems
- Wetland systems



Aerated lagoon in northern Alberta



Residential on site wastewater recycling system in Iqaluit, NU



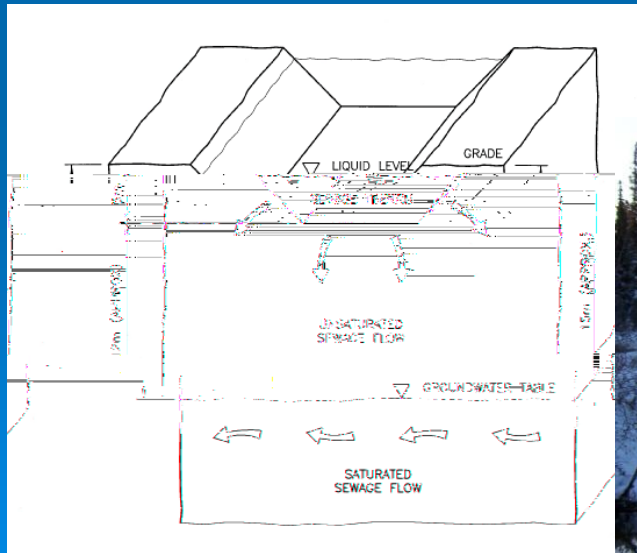
Wetland in Ulukhaktok, NT

Innovations - Wastewater treatment

- In ground disposal in permafrost soils
- Membrane wastewater treatment
- Fixed media filter for nitrification

Soil exfiltration of wastewater uses the elements of nature in the available soil "matrix", and the processes of biodegradation, filtration, adsorption and absorption to remove the contaminants in sewage.

In ground disposal Fort Good Hope, NT

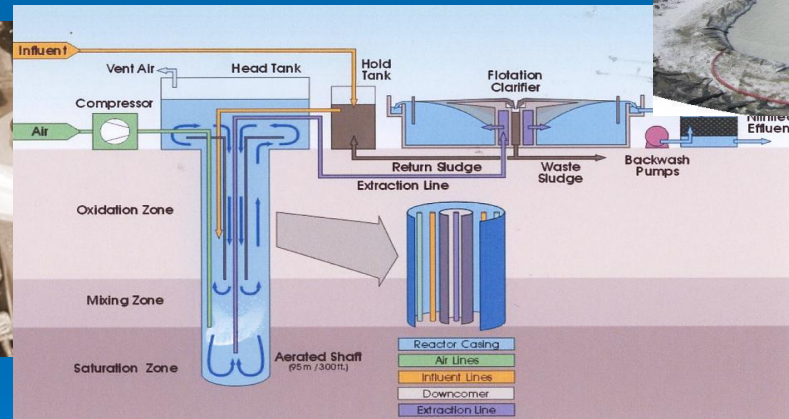


The question of sustainability

Current YT project example

Dawson City and the Yukon government have spent \$35 million in past 20 years (\$28 million since 2007) for wastewater system to serve 2000 permanent residents

WHY – regulatory / judicial decision



The deep shaft process is somewhat unique; however a similar process has been operating successfully in Homer, Alaska for the past 16 years. The capital cost for the deep shaft technology will be approximately \$25 million, with an estimated annual operation and maintenance cost of \$500,000.

The question of sustainability

Current NT project example

Inuvik is incrementally replacing its 50 year old above ground water and sewer system at a cost of \$6000 per meter with an estimated cost of at least \$150 million for complete replacement of old system

WHY – political / technical decision



The question of sustainability

Current NU project example

Water and sewer for the community of Resolute is being replaced at a cost of \$30 million for new piped water/sewer system to serve 250 people

WHY – political / technical decision



Buried water and sewer system in Iqaluit, which will be similar to the Resolute system



The question of sustainability

NT Resources available through the School of
Community Government

GNWT Community Government Toolkit...

Community Operations; Governance;
Management; Human Resources;
Infrastructure Planning
Project management; Integrated Community
Sustainability Planning; Program
Responsibilities



Water treatment facility Kimmirut, NU



A legacy

There is a significant gap associated with wastewater management between regulatory principles, and reasonable practices for the communities of the far north.

We are poised to either implement solutions which are appropriate to the administrative, financial, technical, and human resource capacities of northern communities OR create legacies which will unreasonably burden the communities for a generation.



Questions ?

