Global Water Futures Observatories

John Pomeroy, GWFO Director





GLOBAL WATER FUTURES OBSERVATORIES

Canada's Water Crisis in the 21st Century

Rapid Glacier Loss

Snowmelt Flooding

Retreating glaciers creating hazards, July 2021

loss of water storage. Disappearance uprecedented flooding in of Slims River and loss of inflow to Whitehorse and Southern Kluane Lake, YT. Lakes area.



Increasing Wildfires

Series of recent recordbreaking fire seasons in central and western Canada, increasing costs and area burned.

B.C. Lower Mainland Flooding November 2021

Cost of rebuilding estimated at nearly **\$9 Billion.**





Southern Alberta Flood June 2013

City of Calgary and surrounding communities sustained over \$5 Billion in damages. 100,000 people evacuated.

Ice-Jam Flooding May 2022 Unprecedented ice jams and flooding, Hay River, NT.



E her This own Fort McMurray Wildfire May 2016

Direct and indirect damages totaled almost \$10 Billion. 88,000 people evacuated.

~ 并为 例 不 水 Severe Drought 2000–2002

Prairie drought at turn of century cost **\$5.8 Billion**. Drought recurrence since has cost many billions more. Crop insurance payout of **\$2.4 Billion** in SK, 2021.

Large and Sustained Algal Blooms

Increasing frequency and severity of algal blooms in Lake Winnipeg.

Water Shortage August 2022

City of Igaluit declare emergency due to water shortage caused by lack of rainfall.



Drinking Water Advisories

As of 2022 there are 31 long-term advisories in 27 Indigenous communities



Rainfall-Driven and Rain-on-Snow Flooding

Devastating and unprecedented flooding cost \$ Billions and affects:

- Eastern Prairies (2011, 14)
- Southern Ontario and Quebec (2017)
- New Brunswick (2018, 19)
- Nova Scotia and Newfoundland (2021)





Greater Toronto Area Flooding July 2013

Toronto flood caused almost **\$1 Billion** in damage and is the costliest flood disaster in Ontario history.

Threats to Great Lakes Ecosystems

Economic costs of eutrophication estimated at \$270 Million per year for the Canadian side of Lake Erie.







Global Water Futures Observatories (GWFO)

Solutions oriented network of world class observation sites and laboratories



National and Global Need for GWFO

- GWFO research basins, systems and laboratories support development of solutions for
 - Great Lakes health
 - Irrigation and agriculture
 - Flood and drought prediction
 - Climate change adaptation
 - Water sustainability
- Nearly 500 groups across Canada use our information
- Model developments used around the world.
- GWF and CFI legacy will disintegrate without technical teams to operate and integrate observational infrastructure

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Global Water Futures Observatories 2023-2029

INNOVATION

Canada Foundation for Innovation

Fondation canadienne pour l'innovation



UNIVERSITY OF SASKATCHEWAN **Global Water Futures** GWF.USASK.CA

















GWFO Vision

Vision: To operate a national water observatory consisting of a network of instrumented water observing sites, supported by deployable observing systems and major laboratories, that provides open access water data and the necessary infrastructure to collect supplementary data, which informs the development and testing of water prediction models, monitors changes in water sources, underpins diagnosis of risks to water security and helps design solutions to ensure the long-term sustainability of Canadian water resources.

Principles of Operation

- provide unique water data of interest to characterizing and monitoring the water conditions of Canadian river basins
- contribute to a critical baseline of water data to the benefit of multiple users
- support the data collection from, and analysis of water from the network of instrumented water observing sites
- adhere to the principles of open access.

GWFO: Big Data for Water Sustainability Solutions



Deployable Systems & Major Laboratories

GWFO Governance will evolve from existing GWF Structures

















Global Water Futures Observatories (GWFO)

Transboundary - Provincial & International 64 instrumented basins 15 deployable systems

18 major water laboratories 5 major river basins **49 HQP**



Ontario: Instrumented Basins and Major Laboratories





Lake monitoring

- HABs, particularly those that produce microcystin, can shutdown water treatment facilities
- Also, rapid changes in temperature, pH (dissolved oxygen) can compromise water production







Canadian Rockies Boreal Forest and Prairies

Instrumented Basins

- 1. Columbia Icefield
- 2. Athabasca Glacier
- 3. Wapta Icefield / Peyto Glacier
- 4. Helen Creek
- 5. Fortress Mountain
- 6. Burstall Creek
- 7. Marmot Creek Research Basin
- 8. Sibbald Wetlands
- 9. Fort McMurray
- 10. Borden Bridge
- 11. Clavet Livestock and Forage Centre of Excellence
- 12. St. Denis National Wildlife Area
- 13. Kenaston / Brightwater Creek Mesonet Site
- 14. Buffalo Pound Lake
- 15. Old Black Spruce (OBS) Boreal Ecosystem Research and Monitoring Sites (BERMS), White Gull Creek
- 16. Old Jack Pine (OJP) Boreal Ecosystem Research and Monitoring Sites (BERMS), White Gull Creek
- 17. Fen Boreal Ecosystem Research and Monitoring Sites (BERMS), White Gull Creek
- 18. Saskatchewan River Delta

Winnipeg

NORTH DAKOTA

Prairie snow depths

Spatial distribution of snow depth mapped with lidar over duration of GWF, along with snow albedo and snowmelt runoff from multispectral



Phillip Harder collecting drone data over Saskatoon feedlot



RGB (left) and lidar-derived snow depth (right) over field

Basin-scale snow depth in the Rockies

Collect snow depth at Fortress Mountain Snow Lab from drone-based lidar, used to create snow water equivalent (SWE) maps



Reigl miniVUX-2 lidar used to collect elevation data over whole basin area

Raw lidar point cloud



Peyto Glacier toe recession mapping

RGB imagery and lidar scans have been collected over Peyto since 2019, allowing us to map the rapid recession of the glacier



Average lateral toe recession: 2019/20: 12.3 m 2020/21: 195.7 m 2021/22: 120.7 m

Operations & User Access

Access granted through a formal process - Strategic Management Committee





No cost to access field sites. Fee structure to access labs and deployable systems

Data Management







GWFO's GWFNet



GWFNet provides:

- access to data and publications, indexed by facility and/or observatory (and user request), free of charge
- highly detailed information for every observatory and its sites and stations
- highly detailed information on the services each facility provides
 - data(sets),
 - publications,
 - deployable systems,
 - and/or laboratory services,
 - and associated f<u>ees</u> (per the GWFO Fee-for-service Model)
- private management and batching of requests for access to each facility (or deployable systems or laboratory services it provides)

and its **sites** and **stations cility** provides

https://gwfnet.net/GWFO

Observatories and Sites -**GWFO**

Related Information

Catalogue Master Index

Programs - GWF Observatories (GWFO)

Alder Creek Smart Watershed (GWFO)

Athabasca Glacier (GWFO)

Baker Creek (GWFO)

Blair Creek (GWFO)

Bogg Creek and Surround Areas (GWFO)

Borden Bridge (GWFO)

Brintnell-Bologna Icefield (GWFO)

Buffalo Pound Lake (GWFO)

Burstall Creek (GWFO)

Clavet Livestock and Forage Centre of Excellence (GWFO)

Columbia Icefield (GWFO)

Dehcho Lake Sampling Network (GWFO)

EIT (GWFO)

Eastern Basin Lake Erie (GWFO)

Elora Research Station (GWFO)

Fairway (GWFO)

Fanshawe Reservoir (GWFO)

Fen - Boreal Ecosystem Research and Monitoring Sites (BERMS), White Gull Creek (GWFO)

Laboratory Facilities and Deployable Systems - GWFO

Programs - GWF Observatories (GWFO)

GWFO Saskatchewan Water Chemistry and Ecology Laboratory

GWFO Smart Water Systems Lab (SWSL)

rograms - GWF Observatories GWFO)

Master

Advanced

ated Information

Catalogue Master Index

Laboratory Facilities and Deployable Systems - GWFO

Observatories and Sites - GWFO

Programs - All



ction 1: Project Information



GWFO Saskatche Chemistry and Ec

Related Information

Laboratory Facilities and Deplo

GWFO Facility Depoyable Systems Laborato Section 1: GWFO Facility

Facility Name

GWFO Saskatchewan Water Chemistry and E

Location

University of Saskatchewan

Oversight/Contact

Name

Helen

Name	Role
Helen Baulch	PI
Katy Nugent	Man

Water quality Water quality Maintenance sondes/elect

Service/Purpose

This facility provides baseline and time-sensitive data on aquatic ecosystem ecology and biogeochemistry, specifically, that aids in understanding the effects of changing climate and nutrient loads on aquatic ecology and biogeochemistry.

Manage

Related Information

Classification Field equipme Field equipme Field equipme Field equipme Deployable sy

Deployable s

Sontek Flow

Sontek Flow Soil moisture

Soil moisture

Ice Auger

Ice Auger

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Item

https://gwfnet.net/GWFO



GWFO Saskatchewan Water Chemistry and Ecology Laboratory

Laboratory Facilities and Deployable Systems - GWFO



Section 2: Depoyable Systems

List of Deployable Systems

	System Description	Equipment Description	Location	#
ent	Sontek Flow tracker (velocity meter)	Flow monitoring	University of Saskatchewan	
ent	Soil moisture sensor	Soil moisture	University of Saskatchewan	
nt	Ice Auger		University of Saskatchewan	
nt	Licor underwater light meter		University of Saskatchewan	
stem	Buoys	For open water or under-ice deployment, wiped sondes at 2 depths, for O2, conductivity and one wiped light sensor. Suited to lentic systems without boat traffic, sonde depth is adaptable, but designed for shallow deployment (3-6m)	University of Saskatchewan	2
stem	Maintenance / setup of		University of Saskatchewan	
	sondes/electronics			

Fee Structure

	Unit	Internal Rate *	External Rate **	Commercial R
racker (velocity meter)	per week	\$300	\$345	\$420
racker (velocity meter)	per day	\$70	\$81	\$98
sensor	per week	\$200	\$230	\$280
sensor	per day	\$60	\$69	\$84
	per week	\$200	\$230	\$280
	per day	\$60	\$69	\$84
ater light meter	per week	\$500	\$575	\$700
ater light meter	per day	\$120	\$138	\$168
and algae system	for first month	\$2,000	\$2,300	\$2,800
and algae system	every month thereafter	\$1,000	\$1,150	\$1,400
/ setup of onics	per person/day	\$400	\$460	\$584

nternal rates refer to users within the University offering the service or any researcher GWFO partner Universit **External rates refer to users from NGO's or Academ

GWFO Priority Research Support Directions 2023-2029







Develop and deliver computer models and analytical tools for water-related disaster warning, prediction of future water flows and risks to water quality



Solutions for adaptation to climate change and associated risk management across Canada.



world





Foundations for the development of the **Canada Water Agency**

Next-Generation water prediction models that will produce fine scale gridded outputs over all of North America. Eventually the

Deliver tools to support the information needs of a wide range of data users across Canada

GWFNet – a standard for disseminating water data from water observations over Canada to provincial and federal government agencies, industry, agriculture, communities, and other researchers

Hydrological Modelling: Saskatchewan River Basin



Benefits Enabled by GWFO to Canadians

National Flood, Drought, & Water	Foundation f
Quality Prediction	Water №
Floodplain Mapping & Risks Associated with Water-related Disasters	National a
Irrigation, Beneficial Management	Water In
Practices & Precision Farming	– Inc
Flexible & Responsive to Climate Change & Extreme Events	Attract & Professionals Le

For the Federal & Provincial Ianagement Strategies

nd Transboundary Lake Restoration

formation for Prosperity dustry, Communities æ

& Retain Talented Young & & Global Scientific-thought eaders to Canada

Thank you!



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