

Tobacco Creek Model Watershed – U of S research

The Global Institute for Water Security

Fresh water is essential for human life and well-being, for economic development and for ecosystem health, yet water resources worldwide are under pressure. Our interdisciplinary research links science to resource management and policy to help protect and manage this precious resource.

Officially launched in March 2011, the **Global Institute for Water Security** builds upon leading expertise and capacity in water research at the University of Saskatchewan (U of S).

The institute is funded through the Canada Excellence Research Chair in Water Security - a \$30-million joint commitment between the Government of Canada, the Government of Saskatchewan and the U of S. It is one of the single largest water research investments in the world.



Led by Dr. Howard Wheeler, Canada Excellence Research Chair and director of the institute, over 70 faculty and government scientists and 50 students and post-doctoral fellows are developing the modelling tools, techniques and policies to sustainably manage the world's freshwater resources. The U of S has rapidly become a hub for international water expertise.

Our Research

Research at the Global Institute for Water Security is focused on sustainable use of water resources and protection against flood and drought hazards. Multi-disciplinary science, engineering and social science teams work with industrial and government partners to address five broad water security issues:

- Climate change and water security
- Land – water management and environmental change
- Sustainable development of natural resources
- Socio-hydrology
- Water and health

GIWS has upgraded and installed observation networks throughout the Saskatchewan River Basin in the Rocky Mountains, Boreal Forest and Prairies. These world-class networks help improve the ability to predict river flows, and our understanding of how water quality and river basin ecosystems respond to climate change.

Water quality challenges

Increased nutrient concentrations have caused changes in aquatic ecosystems. In many cases, eutrophication, or nutrient enrichment, has caused a shift in lakes from relatively healthy clear-water conditions, to degraded conditions with very high algal production, harmful algal blooms and low oxygen leading to fish kills. Despite decades of work to reduce municipal nutrient loads, many lakes are seeing a resurgence of eutrophication problems. This has led to recognition that we need to further reduce nutrient loads. In many cases, these nutrient load reductions will need to come from non-point sources, including agricultural runoff.

The long history of research in South Tobacco Creek has been incredibly valuable in informing our understanding of nutrient fluxes, and of hydrology, and in lending insights into potential solutions to eutrophication problems in the Lake Winnipeg Basin and beyond.



Our research, funded by the Canadian Water Network, in collaboration with the Tobacco Creek Model Watershed and Environment Canada researchers, will help further our understanding of the potential impacts of beneficial management practices, and of drivers of nutrient fluxes, and changing hydrology. This work is led by Drs. Howard Wheeler, John Pomeroy, and Helen Baulch.

Research Focus – Tobacco Creek Model Watershed

Sediments and small dams

Two University of Saskatchewan masters students, Raea Gooding and Noel Galuschik have now completed an extensive field program to understand nutrient dynamics within tributaries of Tobacco Creek, and within beneficial management practices, specifically, within headwater dams.

Their work asks the question – do sediments alter stream nutrient concentrations? And do these interactions yield a net benefit in terms of water quality?



Final results aren't anticipated until later this year, but Raea's work suggests that streams and dams are important sites of permanent nitrogen removal due to denitrification, with dams representing a potential denitrification hotspot – with very high capacity to retain nitrogen, which will help improve water quality.

Unfortunately, stream sites are often nitrogen saturated, which means they are not able to remove more nitrogen, should its concentration increase. Dam sites are more able to respond, but in some cases dams are also nitrogen saturated.

Noel's work shows that stream and dam sediments often have the capacity to absorb phosphorus from the water column. Her work is currently focused on understanding spatial and temporal dynamics. Where are the most important sites for sediment phosphorus retention, and why? And, why do we see changes in this over the season?

If you'd like more details on this work, please get in touch with us.

Mathematical modelling

Understanding hydrology and nutrient fluxes at the scale of large watersheds is an incredibly complex, but important scientific need. Mathematical models have emerged as a key tool in understanding complex processes affecting nutrient export and hydrology (including flood risk, and soil moisture). These tools allow us to better understand what is driving current conditions. They can also be used as a tool for asking questions about the future. For example, we can ask 'what-if' questions regarding the implementation of different beneficial management practices, and about the impacts of climate change. We welcome input on what types of scenarios would be useful to explore, and what types of beneficial management practices you'd like to employ.



Postdoctoral Fellow Taufique Mahmood, and masters student Jennifer Roste are working on modelling hydrology at multiple scales, and are developing new tools to better understand nutrient export and its controls. These new tools are informed by the long history at Tobacco Creek. Taufique's work has shown the importance of stubble height in determining snowpack and spring streamflow. He's also shown that although the small dams reduce peak flows, the impact is fairly small in wet (flood) years. Jennifer's work is currently focused on understanding the controls on nutrient export from prairie catchments, information that we'll integrate into our next phase of biogeochemical modelling work.

Questions and comments?

If you have questions, or would like further information, please contact Dr. Helen Baulch. Helen.baulch@usask.ca; 306-966-2549.