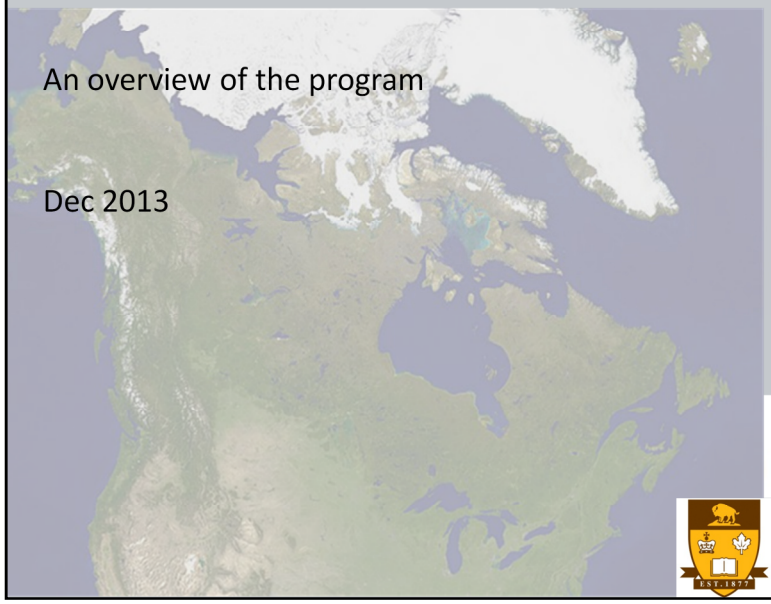
Watershed Systems Research Program



An overview of the program

Dec 2013

Watershed Systems Research Program

University of Manitoba

Overview

- Background to the Watershed Systems Research Program
- Program strategy
- Program research – just some of the projects we are involved in

Watershed Systems Research Program

University of Manitoba

The program was set up in late 2010 by the Government of Manitoba in response to recommendations by the Clean Environment Commission and the Lake Winnipeg Stewardship Board. A core team to establish the program were appointed by February 2012.

Supported by an investment of $1.25 million over 5 years

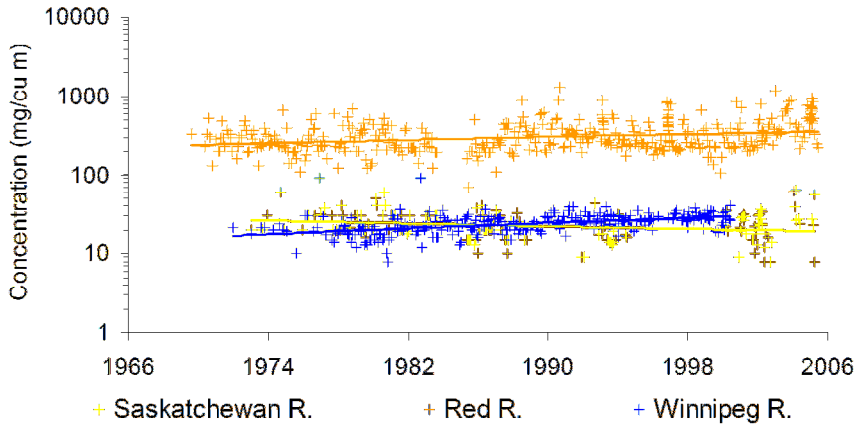
Based at the University of Manitoba.

Algal blooms caused by toxic cyanobacteria in Lake Winnipeg have become a major issue affecting people's enjoyment of the beaches, and has raised concerns about the health of the lake, the safety for those using it for water supply or for recreation and the potential impact on the Lake Winnipeg fishery.

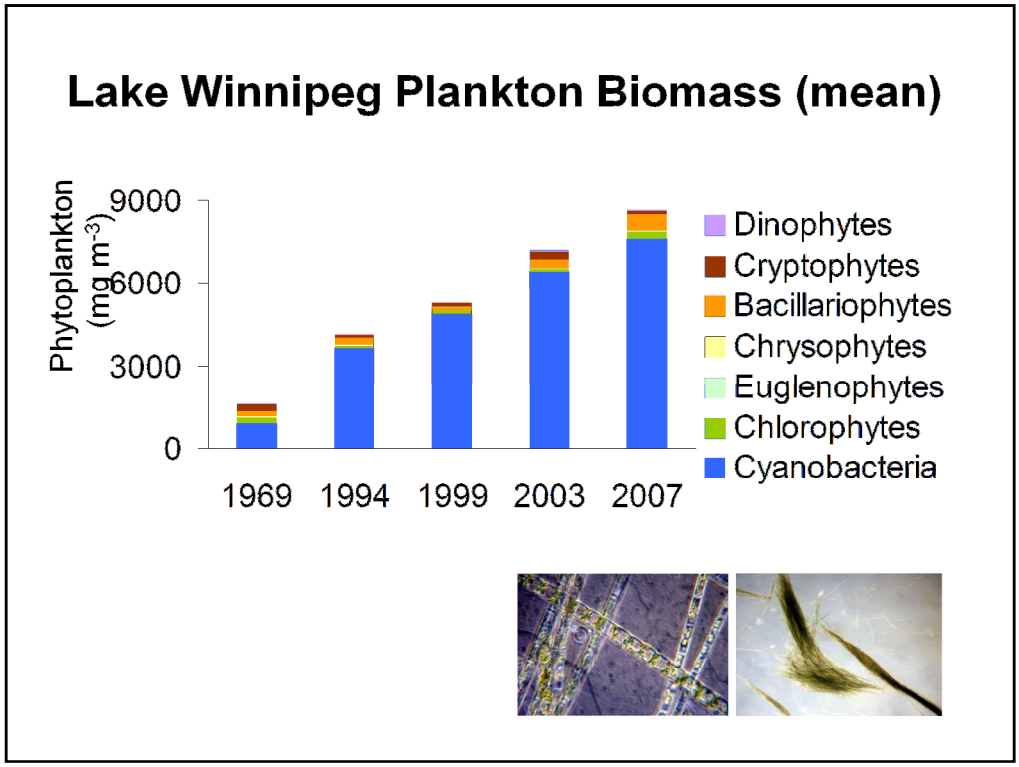
The blooms are not a new problem.
Paleo studies have shown cyanobacteria are present in sediment cores
Government Research scientists raised concerns about the changes in phosphorus concentrations in the lake in 1969, and research at that time from the Experimental Lakes and elsewhere demonstrated the links between changes in algal populations and phosphorus concentrations
In 1974 – the government was being called to take action in press articles
In the late 1990's the Lake Winnipeg Research Consortium began it's program of lake research
In 2003 the Manitoba Government set up the Lake Winnipeg Stewardship Board to make recommendations for action, which they did in 2006

Historic phosphorus concentrations in the Saskatchewan, Red and Winnipeg Rivers

From data supplied by Manitoba Water Stewardship (Sask. & Red R.) and Environment Canada (Winnipeg R.)

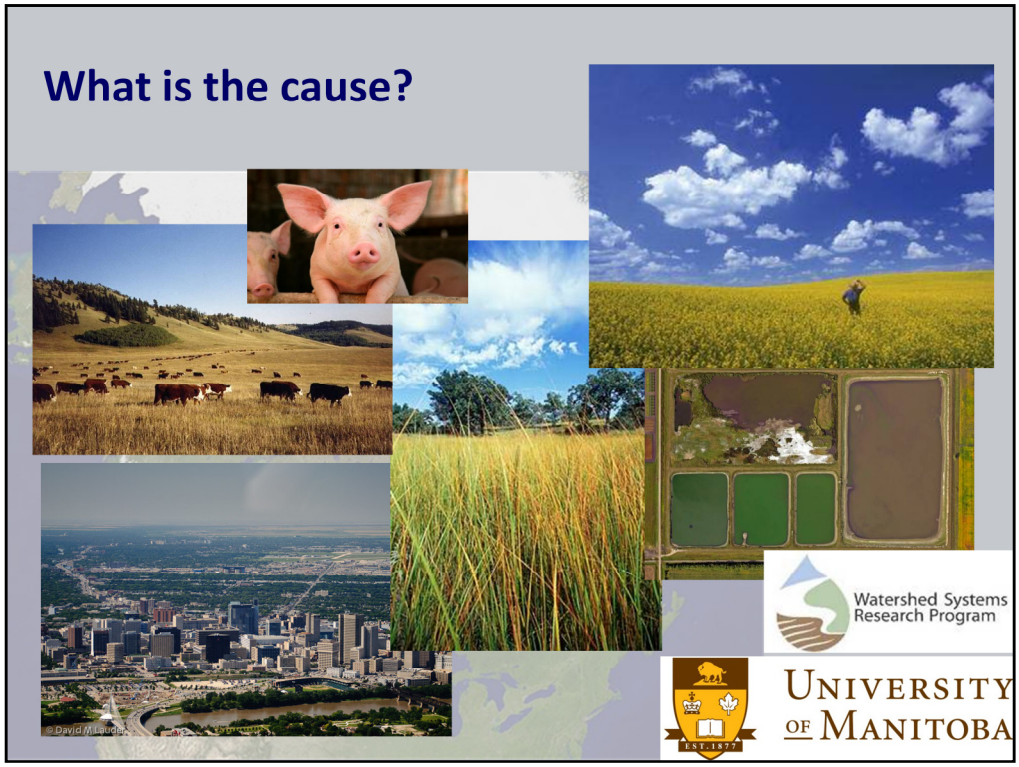


Phosphorus concentrations in the rivers flowing to Lake Winnipeg have been increasing since the 1970's



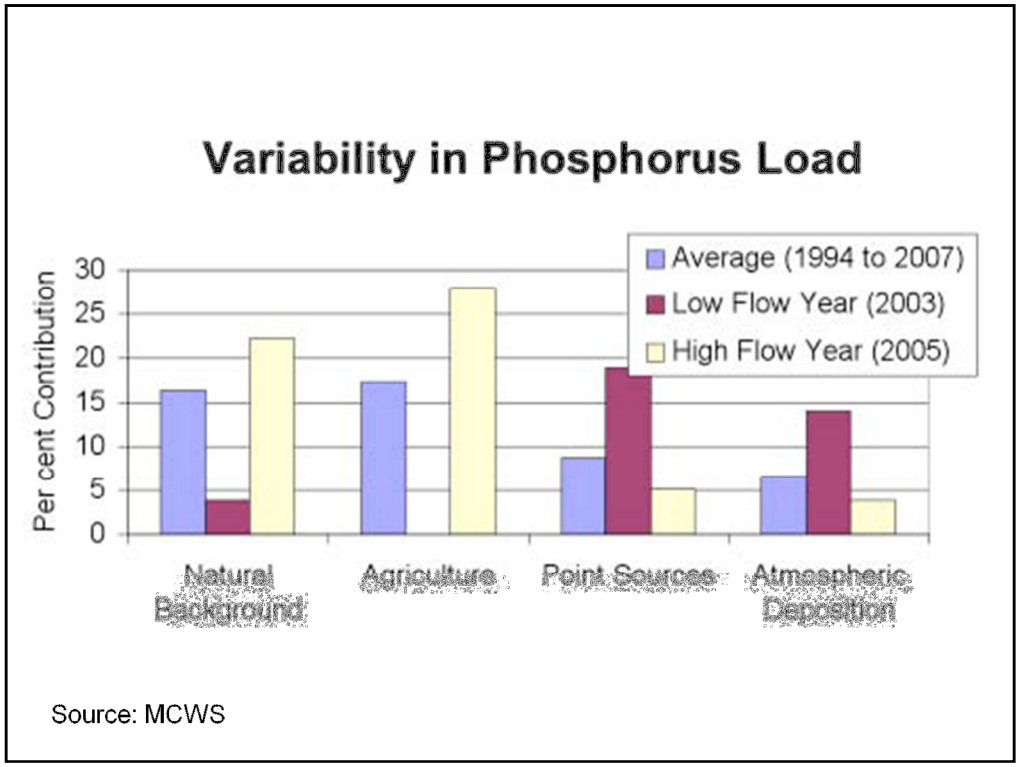
The algal population in Lake Winnipeg has changed – shift to cyanobacteria 'blue-green algae

And the quantity of algae have increased as a result of the increased nutrients entering the lake.



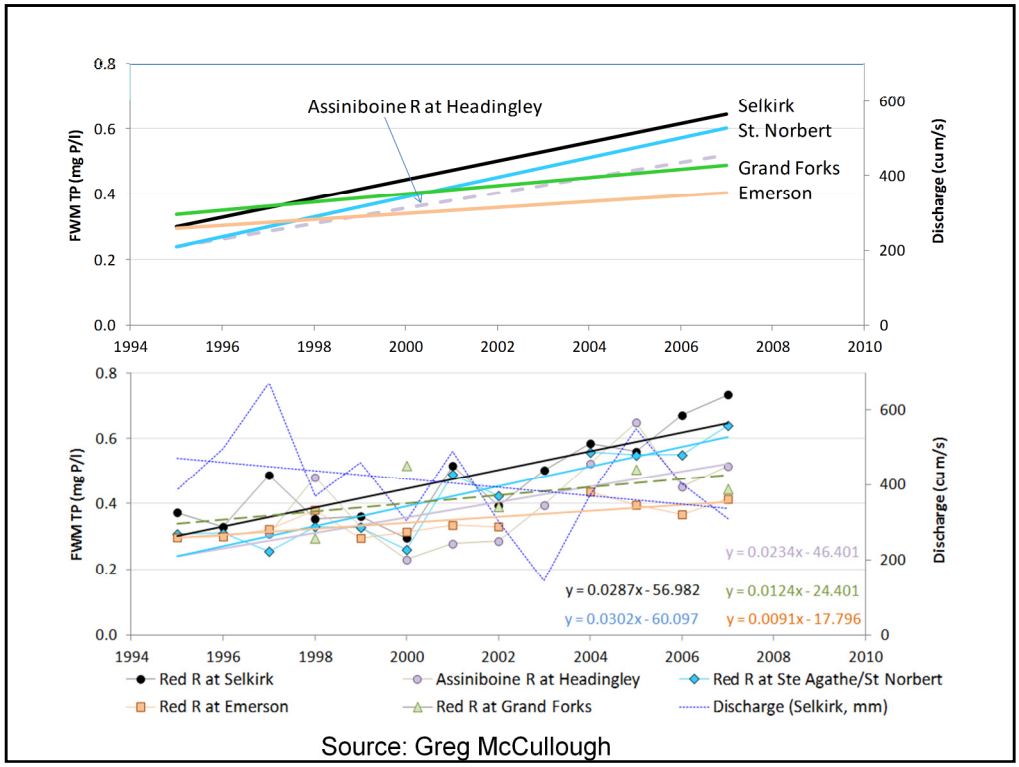
What's the cause – well that's the problem!

Phosphorus lost from agricultural land, natural areas and from areas where people live are all causing phosphorus to increase



The estimated contribution of different sources are shown in this graph from MCWS

You can see here, that in high flow years, the contribution of Phosphorus is significantly higher.

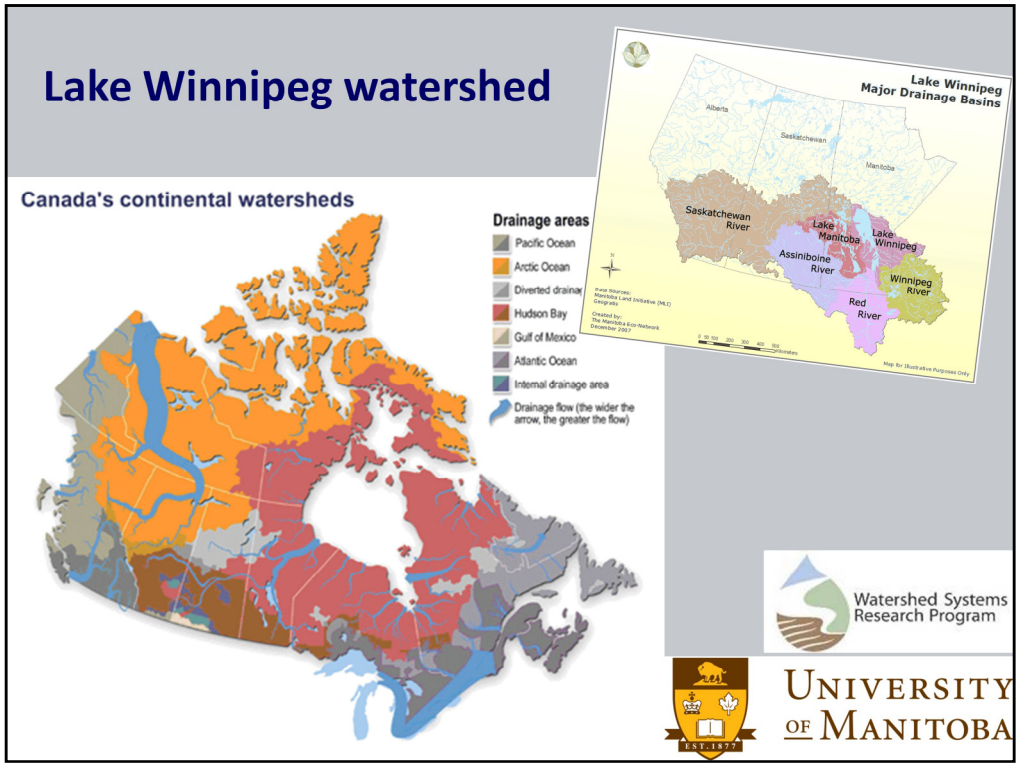


Source: Greg McCullough

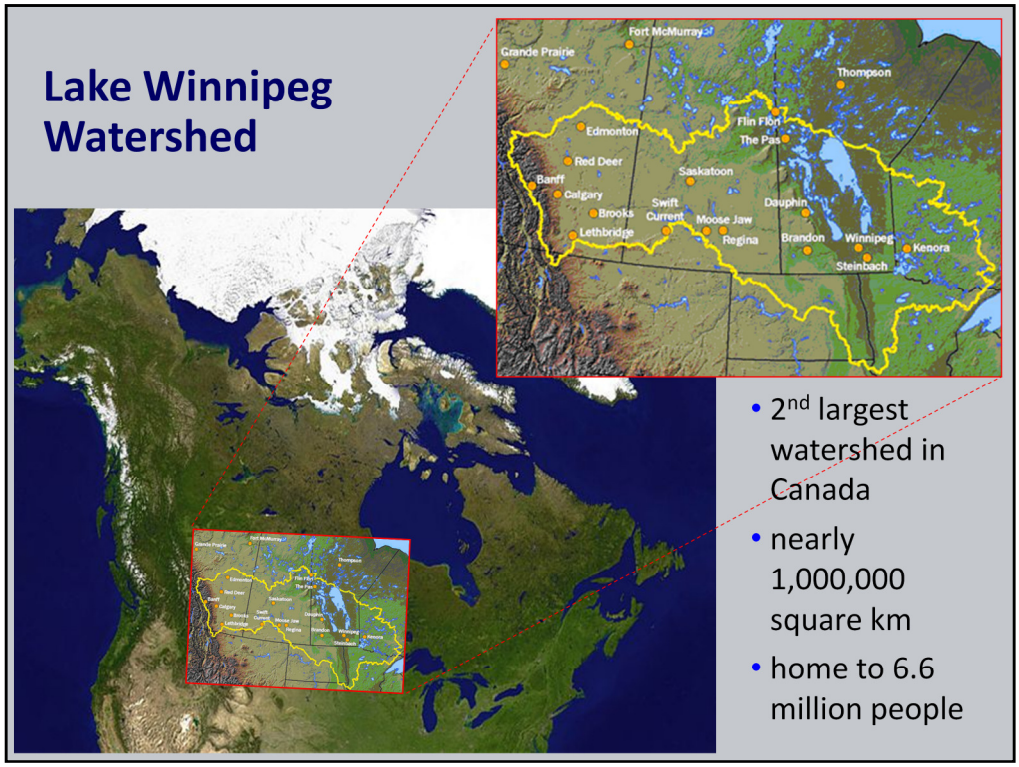
And Greg McCullough has made clear link between flow and nutrient phosphorus. Flood events contribute significantly to the loss of phosphorus from land to water.

So the objectives for the WSRP are…

And our objectives…



The Lake Winnipeg watershed is part of the Hudson Bay system that flows to the arctic.



The watershed is large – the second largest in Canada

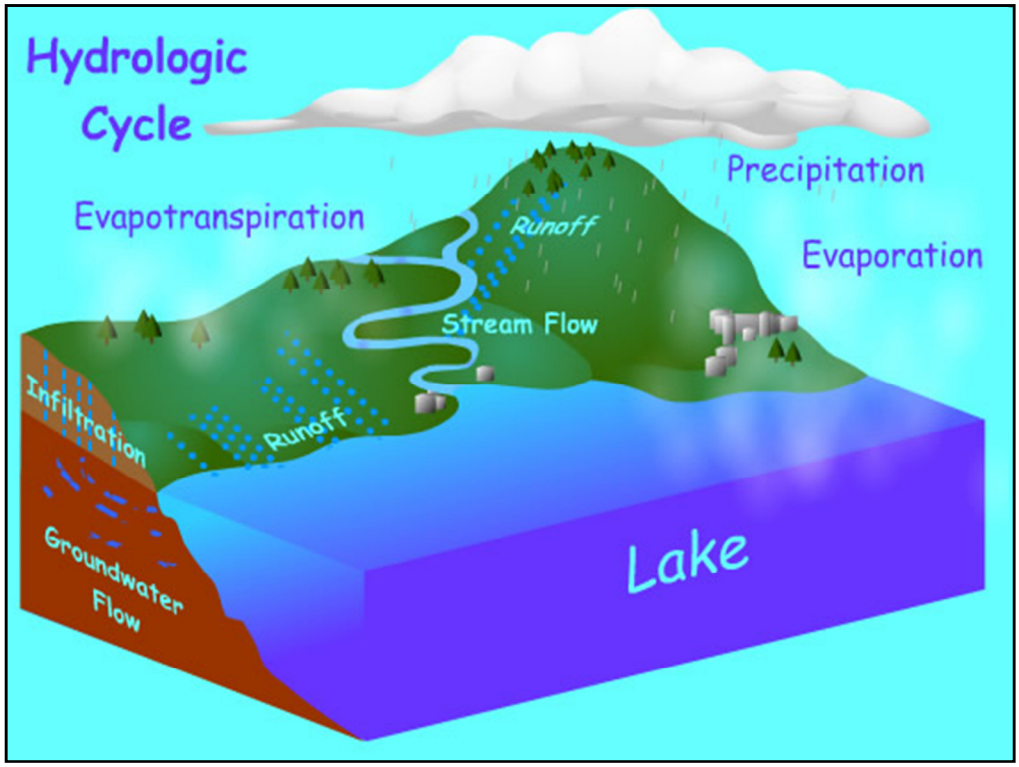
Extends east via the Winnipeg River to the Canadian Shield.

Extends across much of the Prairie Pothole Region via the Saskatchewan and Assiniboine Rivers.

Extends west via the Saskatchewan River to the foothills of the Rocky Mountains.

The watershed covers much of the area left as Lake Agassiz retreated following the last glaciation, and the escarpment we see in the west was that lake's shoreline.

Covering a lacustine plain, the watershed is largely relatively level in an arid to sub-humid climate, where run-off is dominated by snowmelt



And if we consider the hydrologic cycle – there are a number of different processes going on across a watershed above, on, through and below ground, and in watershed research we are basically interested in all of them

Watershed research interests

Tillage practices Landscape Crops uptake of nutrients Beneficial Management Practices Managing vegetation over winter Nutrient transport processes Fingerprinting nutrient sources Fingerprinting nutrient movement Connectivity between water on surface, in soil, and groundwater Temporal and spatial effects on soil and water interactions Atmospheric sources of nutrients and how they reach water How to model/predict nutrient losses and water flow Biogeochemical and biophysical processes Impacts of snow, ice, vegetation, flooding, erosion, melting permafrost, changing carbon flux on contaminants in aquatic ecosystems	How nutrients move in streams In-stream nutrient cycling Interactions between sediment from land, stream-bed and stream-bank Hydrologic connectivity How streams transport run--off materials Flow processes controlling connectivity Impacts of natural and man-made flow control structures on nutrient cycling Connectivity in near-level, high relief, prairie pothole, wetlands, tile drains, surface drains, and riparian areas Riparian Zones function and management Measuring human impacts Predicting flow Cumulative effects monitoring	How nutrients cycle in terminal basins and lakes How nutrient input changes impact nutrient cycle in larger water bodies Impacts of changes to nutrient load on ecology in large water bodies Shore management practices impacts on nutrient cycling Measures to control nutrient cycle in large water body	BMP effectiveness Effective design and implementation of BMPs Water storage systems Use of vegetation to remove nutrients Risk management tools Decision Support Tools Teaching tools for farm advisors Data sharing

This list covers many of the factors the WSRP is interested in.

There's a lot here, and it spans areas beyond the expertise of the core team. There is also several lifetime's work here which obviously can't be delivered in the time over which the program is funded.

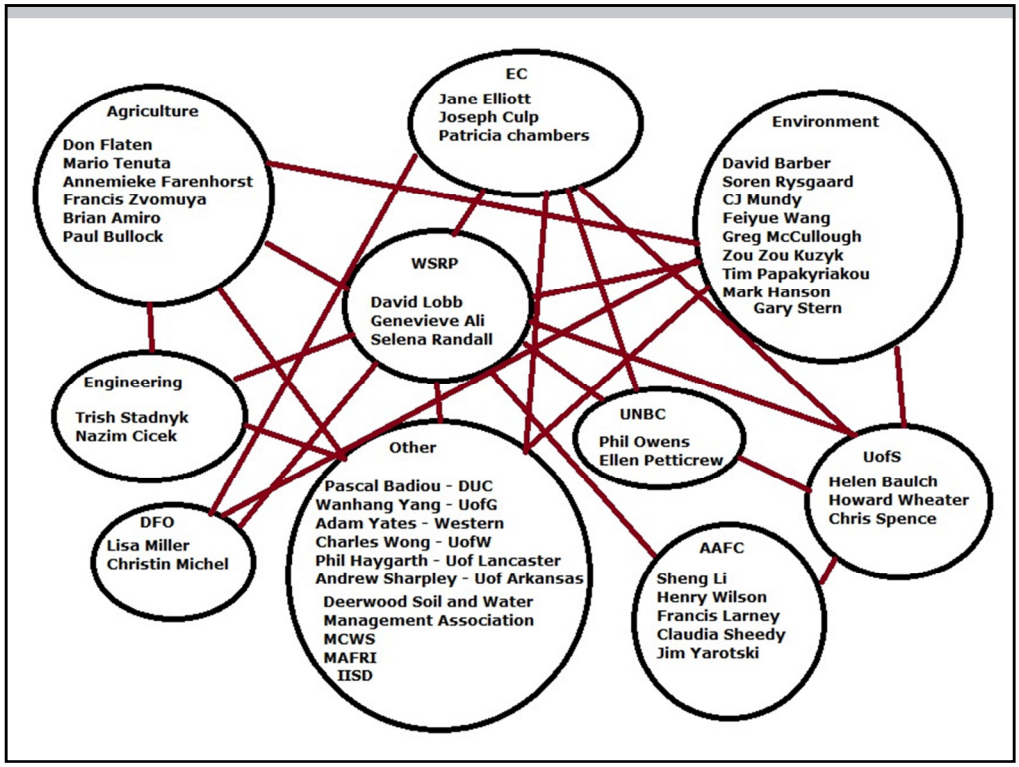
So we have to have a strategy...

So we have a strategy…

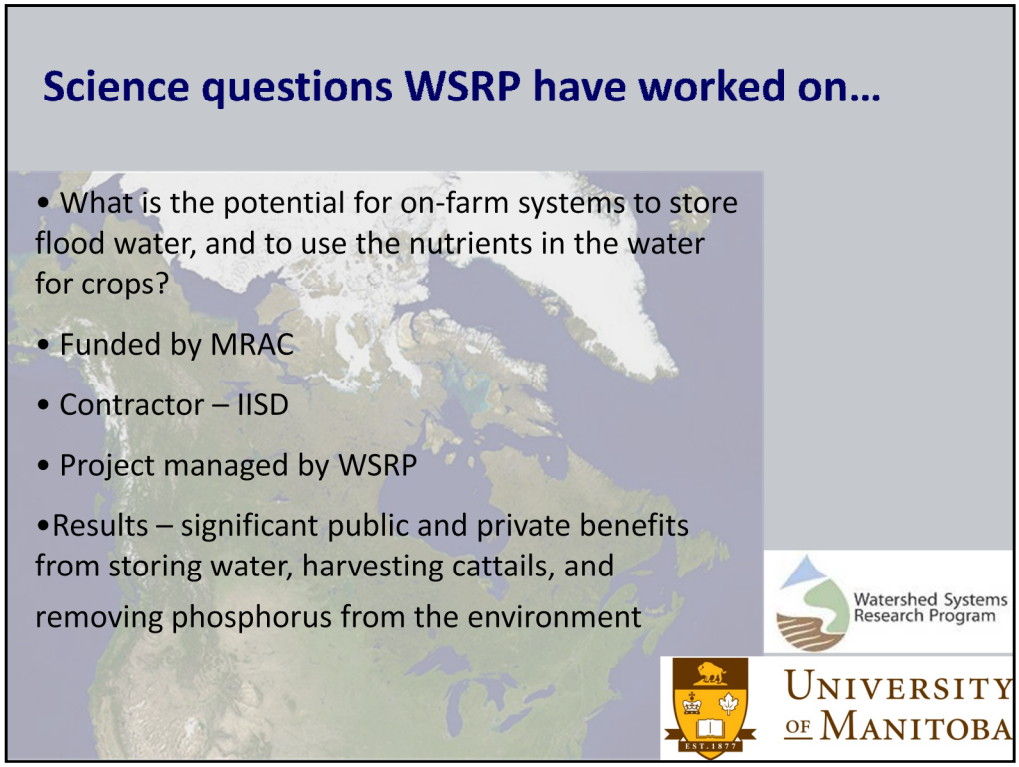
A core team delivers a program of work, and collaborates with others
David Lobb's group in Soil Science Department, Genevieve Ali's group in Geological Sciences, supported by Selena Randall as Research Development Coordinator
And the program facilitates work by others – and I'll give you a few examples later of this work
We also seek out other research bodies to try and influence the research they do or support so that it covers some of our shared interests
And we also build partnerships for funding – the program was not set up with a pot of research funds – we have to find that

We network with a wide range of people and organizations.

Our starting point is to see how we as a program, and researchers, can help?
We try to communicate about what we are doing – different methods are used



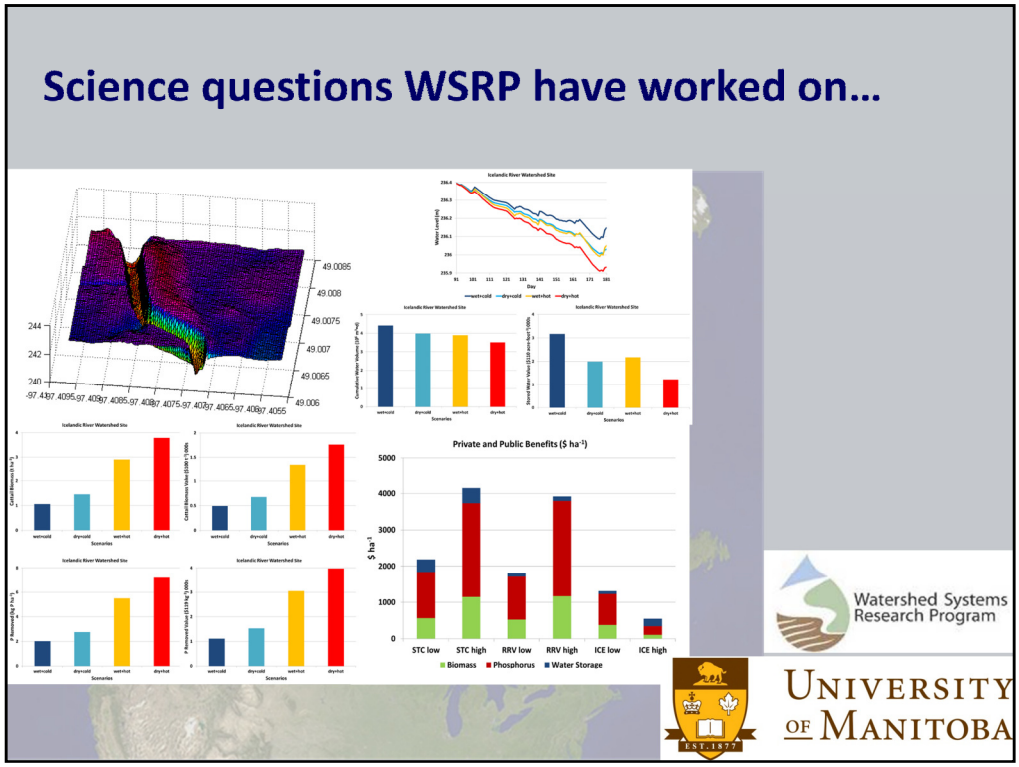
But we know and work with a lot of people who are also doing research we are interested in, and will help us answer some of our research questions.



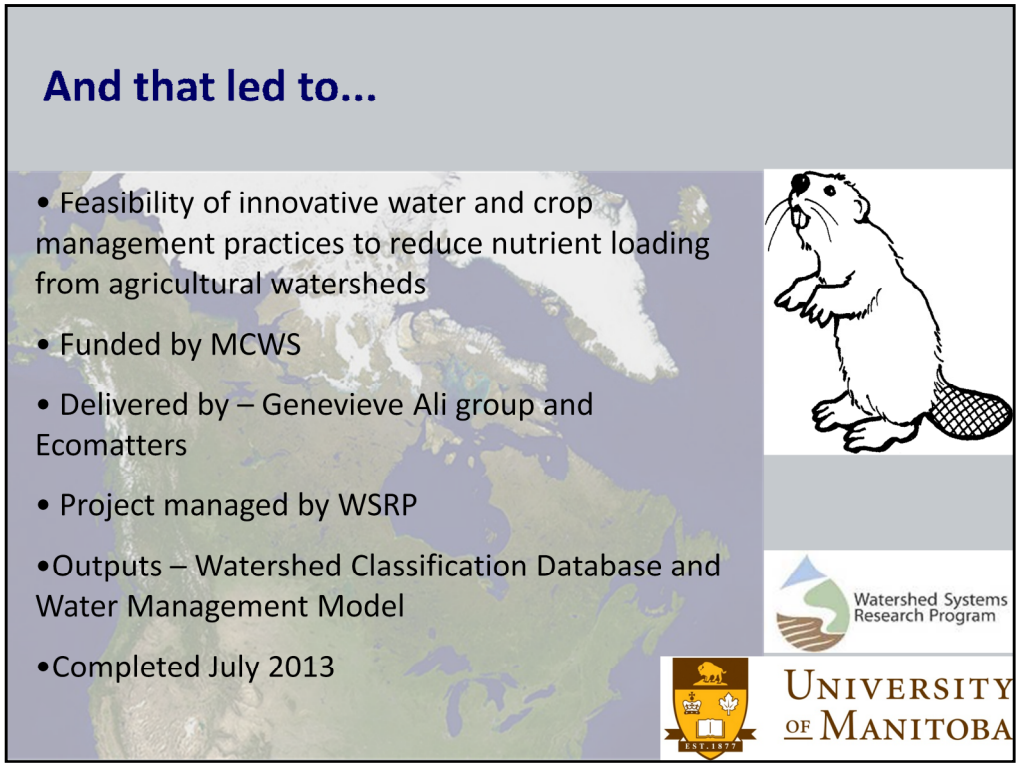
So we know from Greg McCullough's work that there is a link between the flow of water over land during flood events and the nutrient loading to Lake Winnipeg. Which is why we are interested in identifying ways to slow the flow of water and nutrients from the land when the snow melts.

This is an example of a project that WSRP facilitated.
With support from Deerwood farmers, and a grant from MRAC, IISD was contracted to build and test models to look at the potential for on-farm systems to be used to store water on farm, but also for the nutrients in that water to be used on-farm.

This project was a short feasibility study and we have moved onto the next stage following the promising findings



We used a variety of locations where LiDAR data exist across Manitoba (Light Detection and Ranging – optical remote sensing technology)
Predicted the water that could be stored
Used growth models to predict cattail growth
And estimated the amount of phosphorus that that was worth.



This project had two major components: (i) the application of the Watershed Classification Database to a regional assessment methodology for the selection of surface water retention systems; and (ii) the development of a Watershed Management Model to assess the costs and benefits of surface water retention systems.

The Watershed Classification Database is a spatial database under development at University of Manitoba, which encompasses the whole of Lake Winnipeg Watershed. Data have been gathered from Canadian and American sources and analyzed through ESRI ArcGIS and Microsoft Access. For the purposes of this project, the analyses focused on the Manitoba portion of the watershed.

The Watershed Management Model is built in Microsoft Excel and tracks water, phosphorus, costs and other environmental consequences. The key attribute of the model is that it allows various combinations of management features (blocks) to be assembled. The intent is that information about P, water and money is transferred block-to-block, and within each block the effect of the corresponding management features on these quantities is computed. The model used data collected from the Red River Valley and other sites within Manitoba.

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To identify the benefits to the Lake Winnipeg Basin of on-farm water retention and water re-use systems;

To establish the on-farm benefits of systems to store and use surface water;

To identify the design, installation and operating factors for on-farm water retention and water re-use systems;

To develop tools which support the development of on-farm water retention and re-use systems across the Lake Winnipeg Basin.

Researchers from across Canada will be involved in student research projects in Manitoba

Science questions WSRP has worked on

- How effective are riparian buffers at filtering phosphorus?
- What biophysical factors affect phosphorus filtering?
- Funded through LW Basin Stewardship Fund
- Completed April 2012

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This study on riparian buffers built on an earlier study carried out by the Conservation Districts

The Conservation districts contributed this study, which was carried out by the WSRP team, Don Flaten and researchers from UNBC
Grad students Carolyn Baldwin and Chris Randall spent many hours collecting the field data for this project in summer of 2011.

How riparian buffers work in prairies

- The ability of riparian areas to remove sediment and phosphorus is limited in the prairies
- Tillage practices contribute to sediment collection in riparian areas
- Micro-topography contributed to sedimentation in fields and riparian areas

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What we found was that

The ability of riparian areas to remove sediment and phosphorus is limited in the prairies

Tillage practices contribute to sediment collection in riparian areas

Microtopography contributed to sedimentation in fields and riparian areas

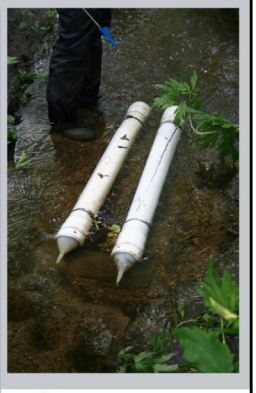
We produced a decision support tool for riparian land managers to help them decide how to include riparian areas in their nutrient management strategy.

We are now examining these findings in more detail through a project funded by EC LWBSF and led by Phil Owens of UNBC

David Lobb is leading research with collaborators from universities of New Brunswick, Saskatchewan and Northern BC to look at the sources of sediment and phosphorus in watercourses.

Sediment characteristics

- Apportion P from fields, in-stream transport, in-stream deposition, and remobilization
- Use chemical and physical signature of phosphorus
  - radioisotopes
  - Stable isotopes
  - Shape, colour and size
- Temporal and spatial variability



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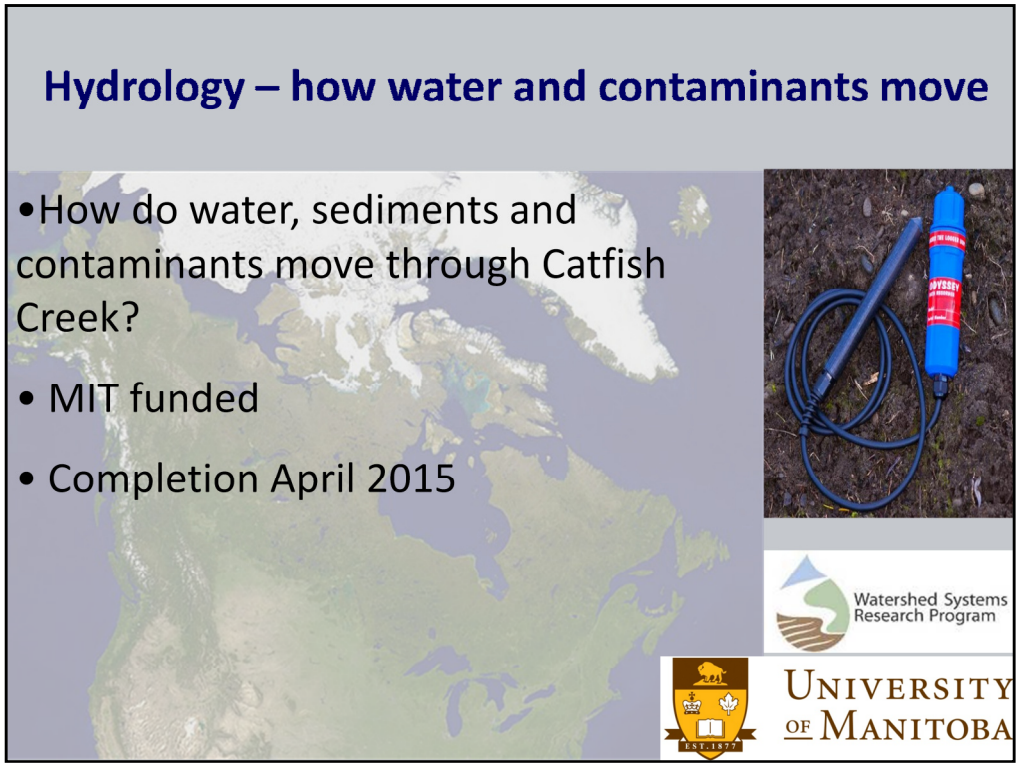
This project involves a number of graduate students at UofM, UofS, and UNBC, as well as Post doctoral fellow Kui, and undergrad and research assistants have helped collect data last summer



MIT have begun enhancement of drainage channels draining to Catfish Creek, to the south-east of Lake Winnipeg.
The Sagkeeng First Nation have expressed concern at the project and its impacts on water and contaminant losses.

Genevieve Ali is leading an investigation
2 grad students Hayla Petzold – precipitation and run-off;
Amber Penner – land to stream transfers

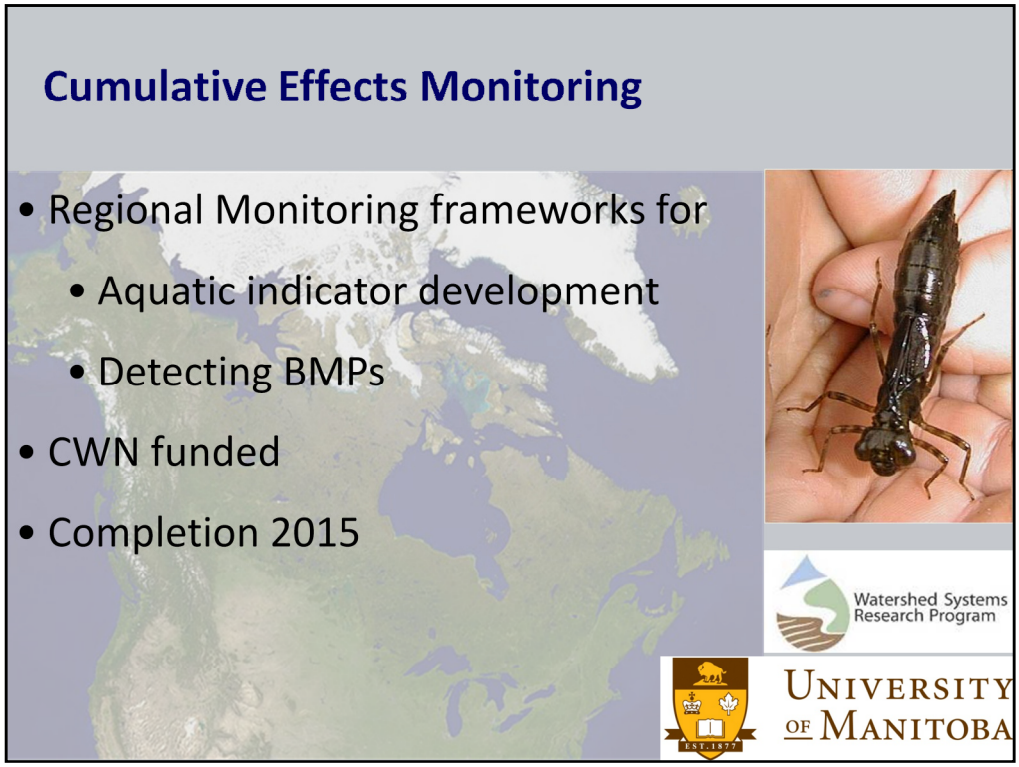
Genevieve Ali is leading this project with Ducks Unlimited

It is considering the scientific criteria to determine priority areas for wetland conservation and restoration. These criteria will be developed based on the topographic, hydrological and biogeochemical characteristics and will consider their capacity to: (a) remain disconnected from the rivers that ultimately drain into Lake Winnipeg; (b) attenuate flood waves; and (c) retain excess nutrients.

Agriculture and Agri-food Canada have been investigating beneficial management practices in watersheds across Canada since 2004.

This program covers a range of agricultural practices to reduce nutrient and sediment losses from agriculture South Tobacco Creek is one of the study sites.

Soil Science Department researchers contribute to the research and for WSRP that includes David Lobb, Research Associate Quiang Huang, PDF Kui Liu, Technician Eva Slavicek, and grad student Carolyn Baldwin who are contributing to erosion model studies, temporal and spatial data evaluation and sediment source studies.



This is another example of research the WSRP is facilitating,

We are part of a consortium that bid for funds from the Canadian Water Network, the other significant partners being Deerwood and IISD.
Researchers at universities New Brunswick, Western Ontario and Saskatchewan are working to develop a regional monitoring framework for Tobacco Creek that will identify the cumulative effects of man-made activities in the watershed and the best indicators for detecting the effects of management practices adopted in the watershed.
WSRP is providing support to the project including sediment sampling, hydrometric measurements, and the program provides a project coordination role.


Watershed Systems
Research Program
UNIVERSITY
OF MANITOBA

For more information

www.wsrp.ca
@wsrpuofm
wsrp@cc.umanitoba.ca

Selena Randall
Research Development Coordinator
522 Wallace/272 Ellis
University of Manitoba

204-891-1287
Selena.randall@umanitoba.ca

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