LAKE WINNIPEG AND THE MANAGEMENT OF AGRICULTURAL LAND IN ITS WATERSHED

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CFWF 2012: Mud, Floods & Suds
Winnipeg, Manitoba
September 22, 2012

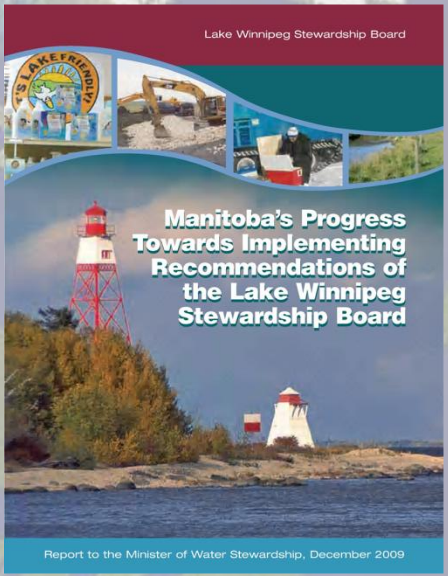
Outline

- Background on the Watershed Systems Research Program
- Overview of Lake Winnipeg, its watershed, and the need to improve our land and water management practices.
- Agricultural beneficial management practices and the lessons learned.
- Innovations in agricultural management practices.
- Commentary on the challenges and opportunities

WATERSHED SYSTEMS RESEARCH PROGRAM

History:

Established in 2010 by the Government of Manitoba in response to recommendations by the Clean Environment Commission and the Lake Winnipeg Stewardship Board



Supported by an investment of $1.25 million over 5 years

Based at the University of Manitoba

Watershed Systems Research Program

Structure:

Staff consists of Senior Research Chair
Junior Research Chair: Genevieve Ali
Research Development Coordinator: Selena Randall

University-based program, working with researchers from across several faculties

WATERSHED SYSTEMS RESEARCH PROGRAM

Goals:

To enhance the quality and use of water resources in Lake Winnipeg and its watershed

To ensure that, as a province, we are on the path to a cleaner lake

WATERSHED SYSTEMS RESEARCH PROGRAM

Objectives:

To advance the science and technology necessary to achieve these goals

- Supporting and leading research initiatives
- Facilitating greater coordination and communication amongst researchers and their stakeholders

Watershed Systems Research Program

Geographic Scope:

The geographic scope is the Lake Winnipeg watershed with a focus on the Red River watershed as the primary source of phosphorus entering the lake

WATERSHED SYSTEMS RESEARCH PROGRAM

Scientific Scope:

The immediate concern is the phosphorus in the lake, understanding and controlling the sources and pathways by which phosphorus gets into the lake.

A longer view of water quality in the lake must be broader, beyond the traditional focus on sediments and nutrients. We must be prepared to tackle issues involving pesticides, trace metals, pathogens, and other emerging contaminants in the waterways and water bodies of the watershed.

LAKE WINNIPEG

Lake Winnipeg

- 6^{th} largest freshwater lake in Canada
- 11^{th} largest freshwater lake in the world
- 24,000 square km area
- over 400 km in length and up to 100 km in width
- 12 m average depth, relatively shallow

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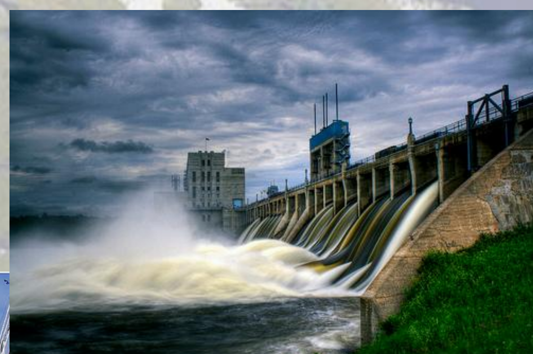
- 11th largest freshwater lake in the world
- 24,000 square km area
- over 400 km in length and up to 100 km in width
- 12 m average depth, relatively shallow
- remnant of glacial Lake Agassiz (8-12k years old)

Lake Winnipeg

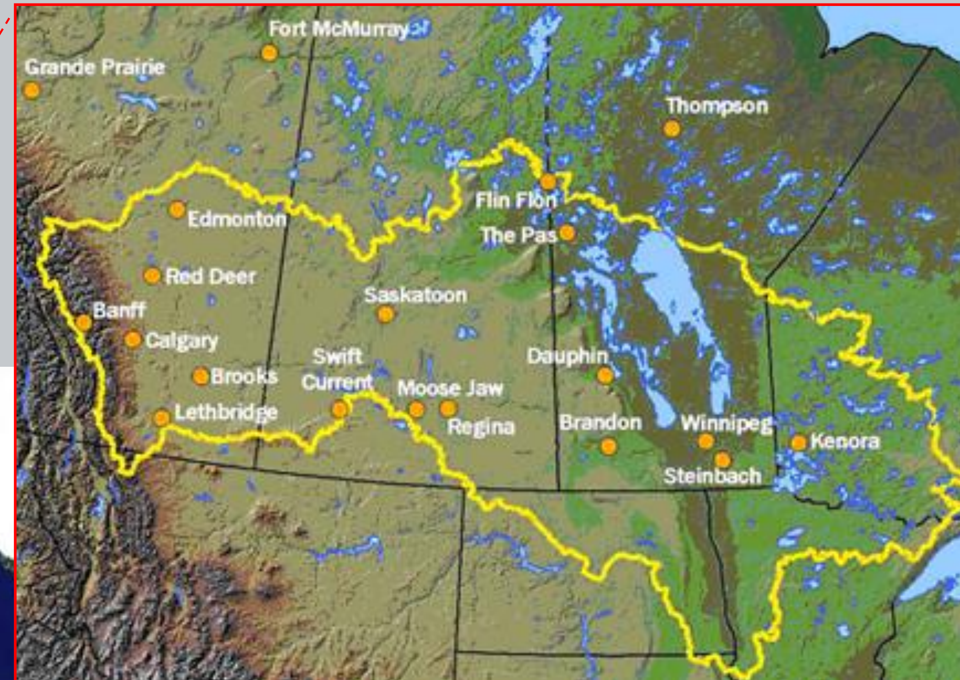
Lake Winnipeg

LAKE WINNIPEG

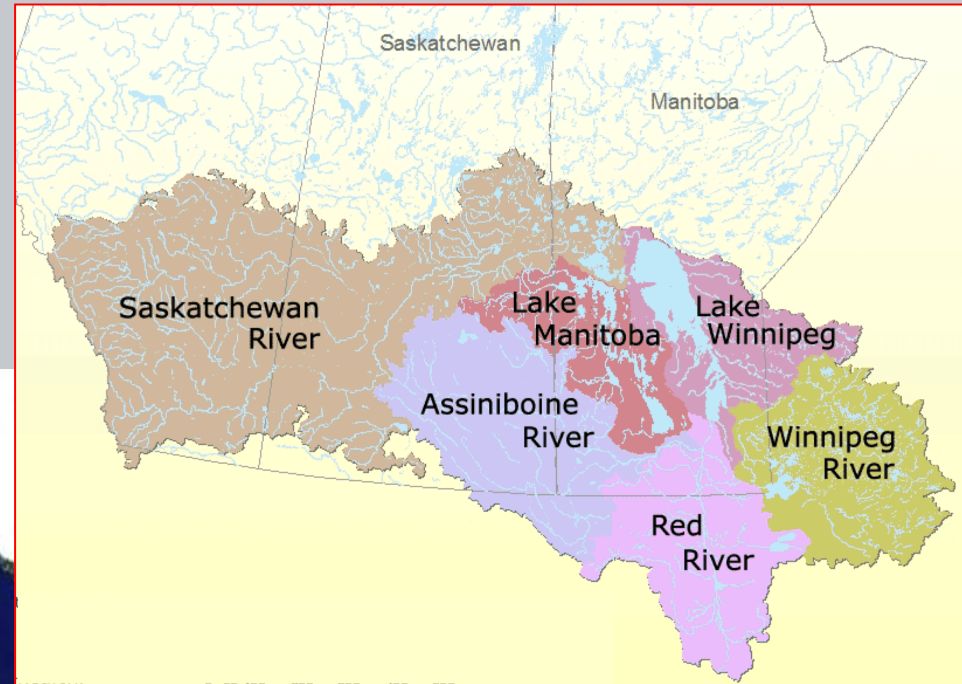
- $21 million per year inland fishery
- multi-million dollar recreation industry
- multi-million dollar hydroelectric industry



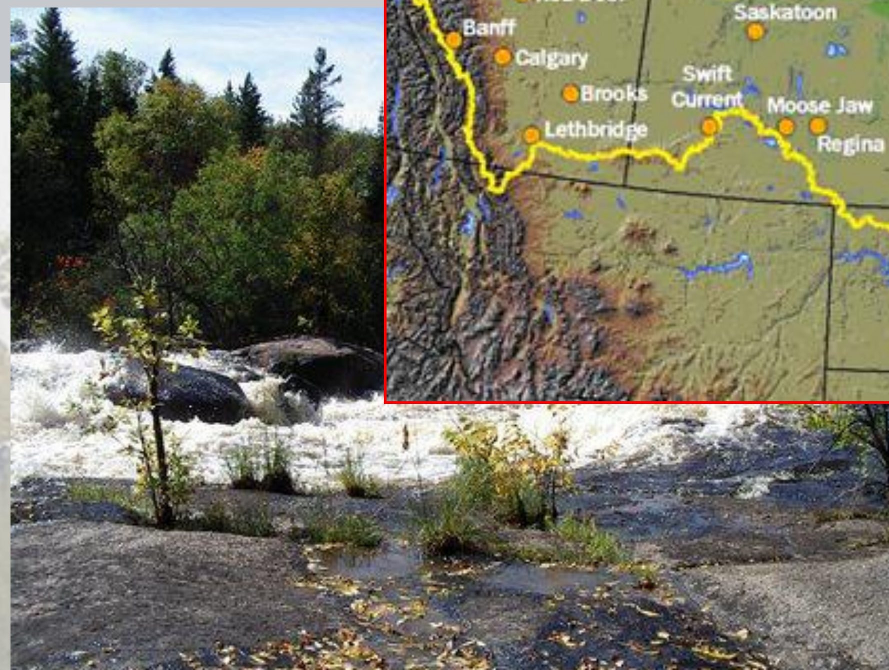
Lake Winnipeg Watershed

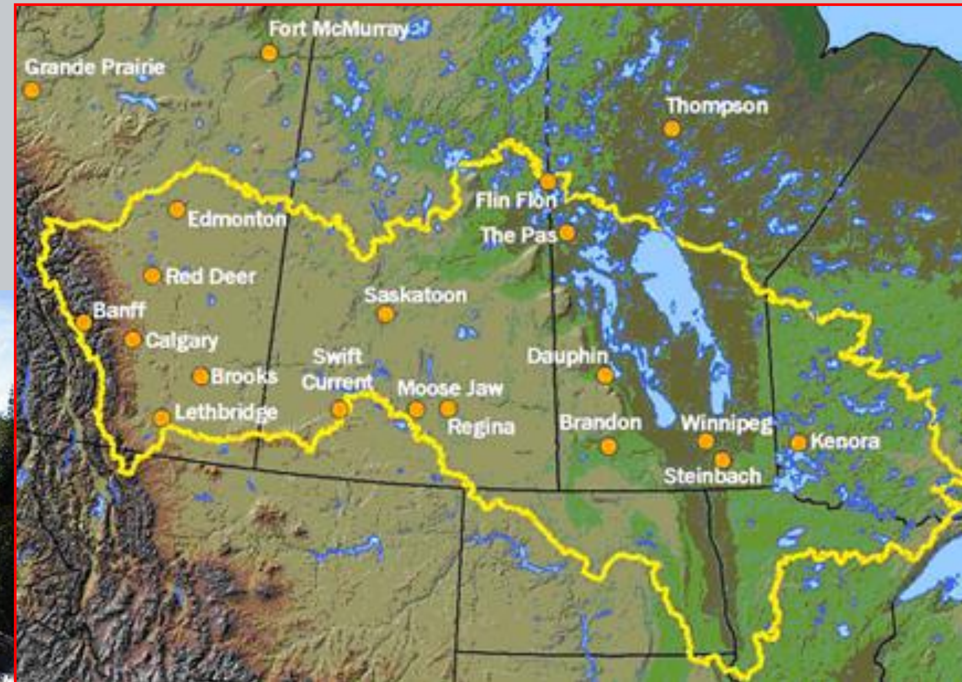


LAKE WINNIPEG WATERSHED



Lake Winnipeg Watershed





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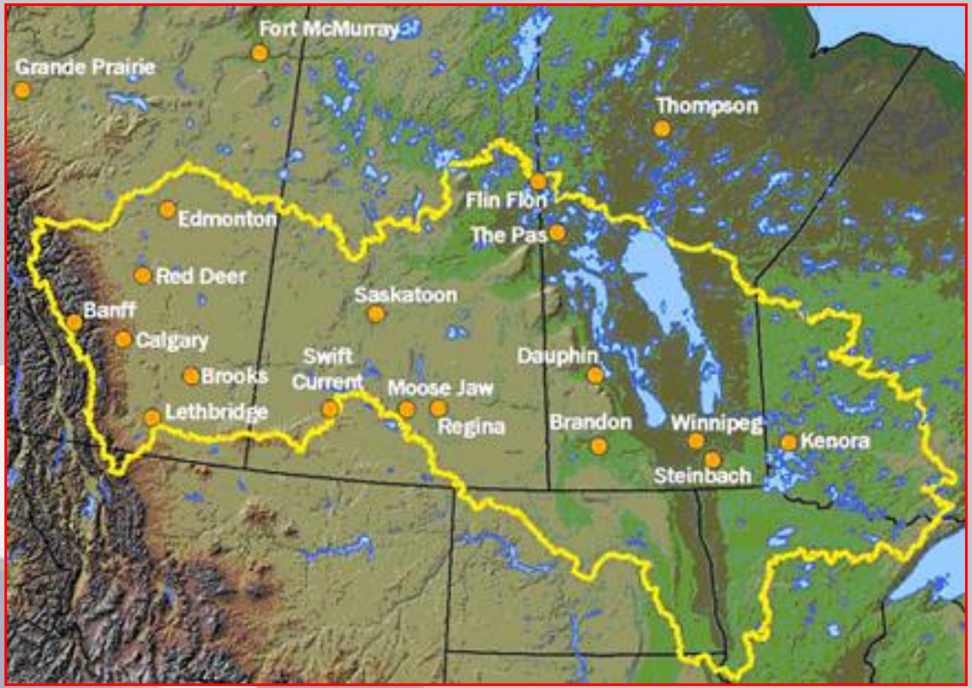

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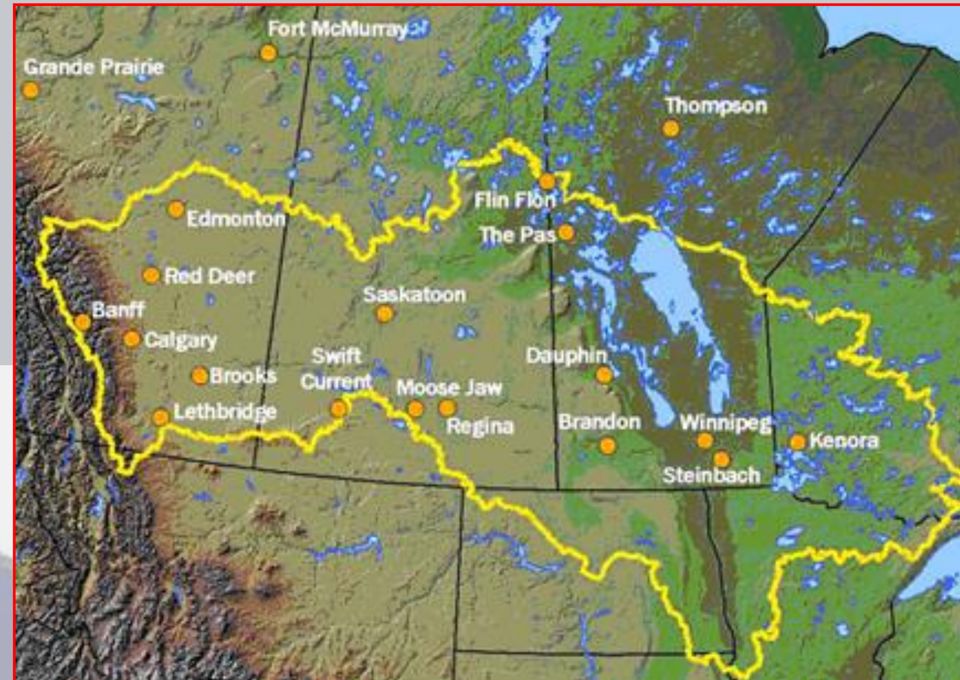

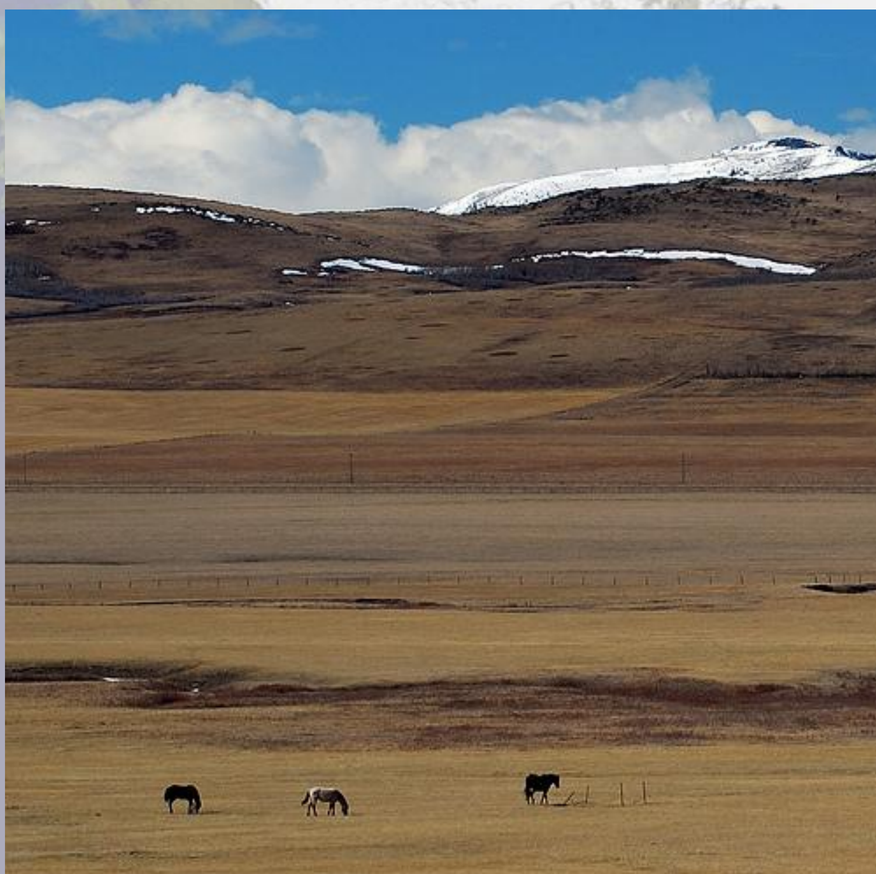

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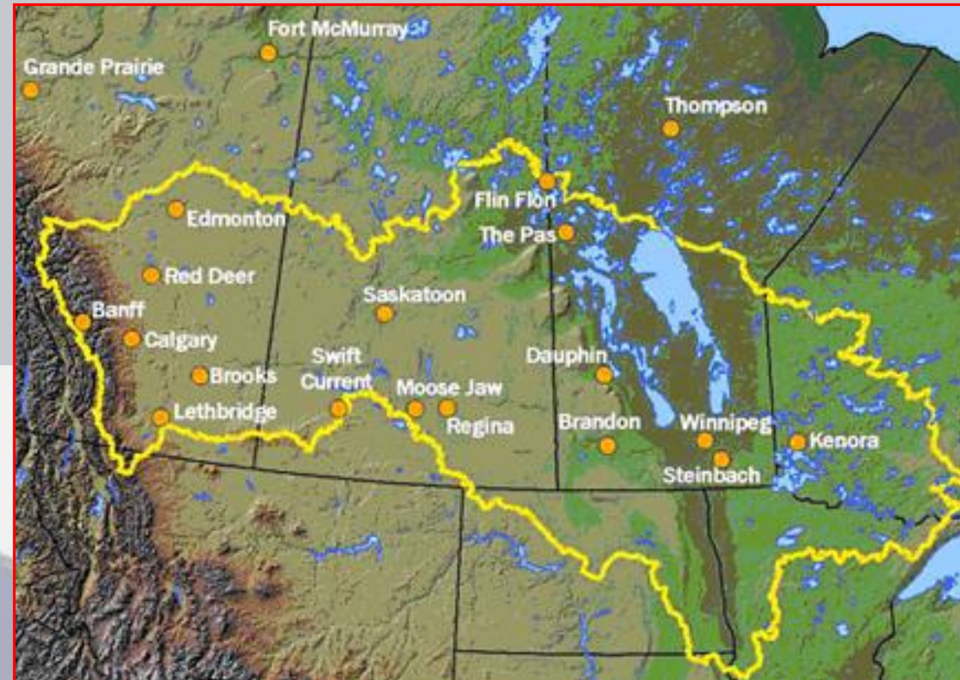

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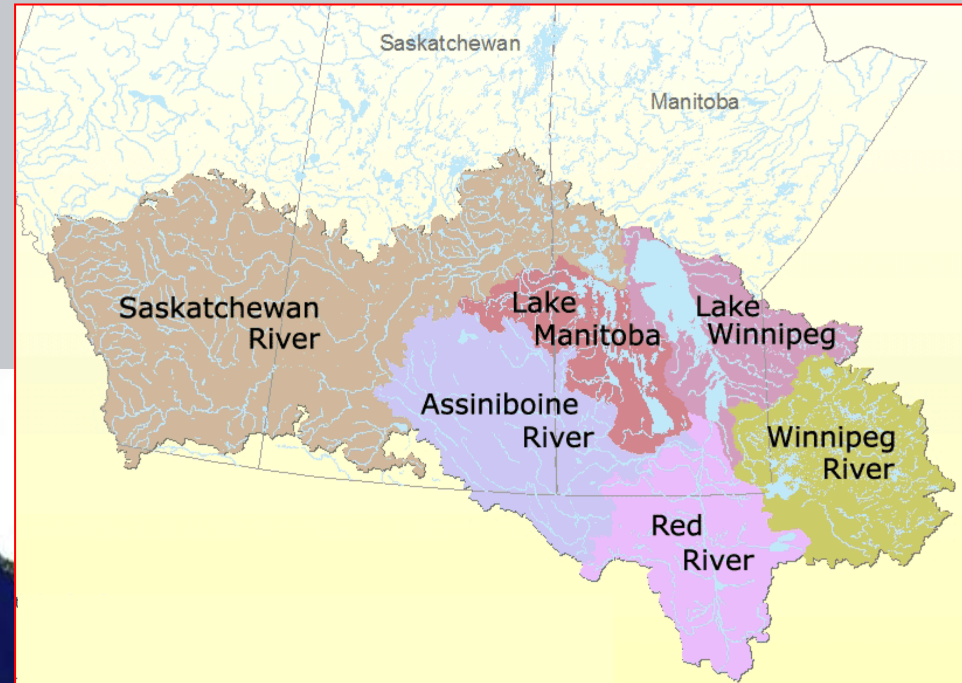

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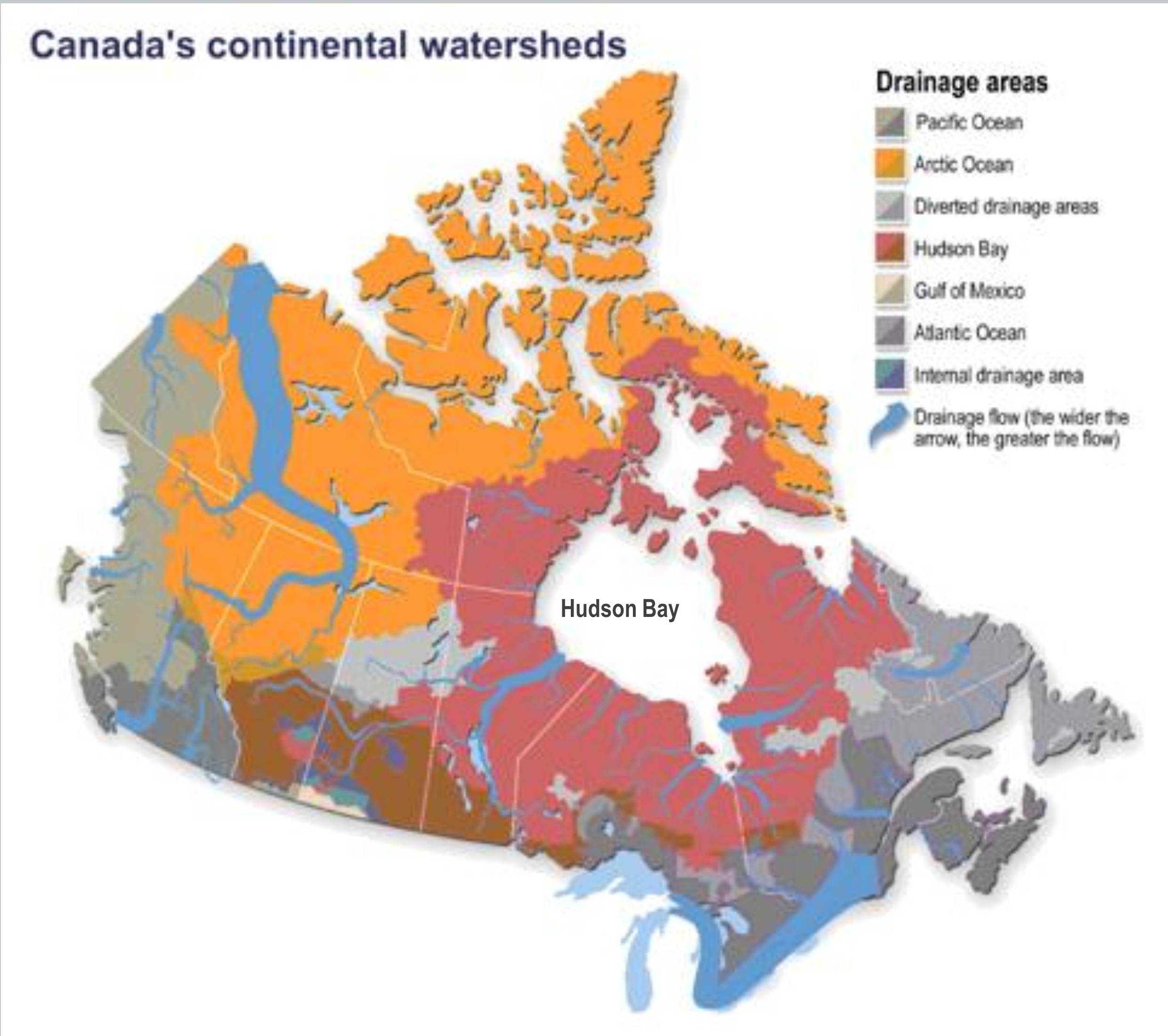

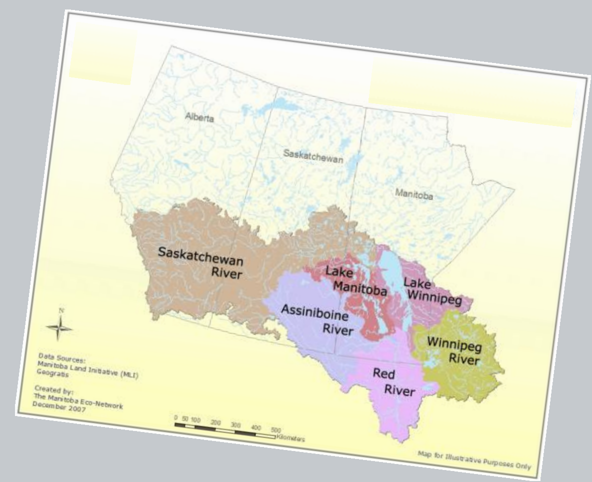

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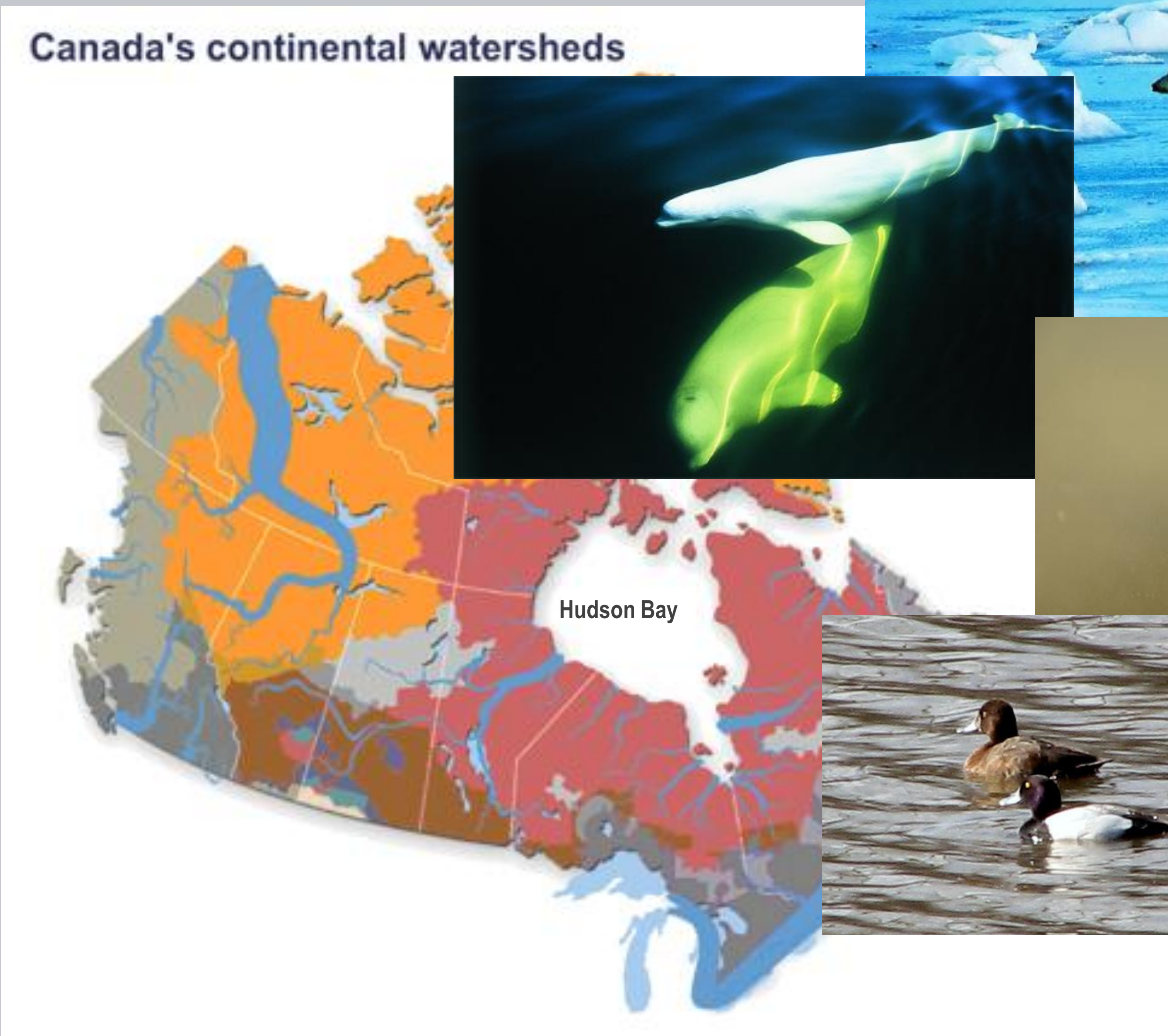

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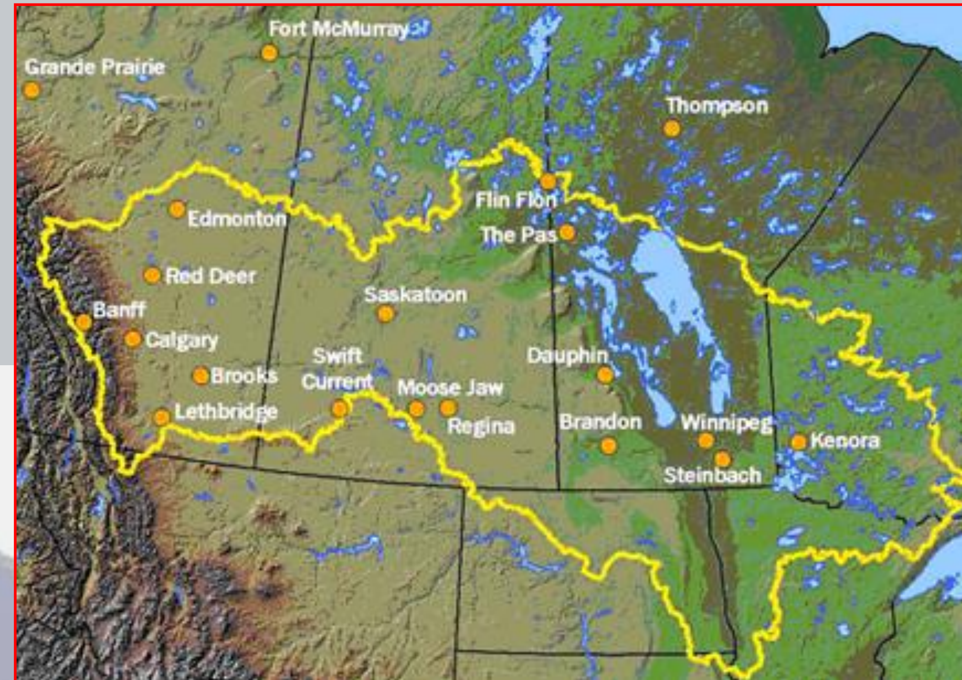
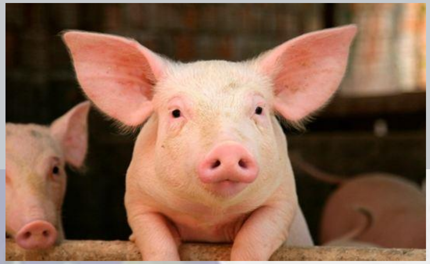
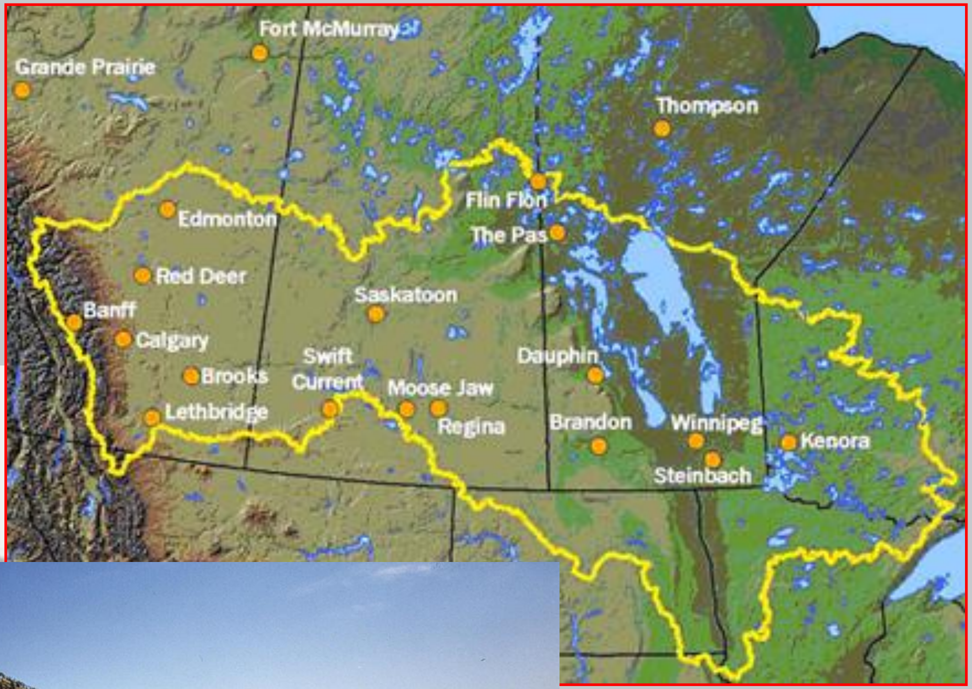


- 2nd largest watershed in Canada
- nearly 1,000,000 square km
- arid to sub-humid climate
- runoff dominated by snow-melt
- relatively level landscape
- home to 6.6 million people

Lake Winnipeg Watershed




- over 50% agricultural land
- $20 billion per year agricultural industry

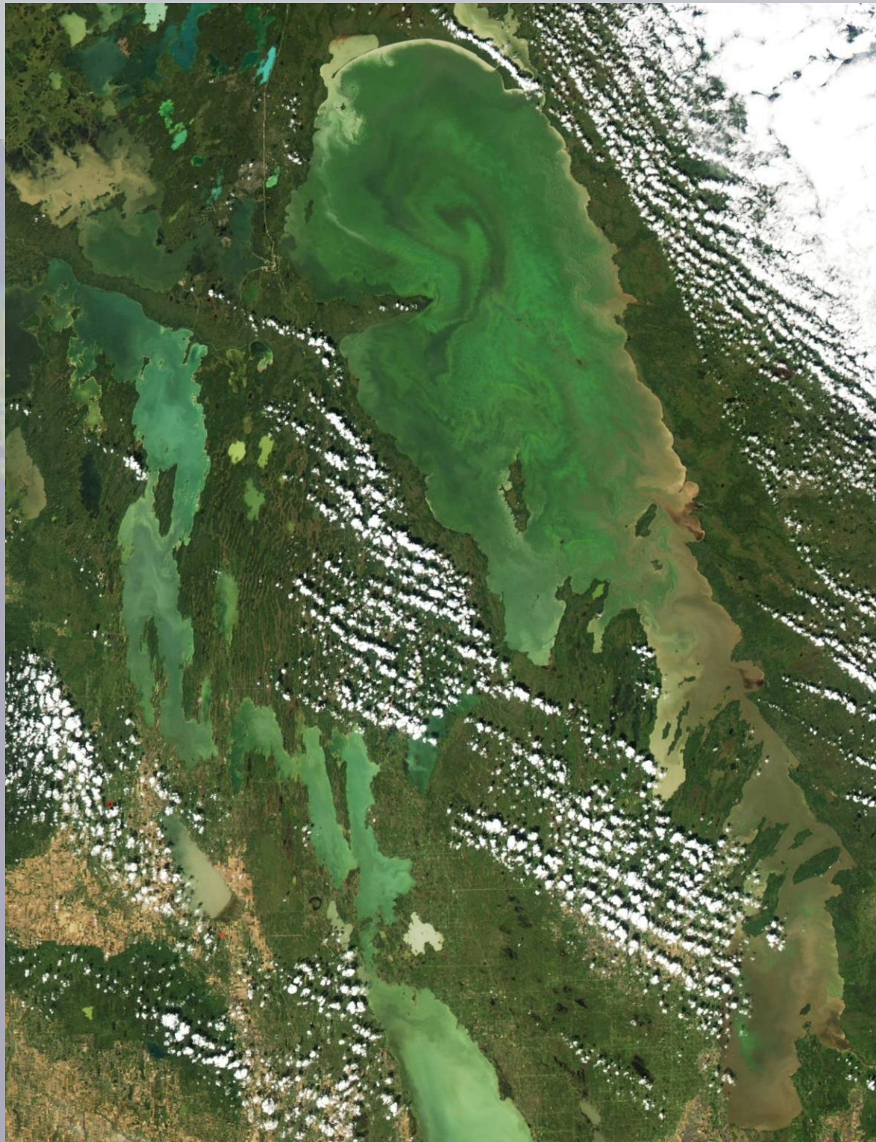




Lake Winnipeg: A Lake in Crisis

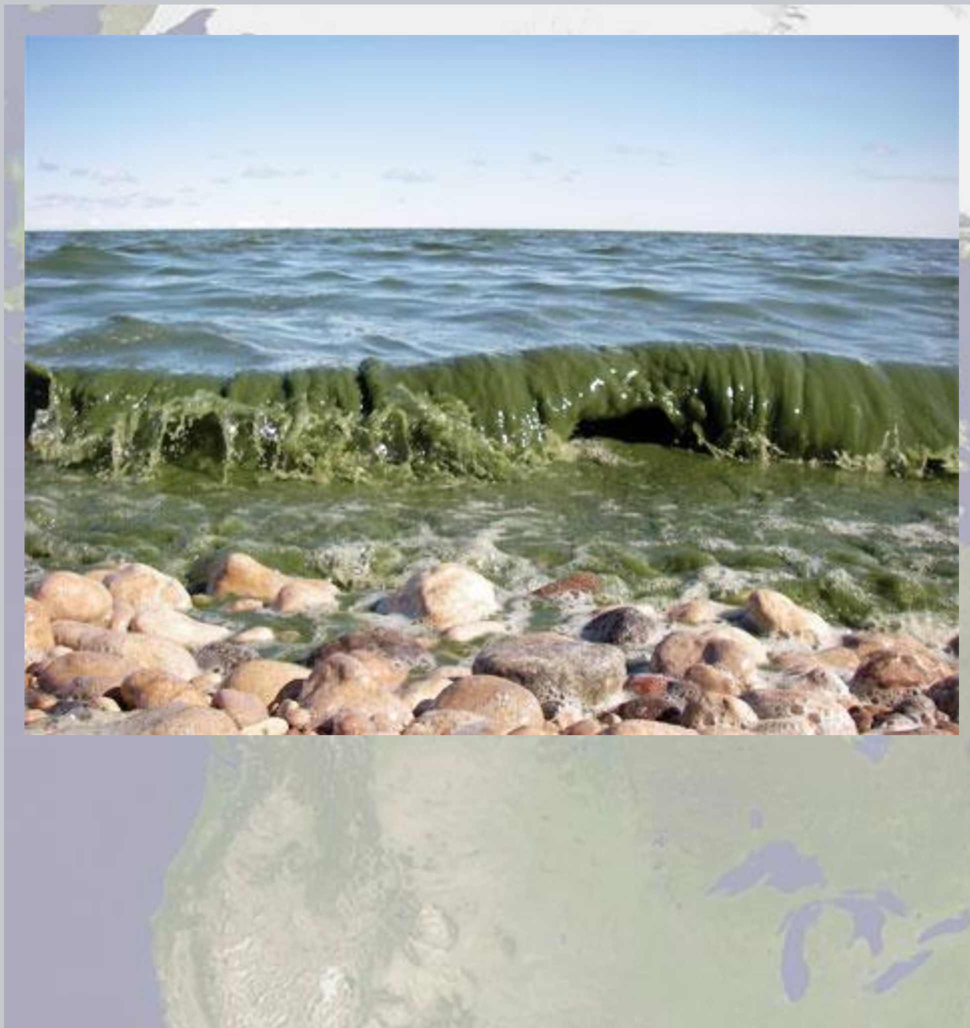
- Lake Winnipeg water is not always clean; it can be very turbid and can have extensive algal blooms.

LAKE WINNIPEG: A LAKE IN CRISIS



- Algal blooms are becoming a more serious issue, becoming more frequent and more extensive.

Lake Winnipeg: A Lake in Crisis



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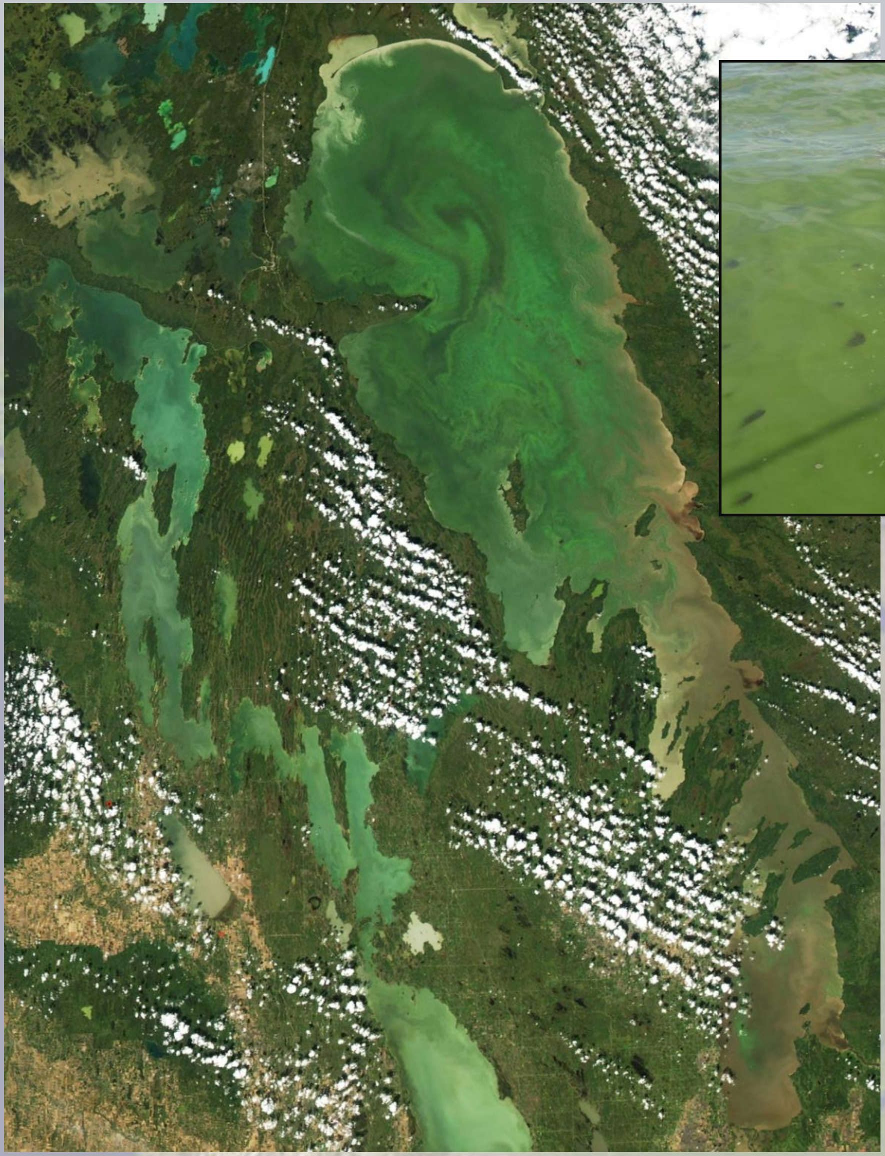
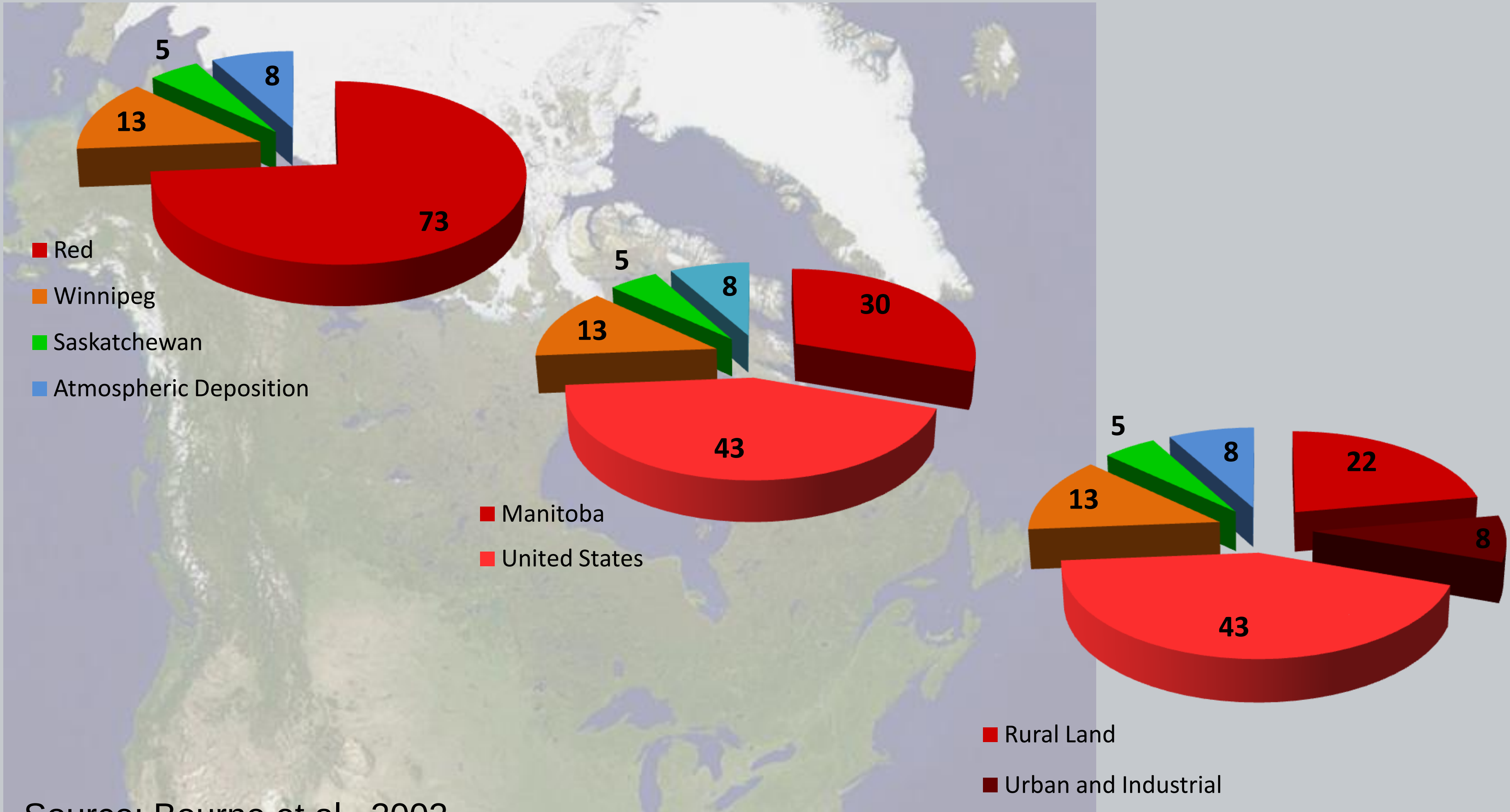


Lake Winnipeg: A Lake in Crisis

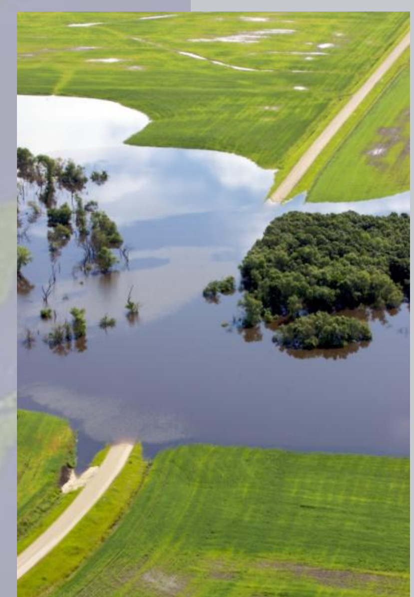
Sources of phosphorus entering Lake Winnipeg (1994-2001)



Source: Bourne et al., 2002.

Lake Winnipeg: A Lake in Crisis

Flooding and Lake Water Quality:



Agriculture’s Response

Conservation Tillage

Conservation tillage is widely accepted as an means to improve both soil and water quality.

Conservation is effective in reducing wind and water erosion through greater crop residue cover.

Agriculture’s Response

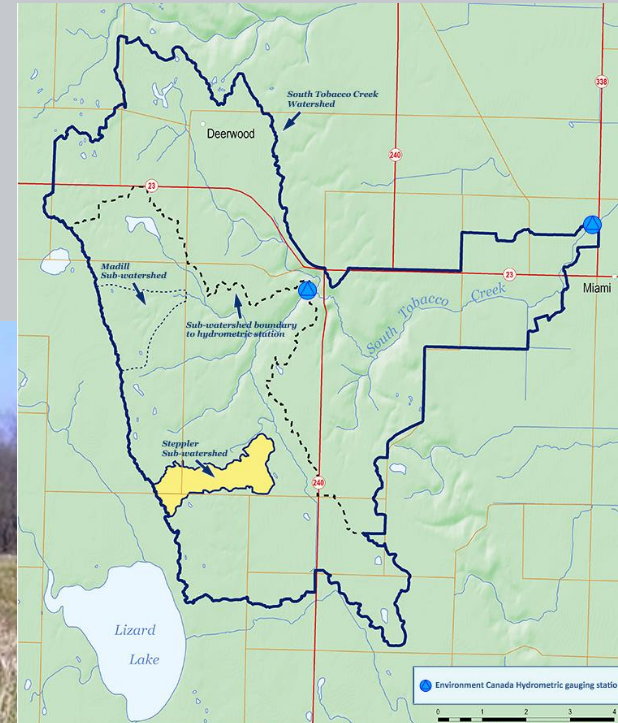
Nothing is ever as simple as it seems....

Keeping crop residue on the surface does not mean that soil quality is improved.

Keeping crop residue on the surface may actually result in more water contamination.

Agriculture’s Response

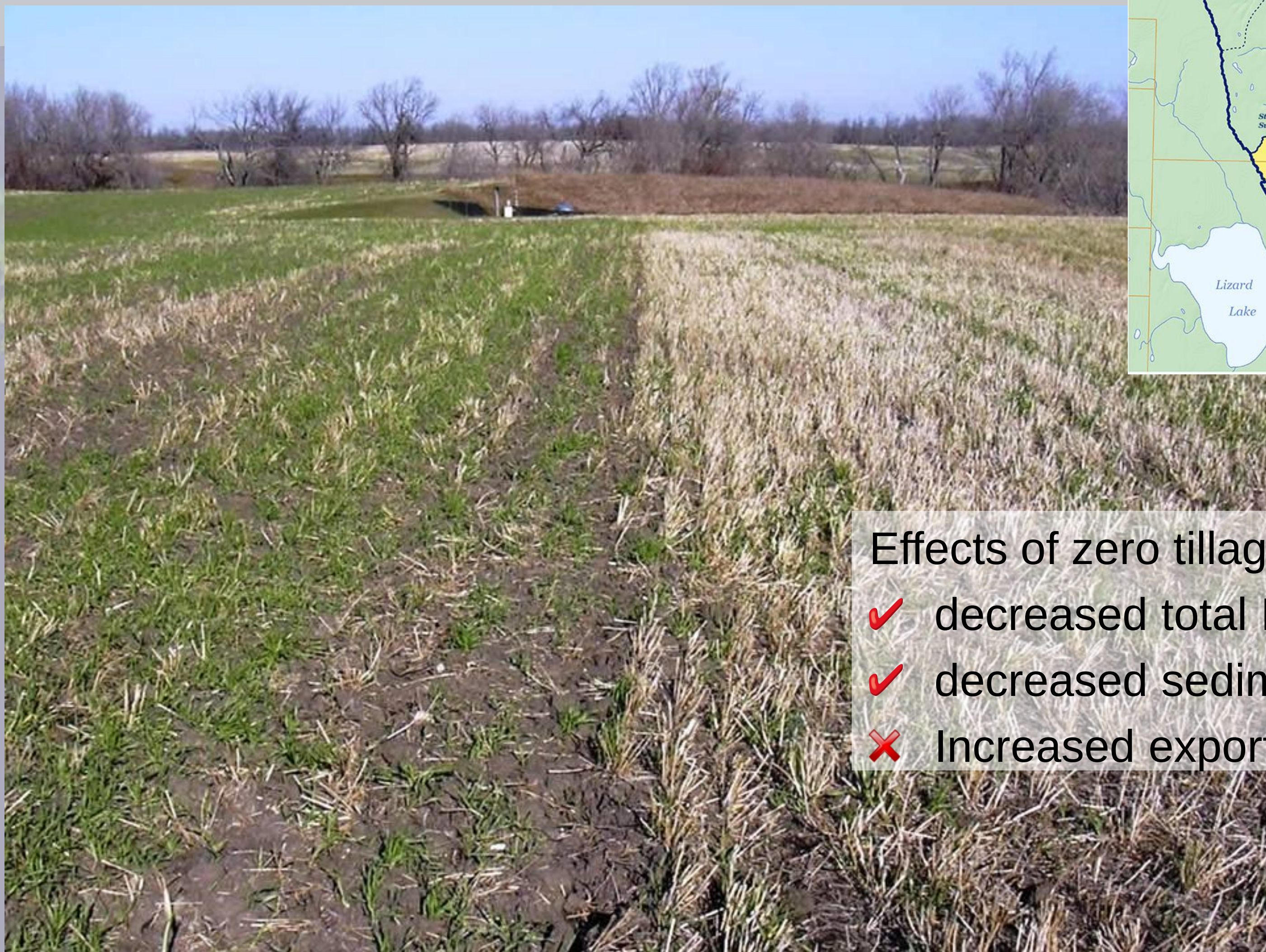
Nothing is ever as simple as it seems....

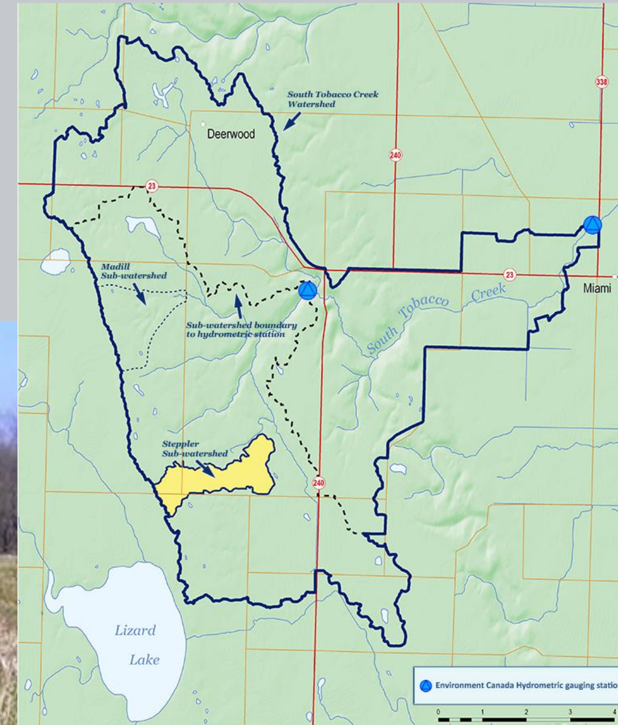


Conventional vs. conservation tillage
in snowmelt dominated runoff:
South Tobacco Creek WEBs
Twin Watersheds Study

Agriculture's Response

Nothing is ever as simple as it seems....





Effects of zero tillage on water quality

- ✔ decreased total N export
- ✔ decreased sediment export
- ✘ Increased export of P (DP)

Agriculture's Response

Riparian Buffers

Riparian areas enhance terrestrial and aquatic habitat.

Riparian areas serve as a buffer for streams from field activities.

Agriculture’s Response

Nothing is ever as simple as it seems....

- Riparian areas are not effective in filtering sediments and nutrients in runoff from land

Agriculture’s Response

Nothing is ever as simple as it seems....

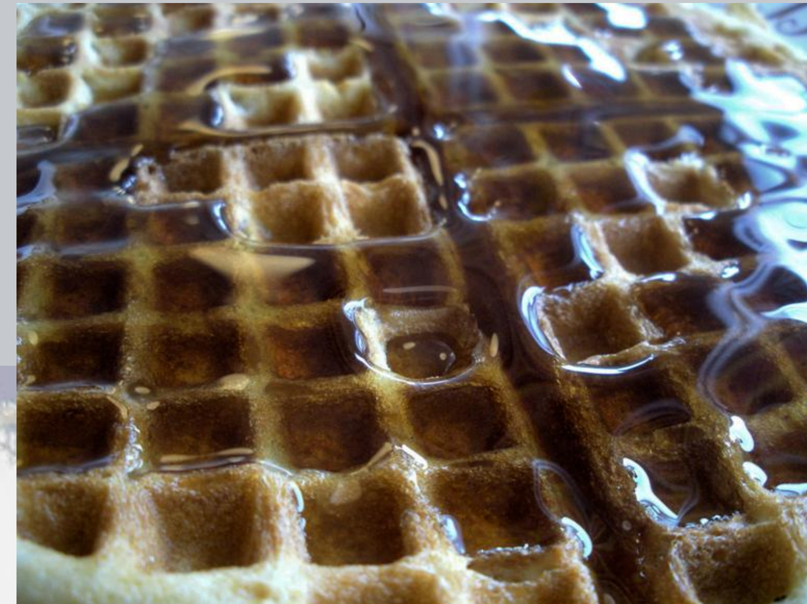
Depth of interaction between runoff and soil is shallow during snowmelt over frozen soil

Agriculture’s Response

Nothing is ever as simple as it seems....

In-stream and near-stream processes (e.g., vegetated buffers and biological uptake) are minimal during snowmelt

Agriculture’s Response



Runoff Control:
Surface Water Management

- Headwater Retention Dams
- Wetland Restoration
- Field Water Retention Structures

Agriculture’s Response

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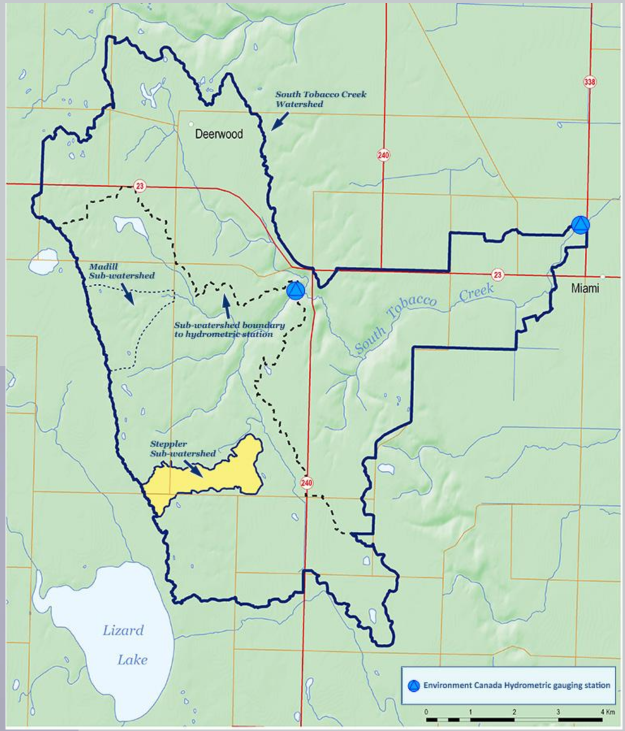

Agriculture’s Response

Runoff Control:
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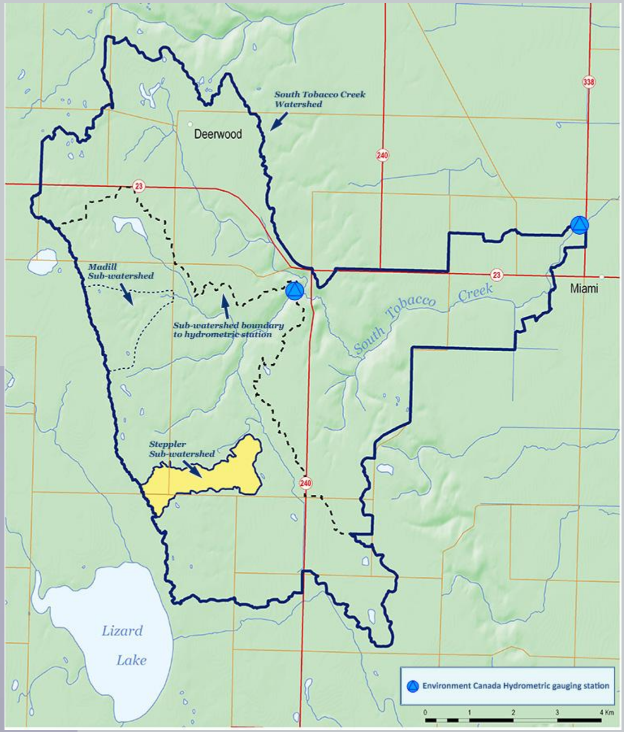

- Headwater Retention Dams
- Wetland Restoration
- Field Water Retention Structures

Retention dams in the South Tobacco Creek WEBs project reduced loads of:

- sediment (77%)
- TN (15%), TDN (14%)
- TP (12%), TDP (10%)

Agriculture's Response

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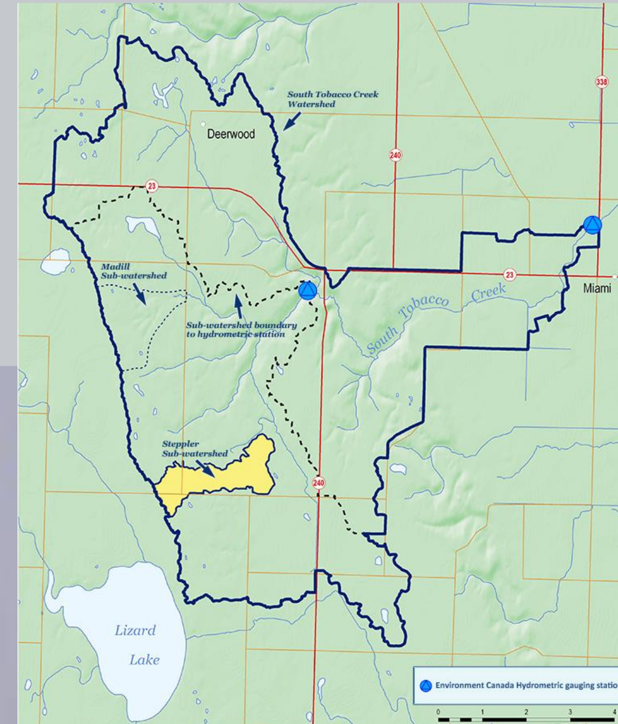
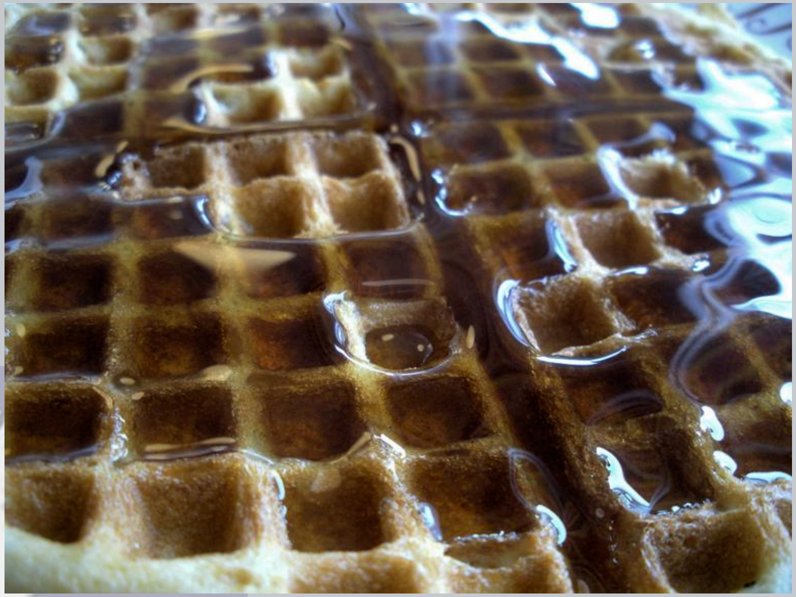


- Headwater Retention Dams
- Wetland Restoration
- Field Water Retention Structures

- Creation of "hungry water" and more downstream erosion of channels
- Transformation of PP to DP in anoxic environments

Agriculture’s Response



Runoff Control:
Surface Water Management

- Headwater Retention Dams
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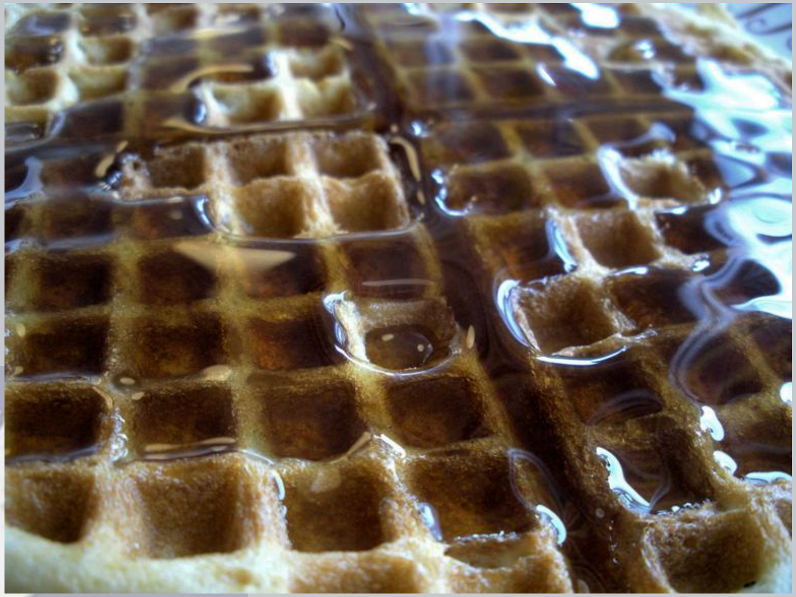
- Detaining water on fields using roadways and municipal drainage systems to reduce flooding downstream.

Agriculture’s Response

Runoff Control:
Surface Water Management



- Headwater Retention Dams
- Wetland Restoration
- Field Water Retention Structures

- Enhancing the “waffle effect”, detaining and controlling release of runoff, is a practice of great interest.
- This may be a good idea for controlling flood waters.
- It will release P from soil into the detained waters and could cause a flush of more concentrated dissolved P into rivers and into Lake Winnipeg.

CHALLENGES

The Role of Agriculture:

Due to its prevalence, agricultural land is a major contributor to runoff leading to flooding, and to nutrient losses leading eutrophication and algae blooms.

SURFACE WATER MANAGEMENT

CHALLENGES

Natural Realities:

SURFACE WATER MANAGEMENT

CHALLENGES

Agricultural Realities:

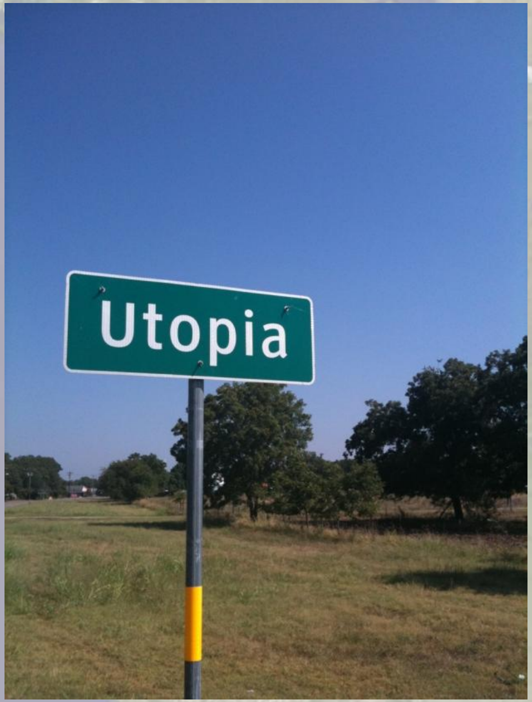
There is little room left for improvement of nutrient management within existing production systems

SURFACE WATER MANAGEMENT

INNOVATION

The Ideal System:

Drainage-Retention-Irrigation System for water management
Capture-Recovery-Reuse System for nutrient management



INNOVATION

The Ideal System:

Drainage-Retention-Irrigation System for water management
Capture-Recovery-Reuse System for nutrient management.

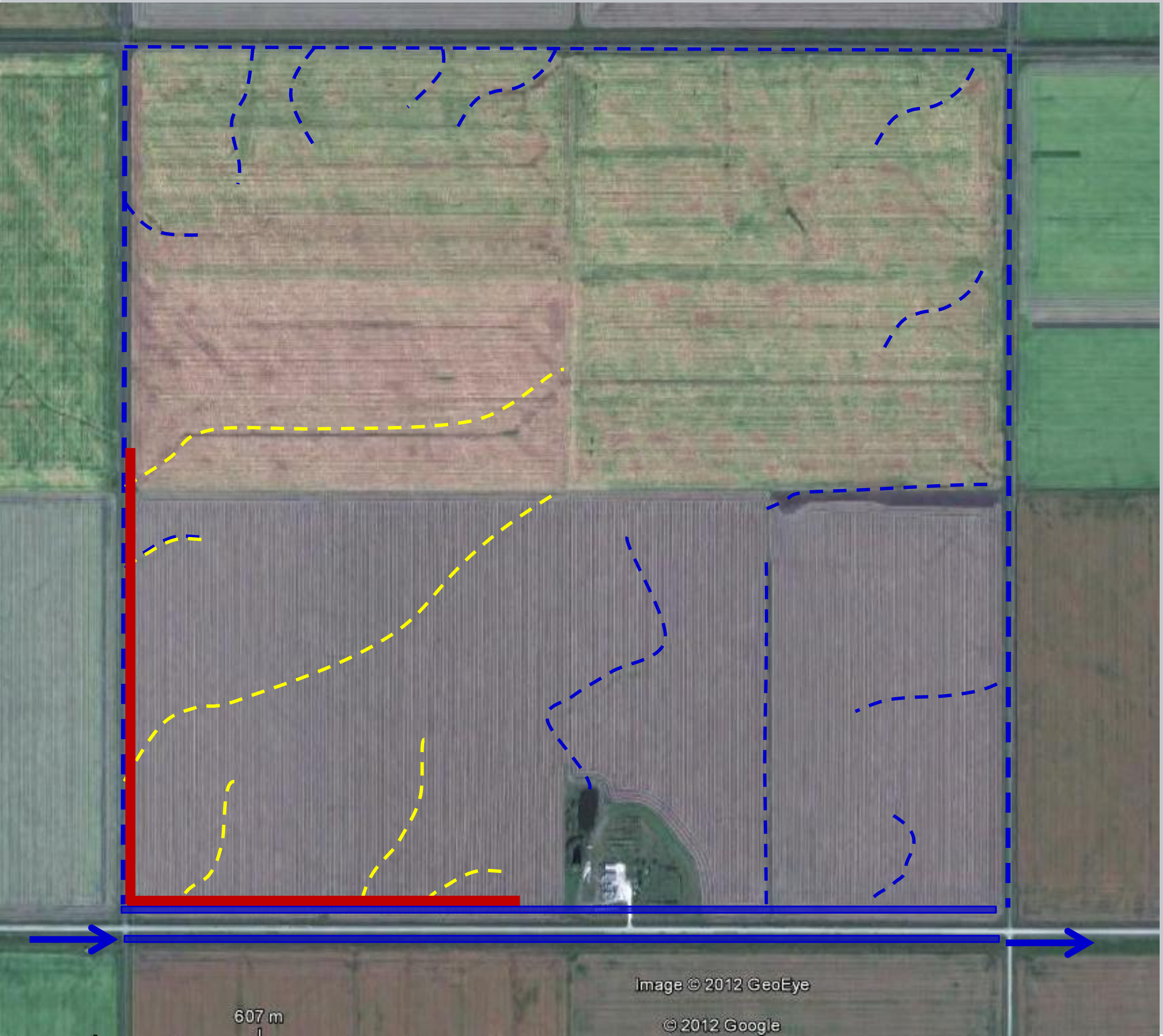
Targets:

Red River Valley

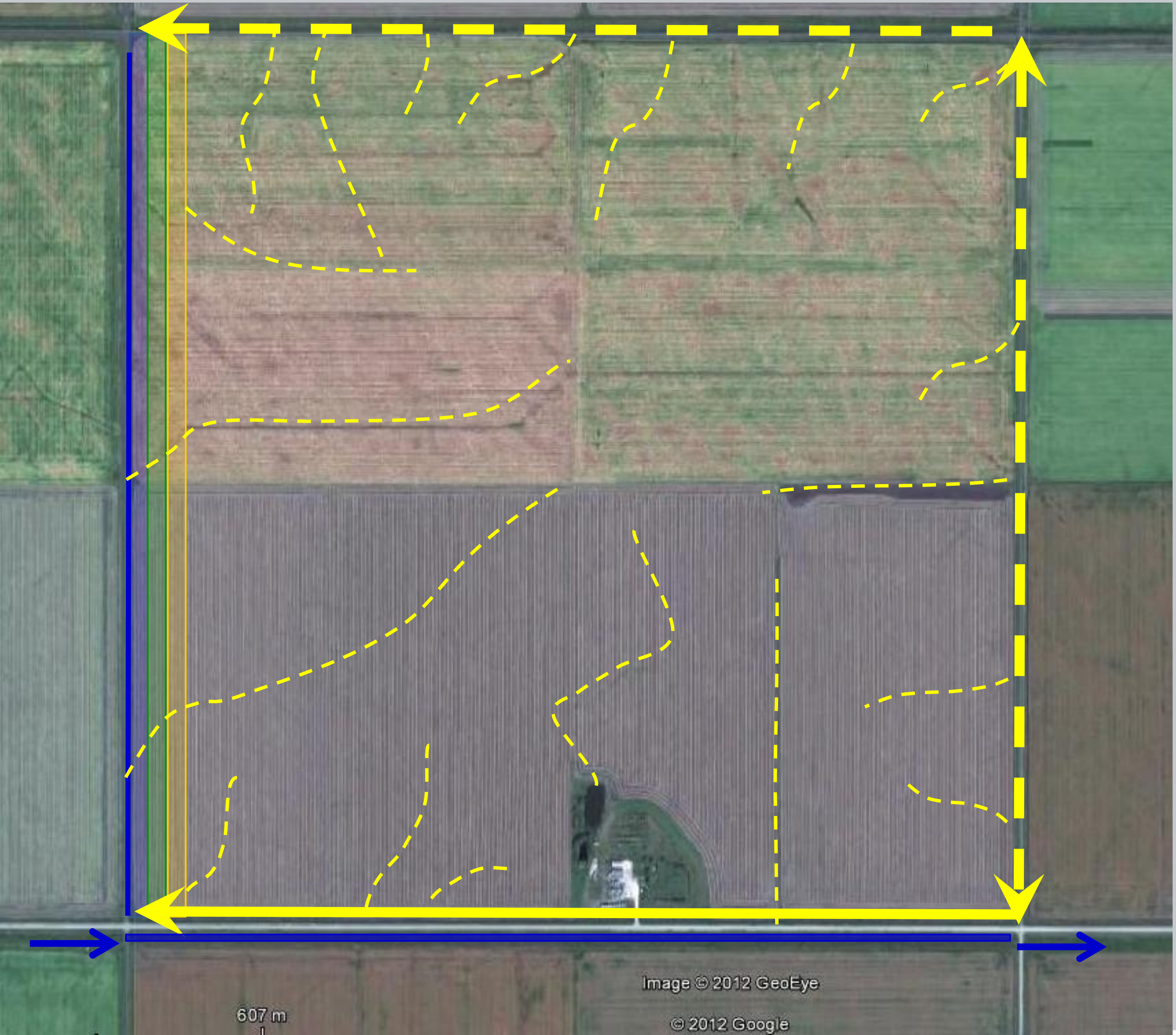
Retain and reuse most of the water and nutrients in most years, 9 of 10 years, 19 of 20 years, even 4 or 5 would be a significant improvement.

Existing Drainage System:

Option 1: Back-flood dams



Option 2: Expanded ditches



Option 3: On-farm ponds (Blue Box – Green Box)

REQUIREMENTS FOR SUCCESS

Economic and Environmental Benefits:

- Increased field crop production through better drainage.
- Potential for irrigation of field crops in drought years.
- Increased crop production in filter field from added water (and nutrients).
- Potential for alternative/multi-use crops and diversification using the filter field (bioenergy crops).

- Ecological goods and services
- Reduced runoff of water and nutrients
- Recreation and wildlife habitat

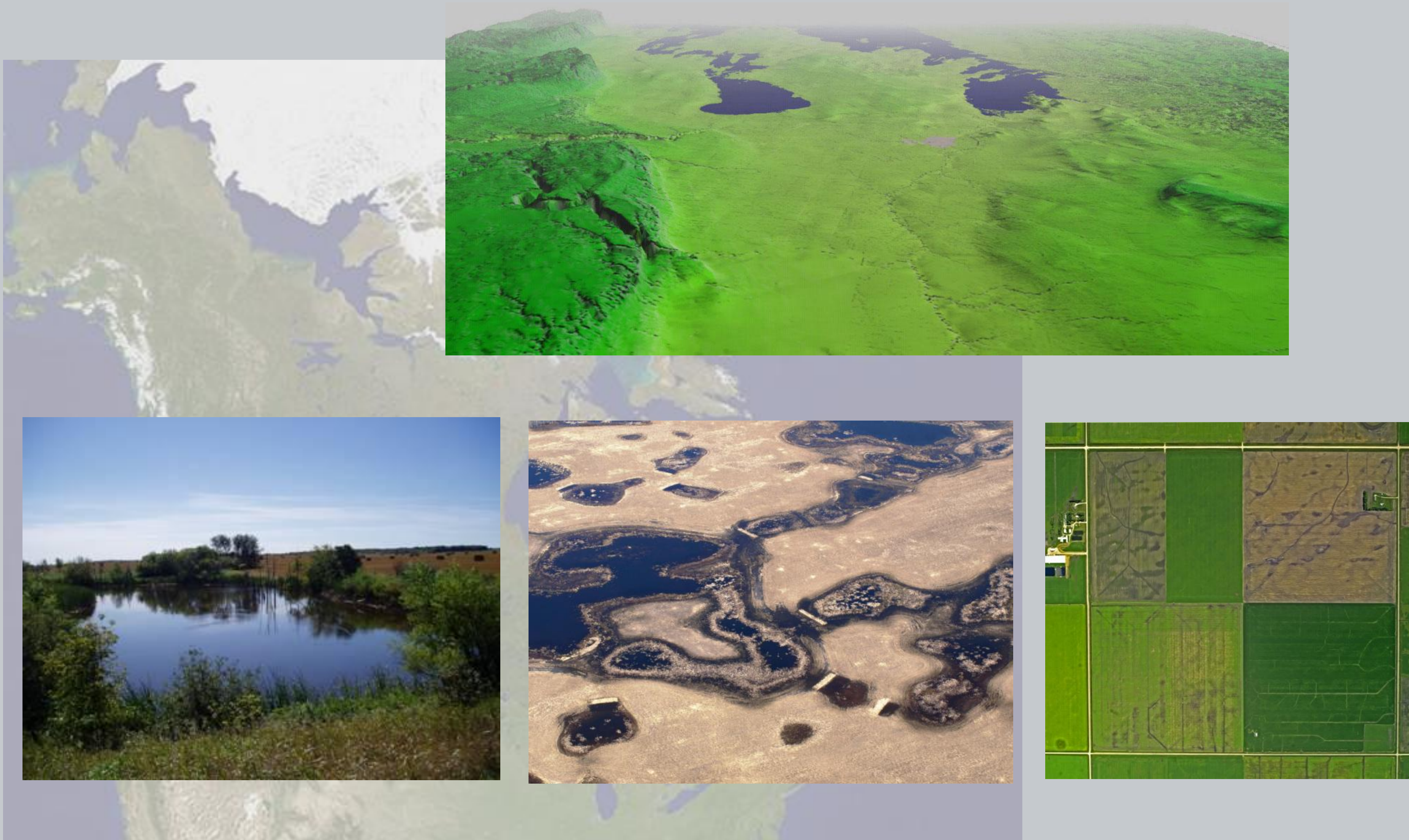
Requirements for Success

Economic and Environmental Risks:

- Construction and maintenance costs
- Upstream water management
- On-farm safety
- Salinity
- Weed control
- Invasive species (hybrid cattails, reed canary grass in wetlands)
- Wildlife habitat: pests: mosquitoes versus dragonflies

Surface water management

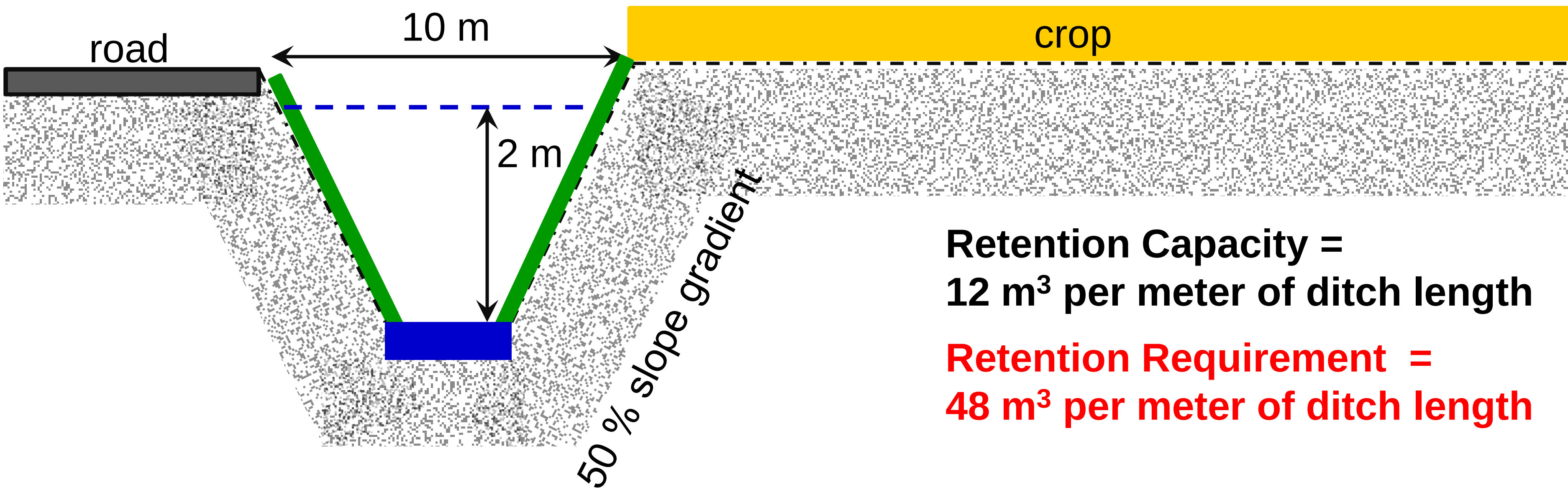
Innovation



Some Final Comments

- Development of appropriate BMPs – “place-based”
  - – filling the knowledge gaps
  - – accepting new technologies
- Assessments on the appropriate spatial scale – watershed-scale
- Assessments on the appropriate temporal scales – long-term
- Assessment of net environmental benefits – integrated/systems approaches
- Valuation of socio-economic benefits – there has to be a real and meaningful value to all stakeholders
- Realistic expectations

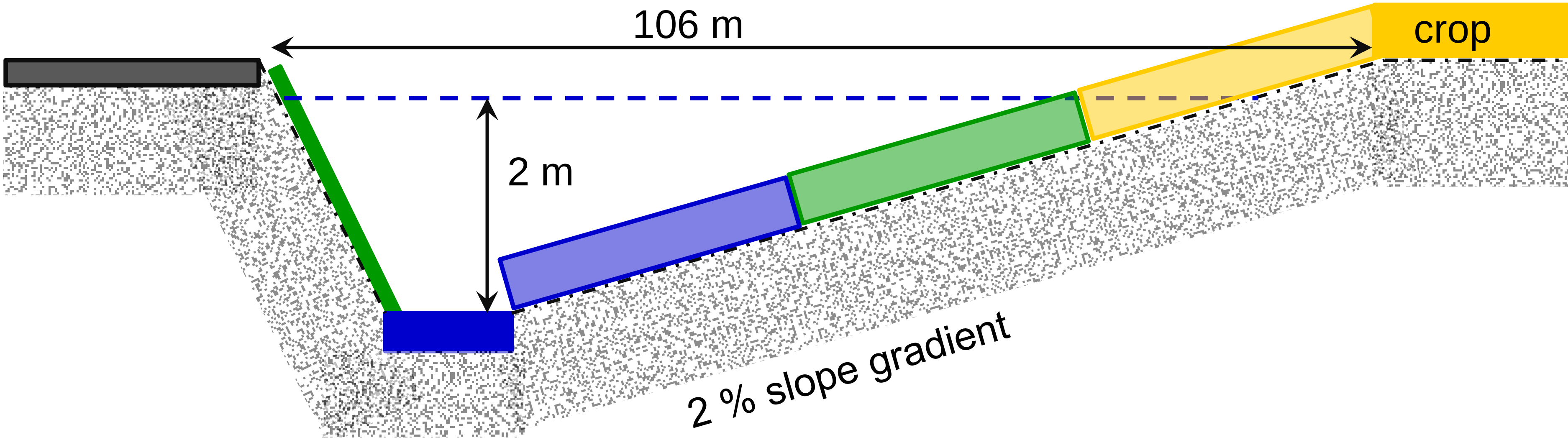
Existing Ditches:



Retention Capacity =
12 m³ per meter of ditch length

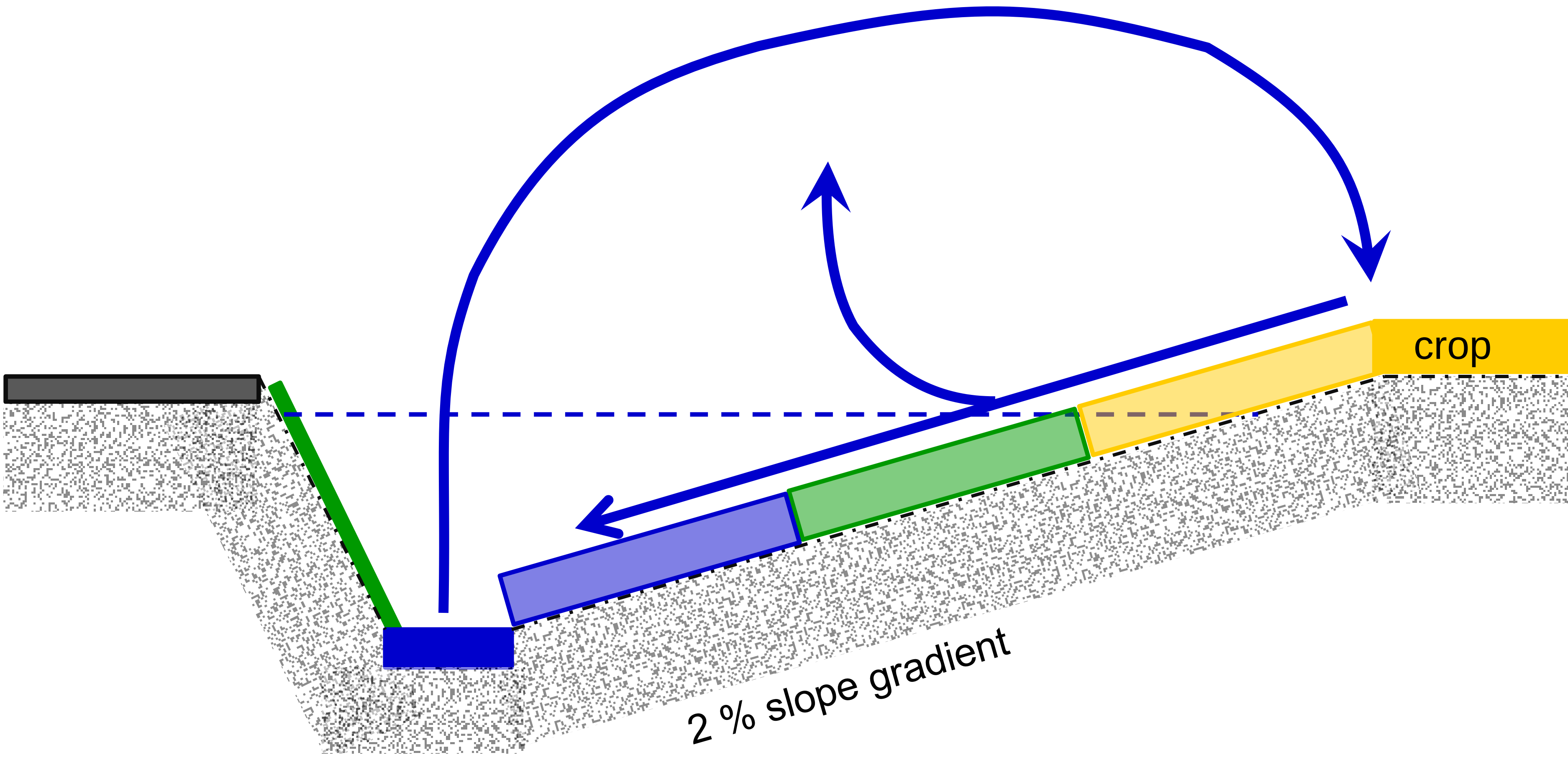
Retention Requirement =
48 m³ per meter of ditch length

Option 2: Expanded ditches



Retention Capacity =
108 m³ per meter of ditch length

Option 2: Expanded ditches



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