

Manitoba Association of Watersheds

Prairie Riparian Areas: Opportunities and Challenges for Production and Conservation



Alex Koiter

Land and water acknowledgement

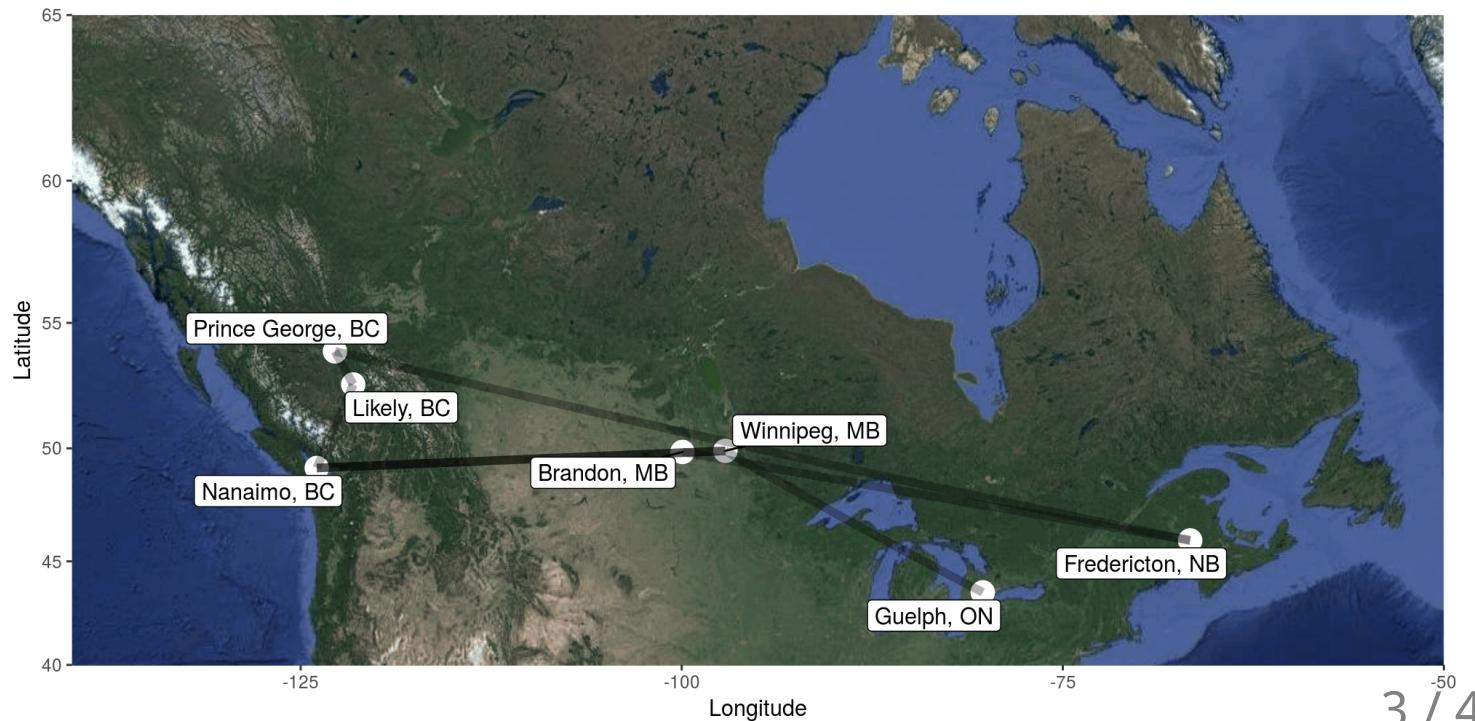
We are gathered here to talk about land and water in Manitoba and it is important to recognize the relationships between the landscape and humanity

A big part of this is understanding and appreciating both the history and future of this relationship

It is important for us to acknowledge that Brandon, and the surrounding area, are the traditional homelands of the Dakota, Anishinabek, Oji-Cree, Cree, Dene and Metis peoples

A little about me

- Associate professor
 - Brandon University, Department of Geography & Environment
- Interested in watershed science
 - Soil and water quality
 - Hydrology
 - Agriculture
 - Geomorphology



Thanks to

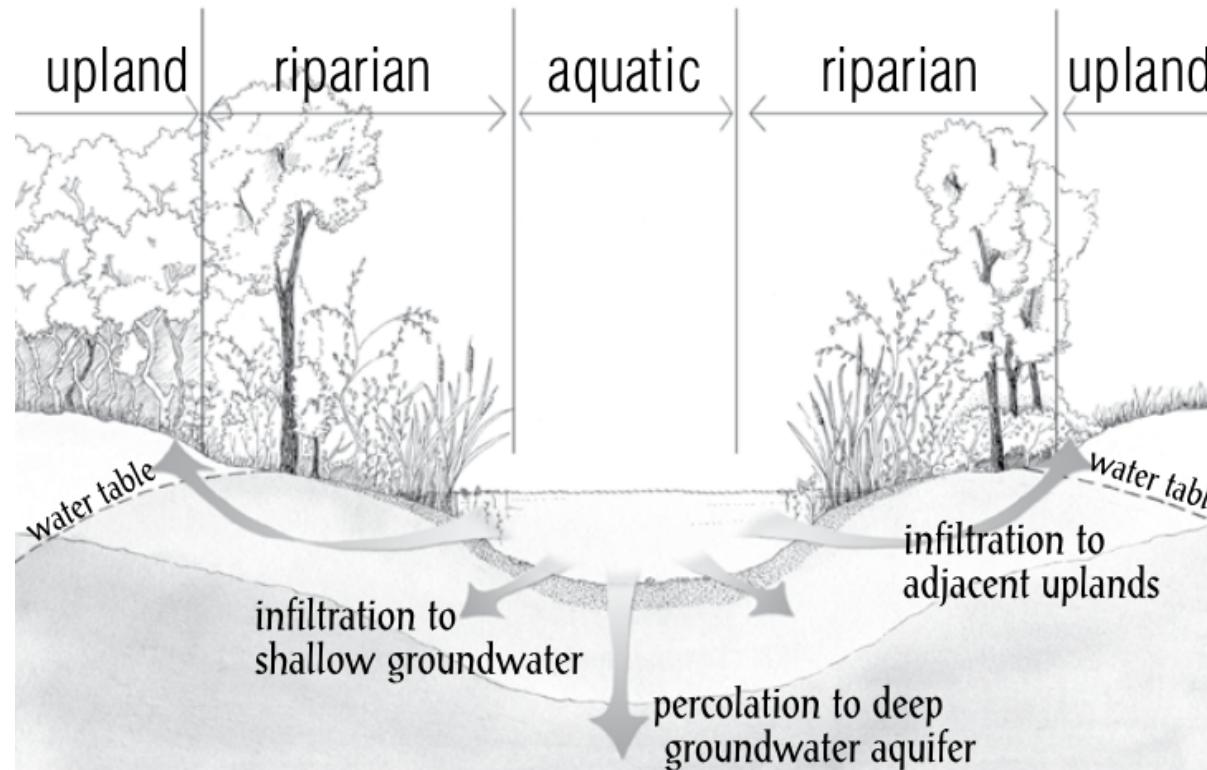
- Collaborators & research groups
 - David Lobb (U of M)
 - Phil Owens (UNBC)
 - Merrin Macrae (U of W)

- Funding
 - Lake Winnipeg Basin Stewardship Fund
 - NSERC
 - ECCC
 - Ducks Unlimited Canada
 - AAFC
 - Deerwood and Soil and Water Management Association
 - Manitoba Beef & Forage Initiatives



What is a riparian area?

- Transitional zone between the aquatic part (the waterfilled basin of the lake or wetland) and the surrounding terrestrial (or upland) area ([Cows and Fish 2009](#))
- "Wetter than dry" but "drier than wet" ([MB Ag](#))
- The strip of moisture-loving vegetation growing along the edge of a natural water body ([Hilliard & Reedyk 2020](#))



What is a riparian area?

Goes by many names

- Vegetated buffer strip
- Vegetated filter strip
- Buffers
- Riparian corridor
- Grass buffer
- Riparian forest



What does a riparian area look like?

- Trees around a small retention dam



What does a riparian area look like?

- Grasses around a small wetland



What does a riparian area look like?

- Trees along a stream



What does a riparian area look like?

- Do wet depressional areas have a riparian zone?



What does a riparian area look like?

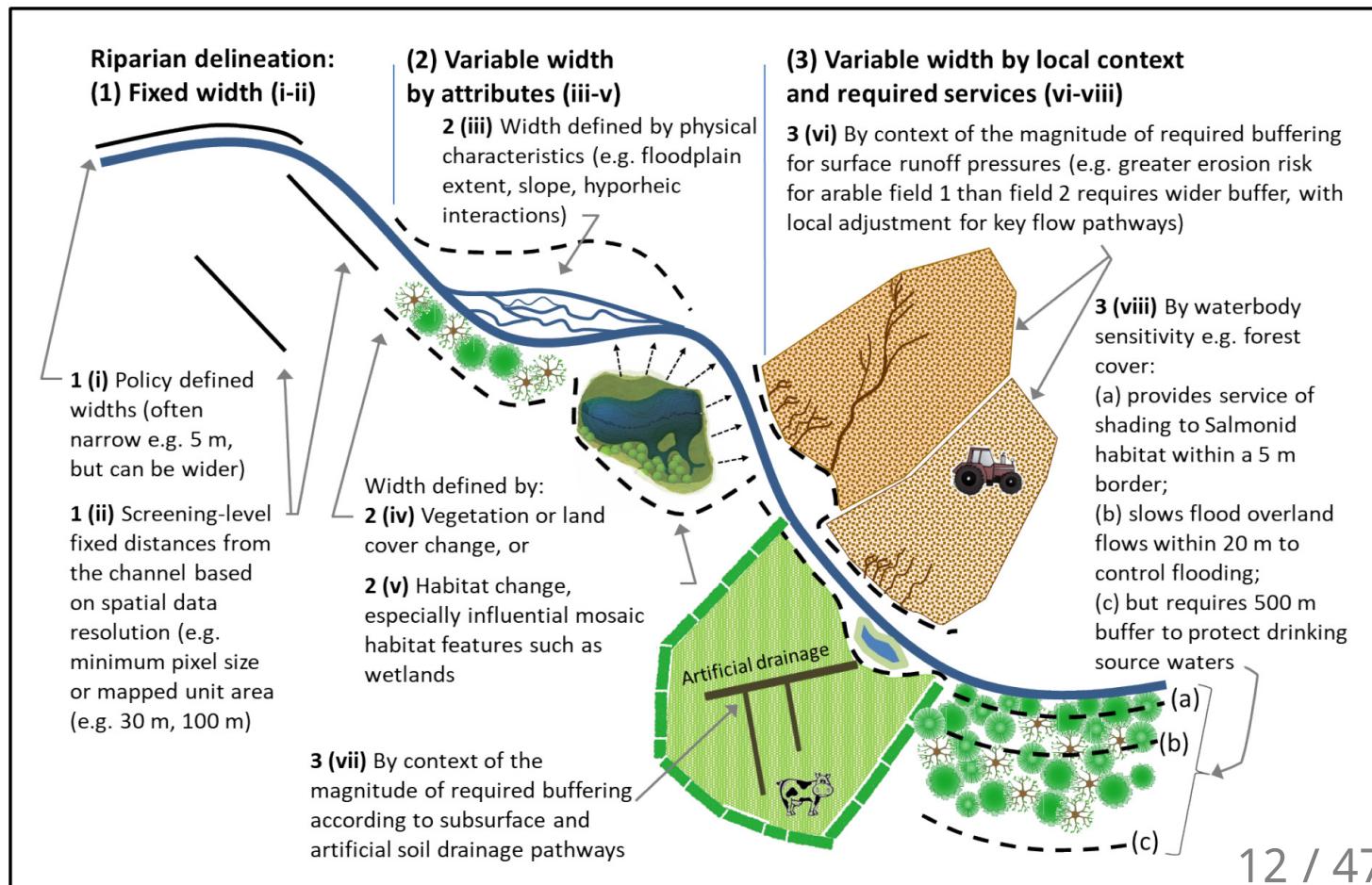
- Do ditches have a riparian zone?



Defining a riparian area

Where does (should) it start and end?

- Historical observations
- Too steep/wet to farm
- Fence line
- Vegetation types
- Hydrology
- Ecosystem function
- Regulatory



Riparian functions

Recreation



Lobb

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Riparian functions

Habitat

- High plant and animal biodiversity
- Important corridors in a very fragmented landscape



Riparian functions

Channel characteristics

- Changes in the vegetation resulted in changes in characteristics
 - Treed vs grassed ([Satchithanantham et al. 2019](#))

Table 3. Summary statistics of geomorphological characteristics for both forest and nonforest reaches.

Parameter (units)	Forest		Nonforest		Paired <i>t</i> test <i>p</i> -value
	Mean	SD	Mean	SD	
LWD (pieces/100 m of stream)	7.50	4.67	1.00	1.84	<0.01
Detritus (%)	39.19	16.98	24.69	17.12	0.05
Bankfull width (m)	8.49	2.50	5.69	2.51	<0.01
Mean bankfull depth (m)	0.85	0.23	0.80	0.35	0.84
Width to depth ratio (m/m)	10.53	3.09	7.65	2.60	<0.05
Flood prone width (m)	24.3	7.74	25.25	7.34	0.41
Entrenchment ratio (m/m)	3.16	1.12	5.49	2.08	<0.01
Incision ratio (m/m)	1.60	0.43	1.53	0.27	0.59
Cross sectional area (m ²)	7.86	4.62	5.37	5.15	<0.01
Sinuosity (m/m)	1.5	0.35	1.25	0.30	<0.05

Riparian functions

Part of the farm

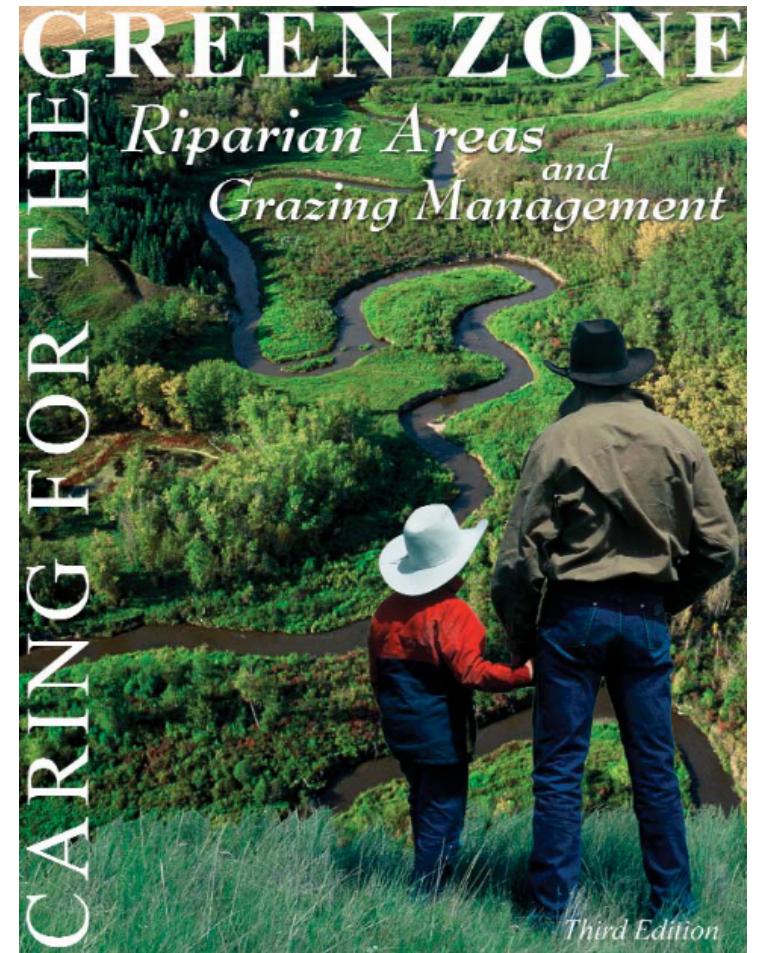
- Riparian areas can account for 5 to 10% of the farm area
 - Up to 25% in the prairie pothole region



Riparian functions

Part of the farm

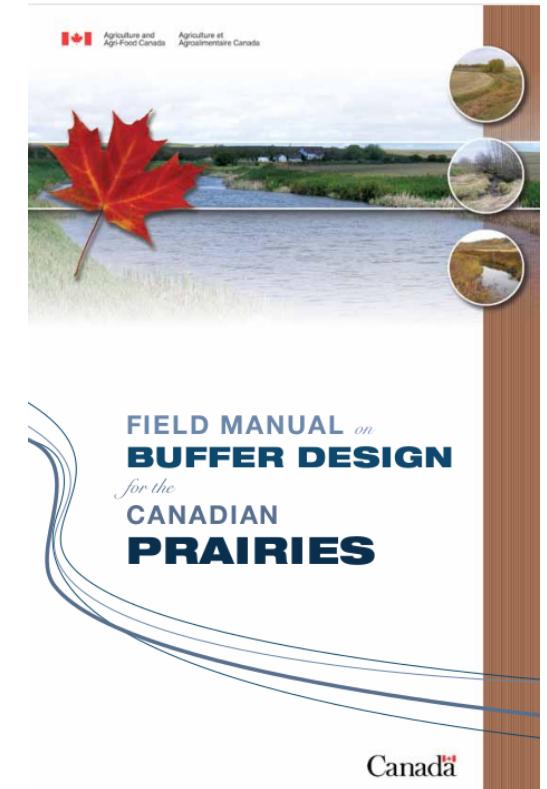
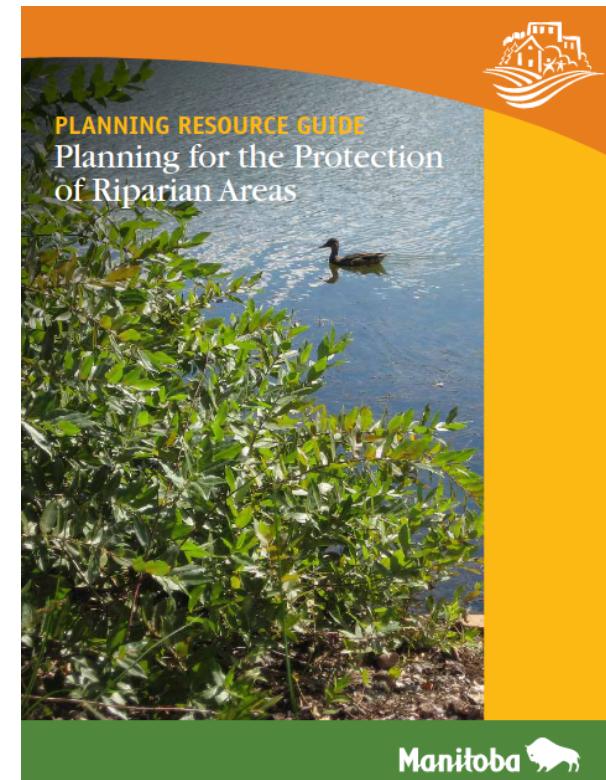
- Important source of forage, especially during drought



Riparian functions

Surface water management

- Often cited as an effective means of reducing the loading of nutrients to surface waters
 - Nutrients, sediment, pathogens, and other pollutants are filtered by riparian soil and vegetation
- Slow runoff → reducing peak flows



Riparian functions

Surface water management

- Eutrophication and algae blooms on Lake Winnipeg
 - Lots of public interest/pressure/outrage in improving water quality
- Riparian areas are considered part of the solution



Riparian areas as filters

Experimental (lab and field)

- Uniform flow of water
- Newly established
- Warm climate/temperature
- Rainfall

Provides lots of good and important information but how well does it transfer to the prairie landscape?

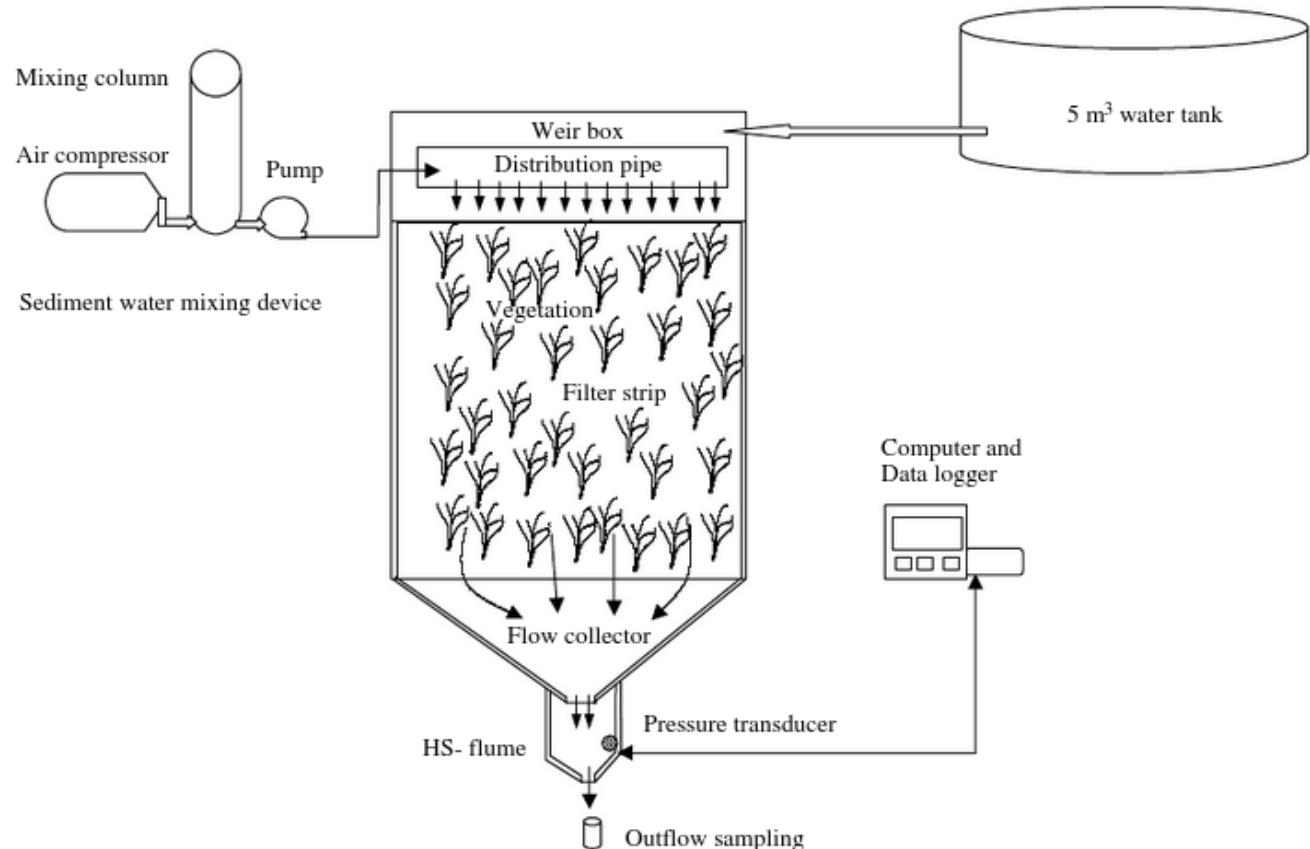
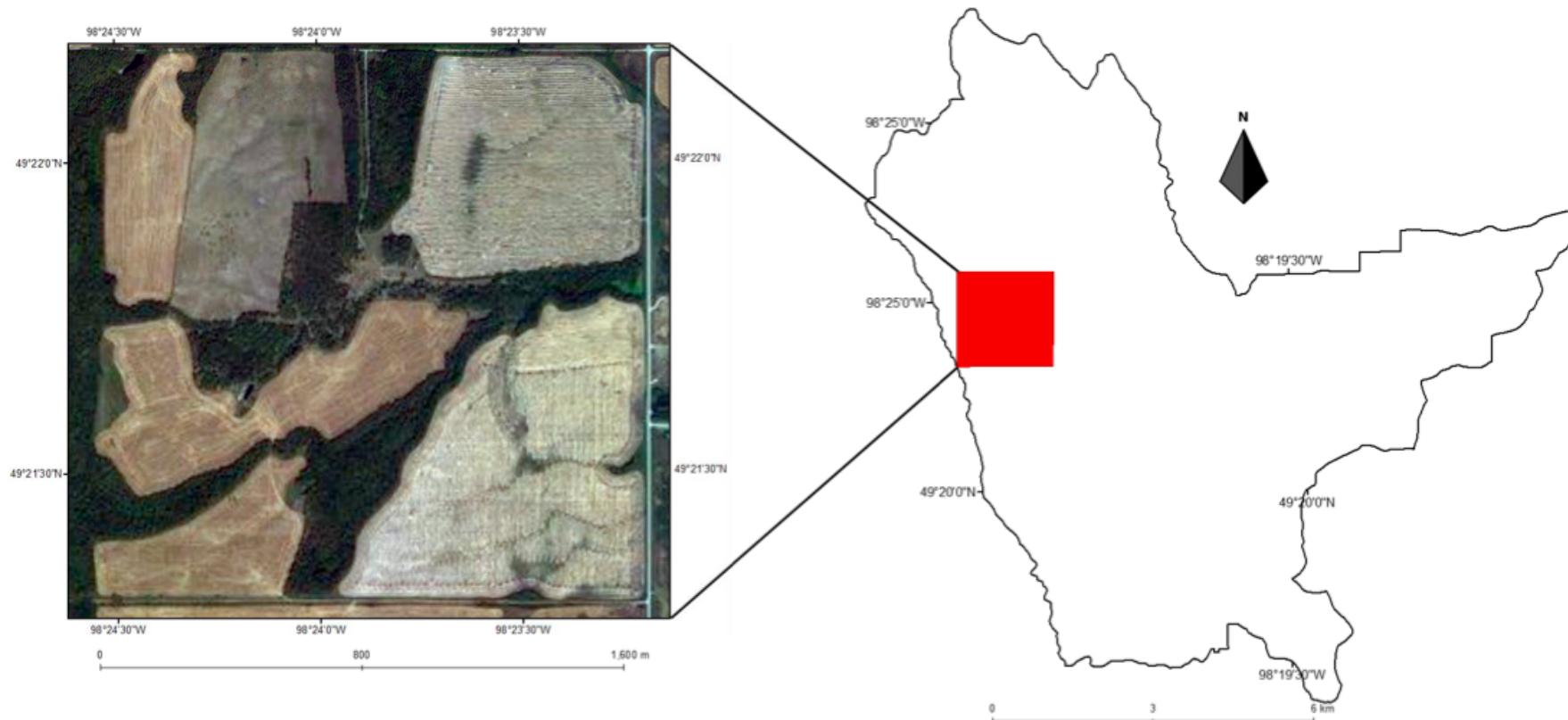


Figure 1. Schematic of supply and monitoring system and experimental setup

Riparian areas as filters

Uniform flow of water?

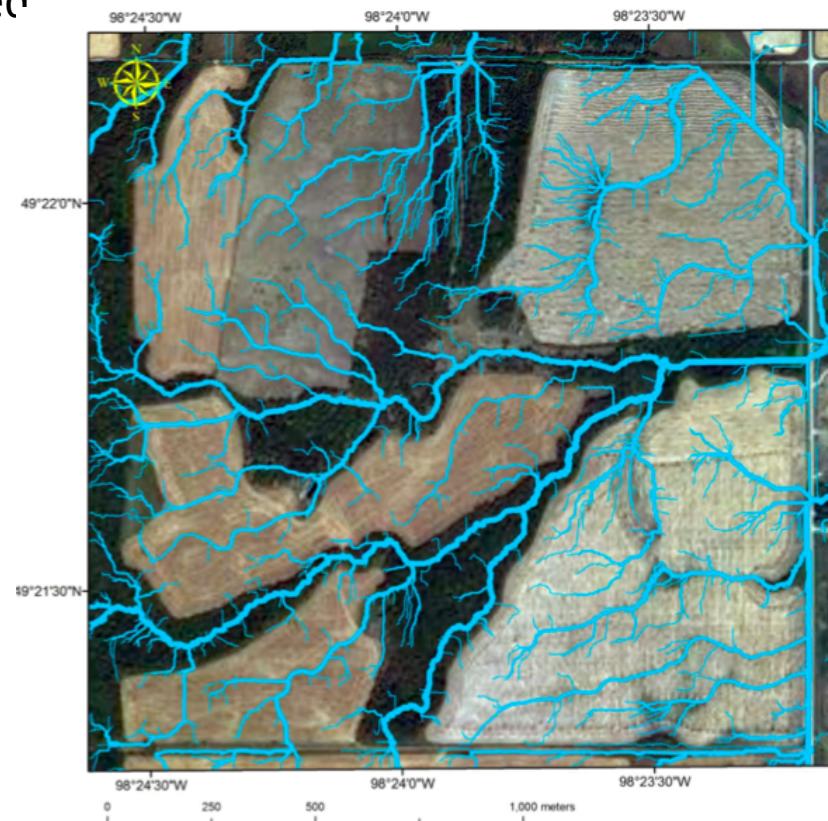
- Lots of nice looking riparian areas in this section



Riparian areas as filters

Uniform flow of water?

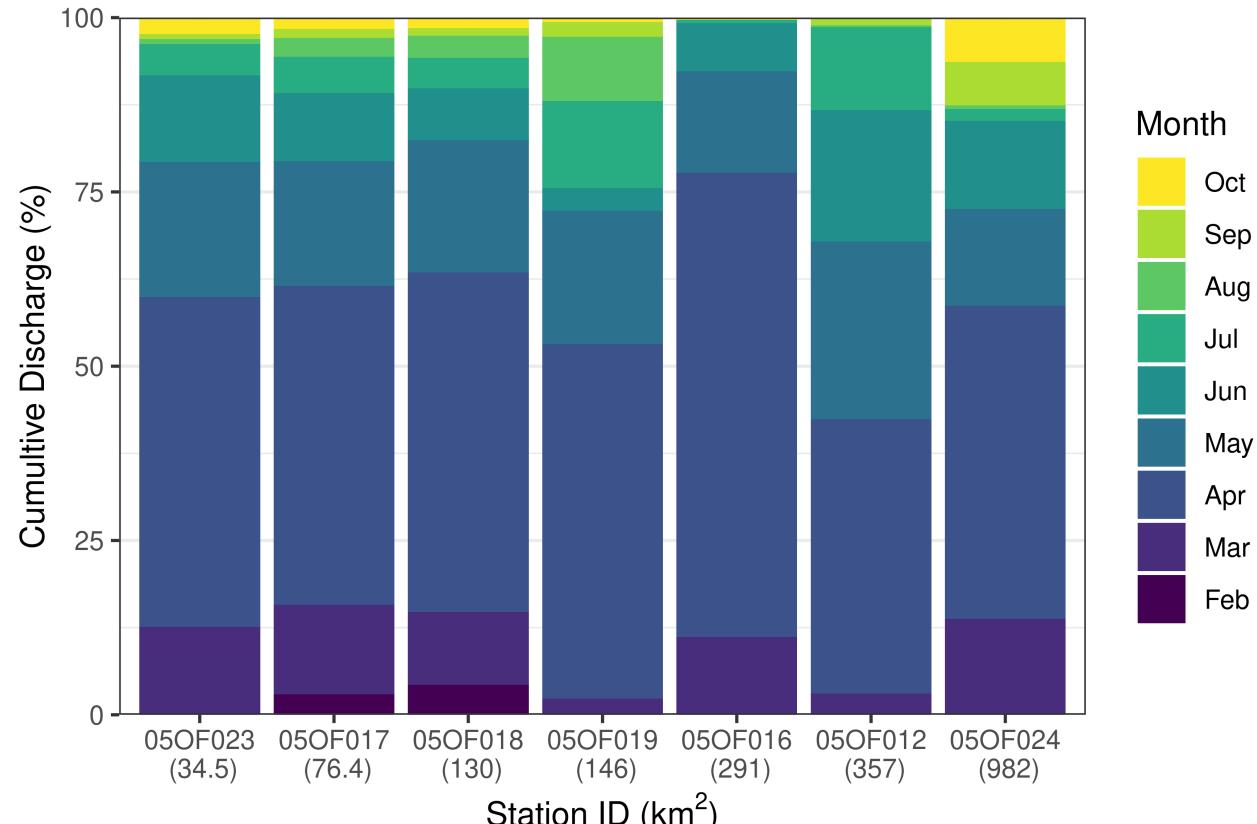
- Only 1-2% of the length of the field-edge vegetation intercepts surface runoff
 - Convergence in the landscape results in concentrated flow paths
 - Most of the riparian areas are **NOT** filtering runoff
 - Variable width may help improve filtering without putting land out of production



Riparian areas as filters

Warm climates and rainfall events

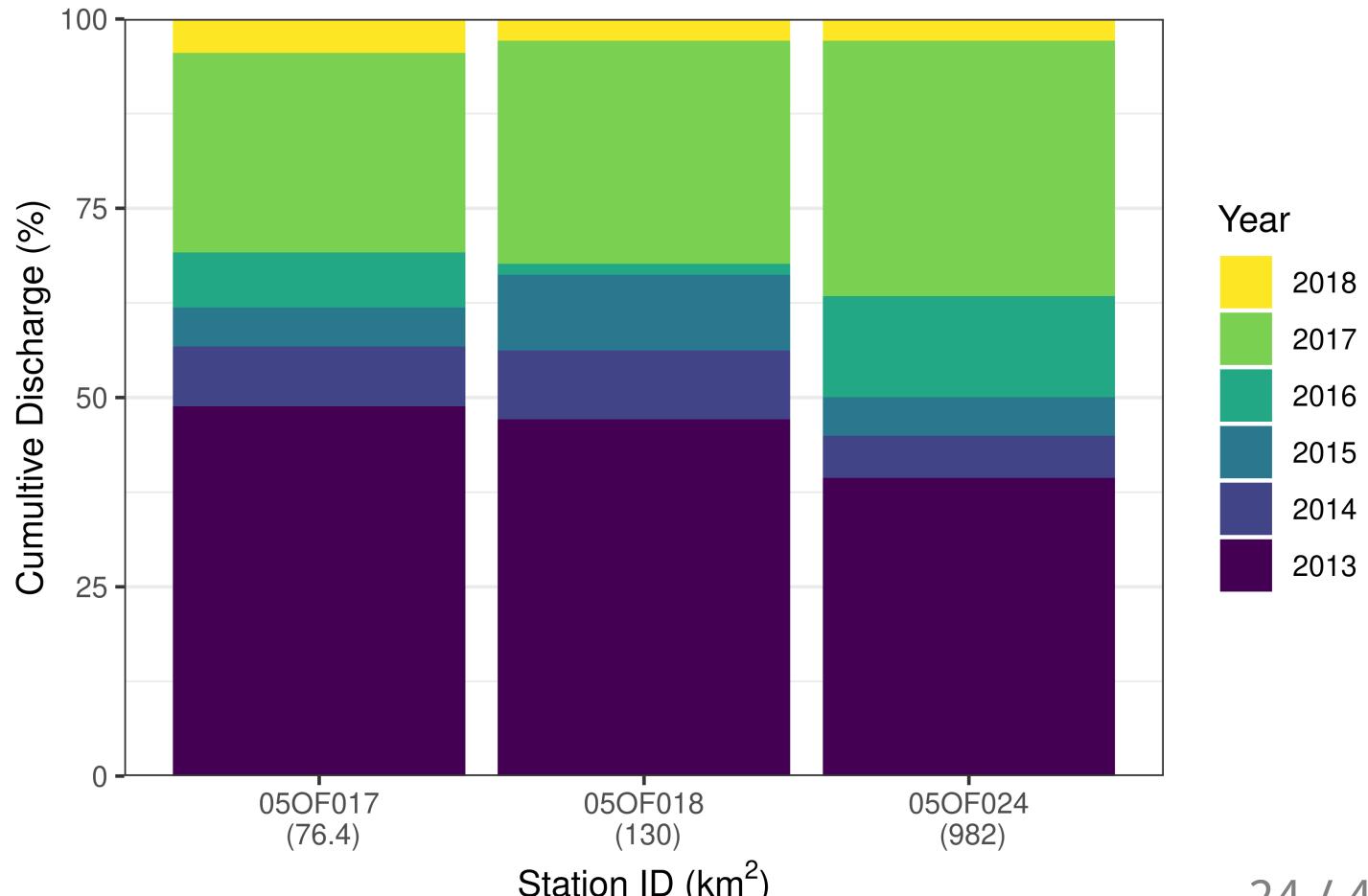
- Information on the efficacy of riparian areas in other locations may not be the same here
 - Snowmelt driven hydrology
 - Most of the time riparian areas are **NOT** filtering runoff



Riparian areas as filters

Inter-annual variability

- Lots of variability between years
 - A few years can account for much of the total flow
 - Riparian areas are more important in some years but less so in others



Riparian areas as filters

Typical prairie riparian area during the snowmelt period

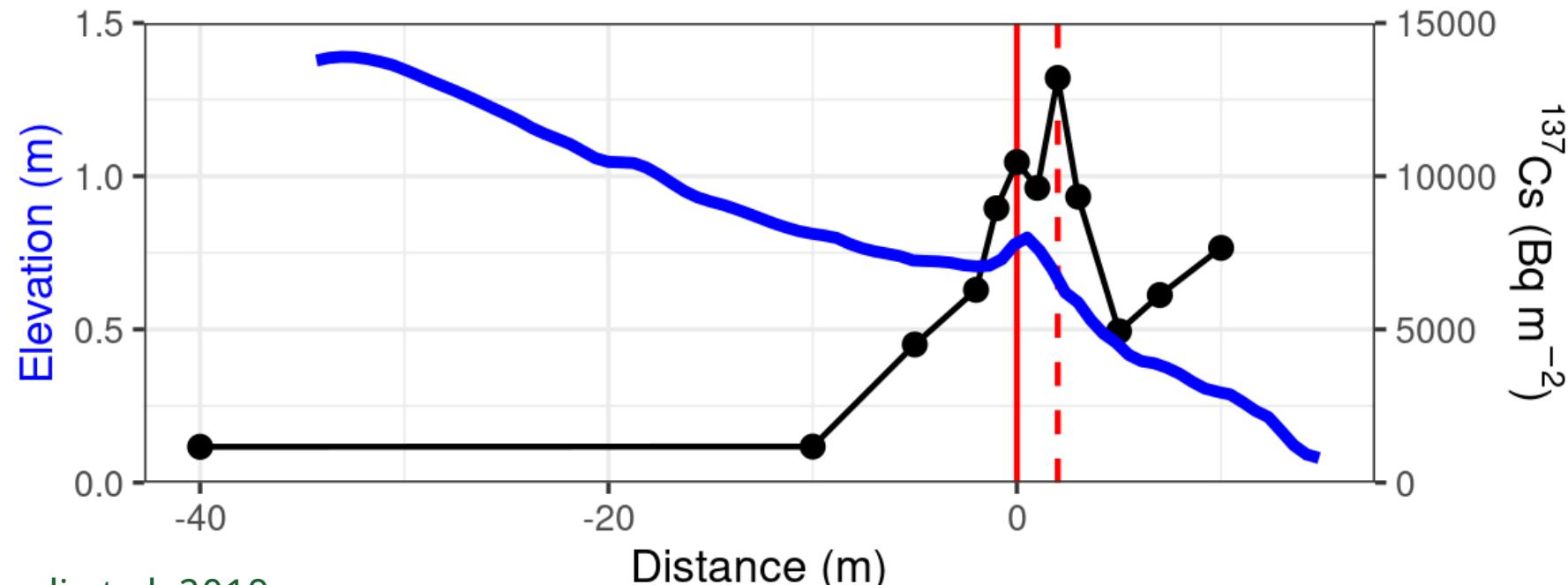
- Frozen soils and dead and dormant vegetation
 - Filtering capacity is not very good during the most critical period



Riparian areas as filters

Sediment and nutrient accumulation

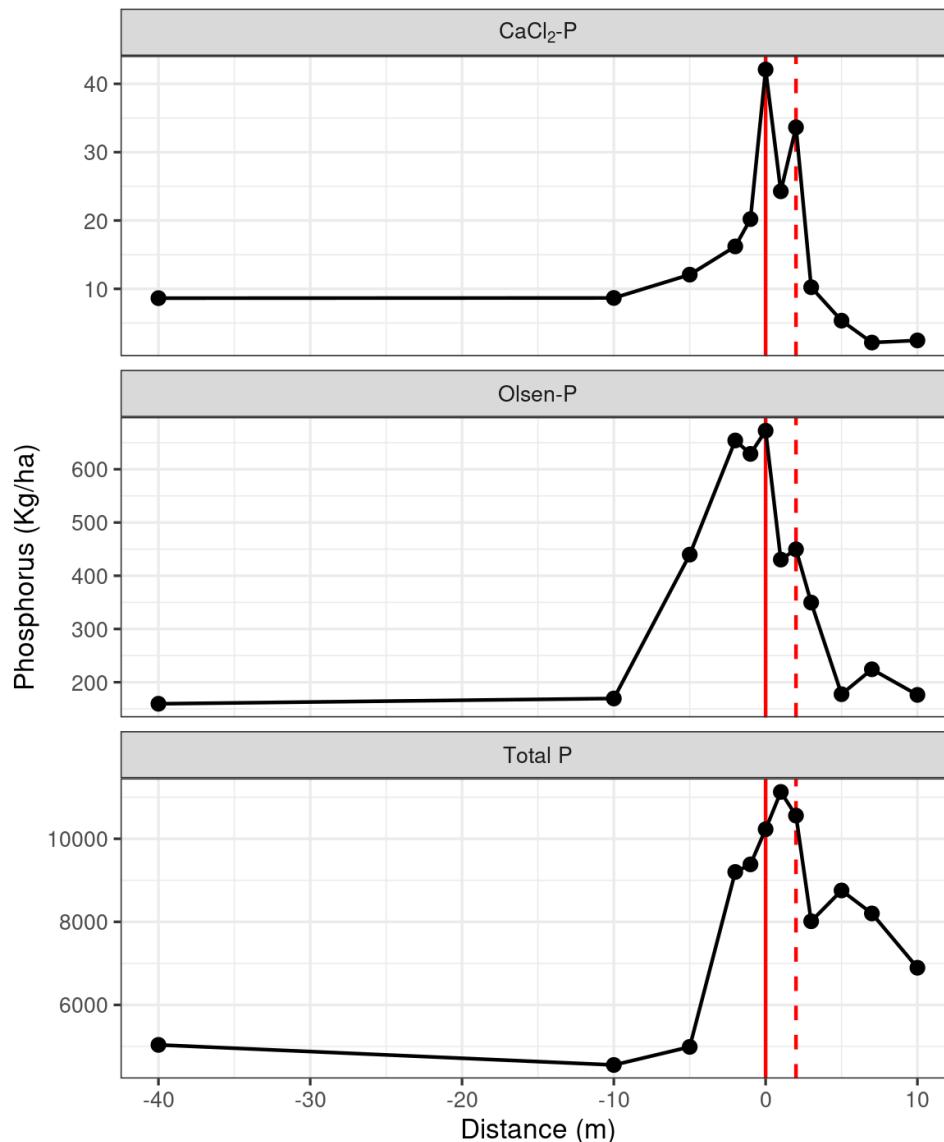
- Accumulation of soil at the edge of the field an within the riparian area
 - Created a step (tillage erosion)



Riparian areas as filters

Sediment and nutrient accumulation

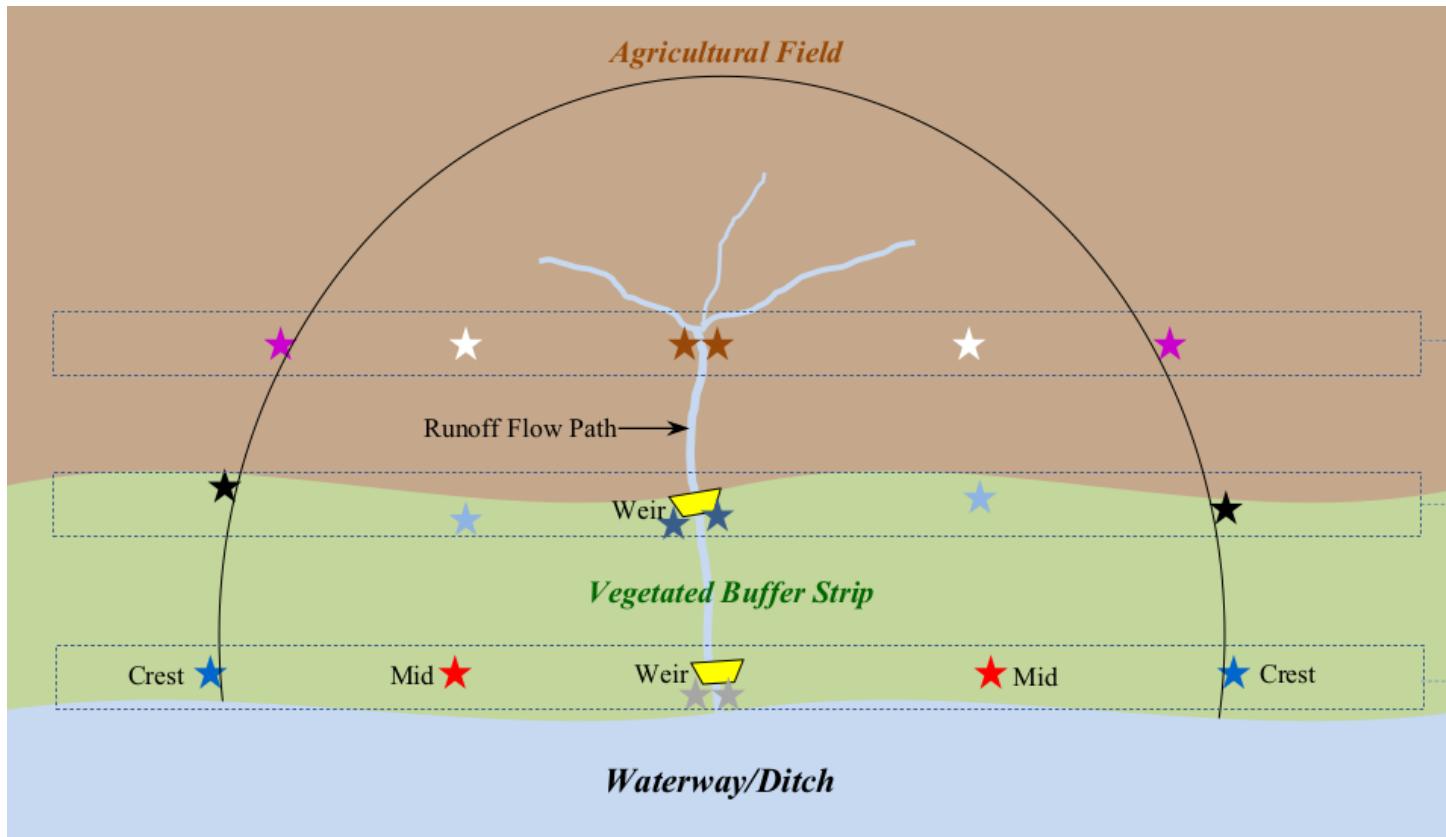
- Accumulation of nutrients at the edge of the field and within the riparian area
 - Ability to retain nutrients declines over time



Riparian areas as filters

Assessing the filtering capabilities

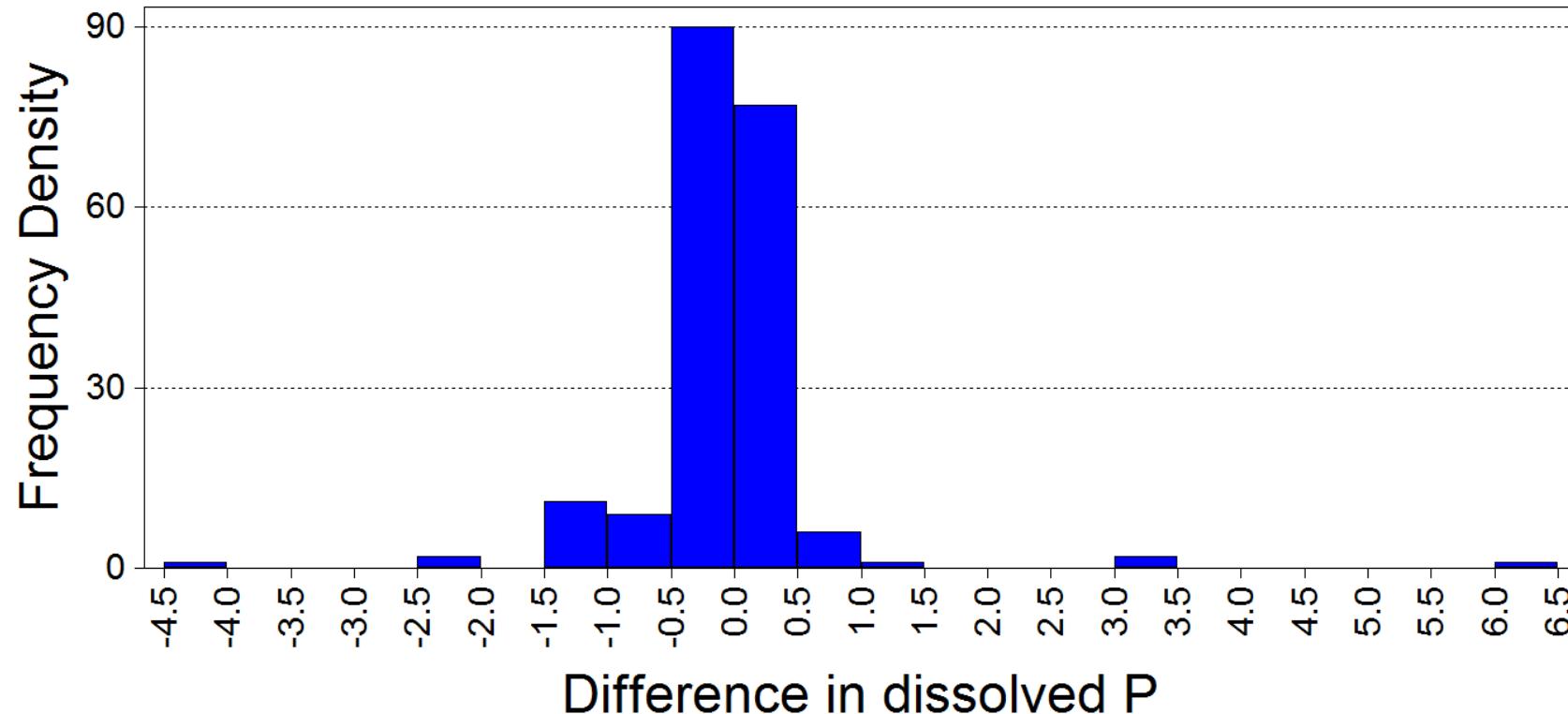
- Three sites across MB



Riparian areas as filters and sources

Riparian areas can be a source of dissolved nutrients

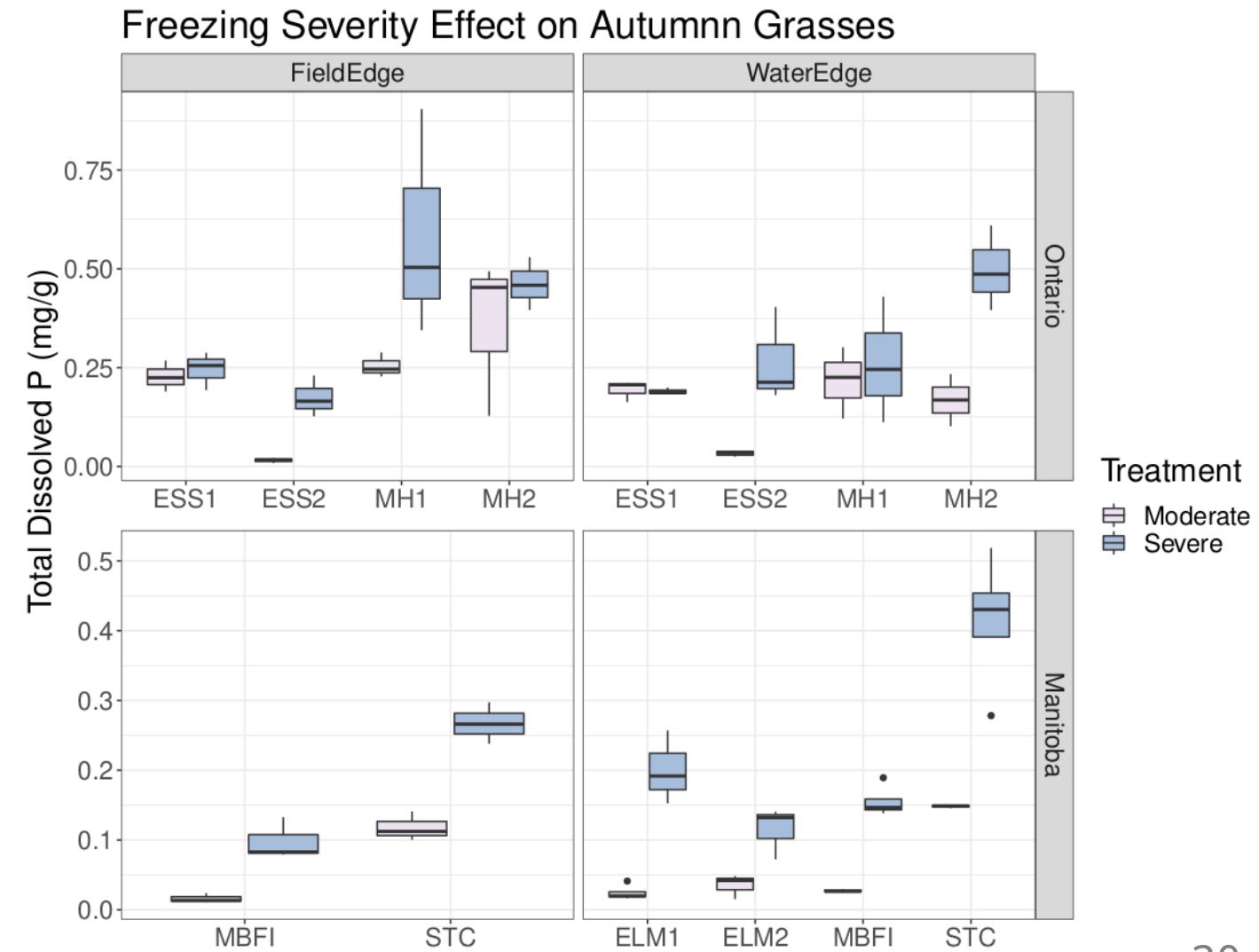
- Both the soil and vegetation can contribute



Riparian areas as sources

Freeze-thaw

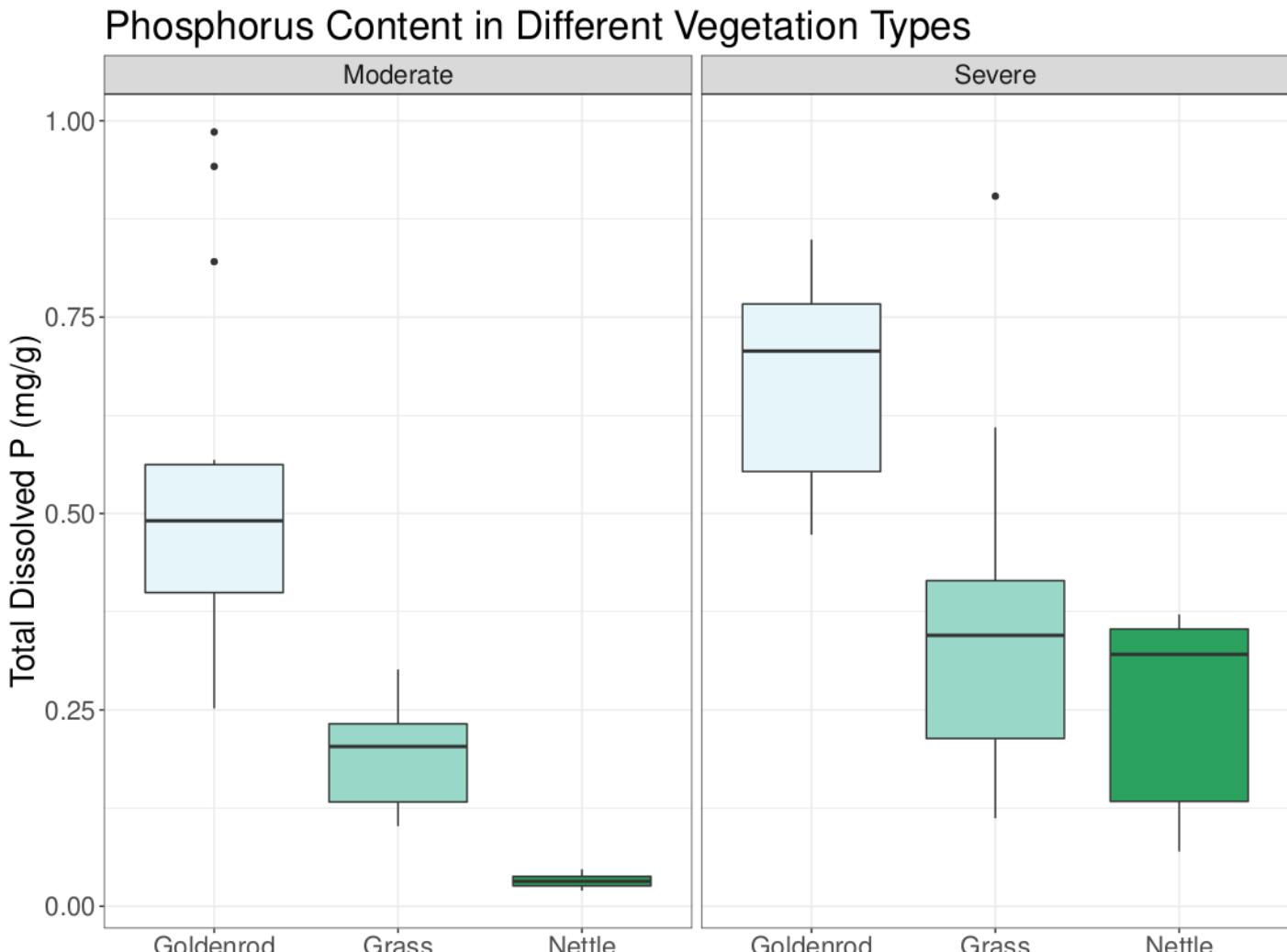
- Freezing vegetation releases water soluble P



Riparian areas as sources

Freeze-thaw

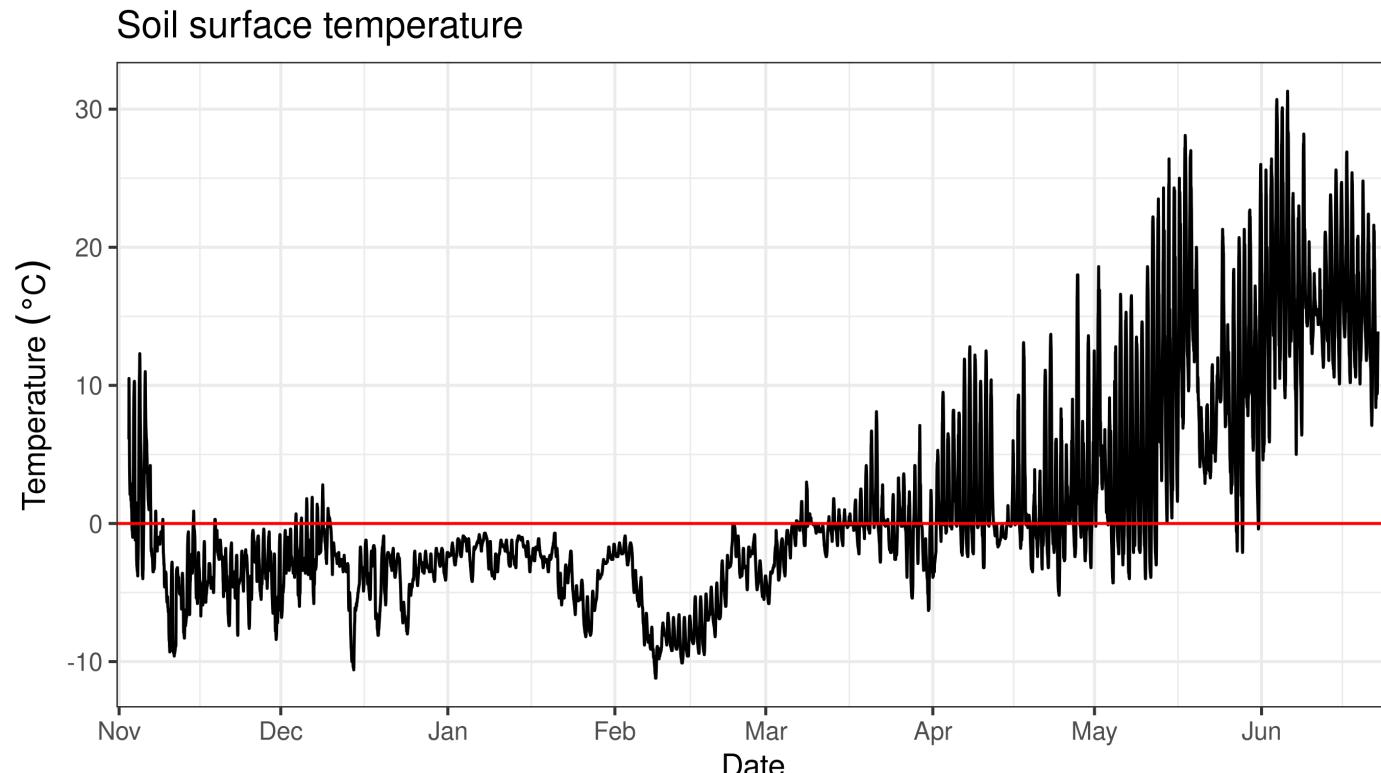
- Different vegetation types have different potential to release P



Riparian areas as sources

Freeze-thaw

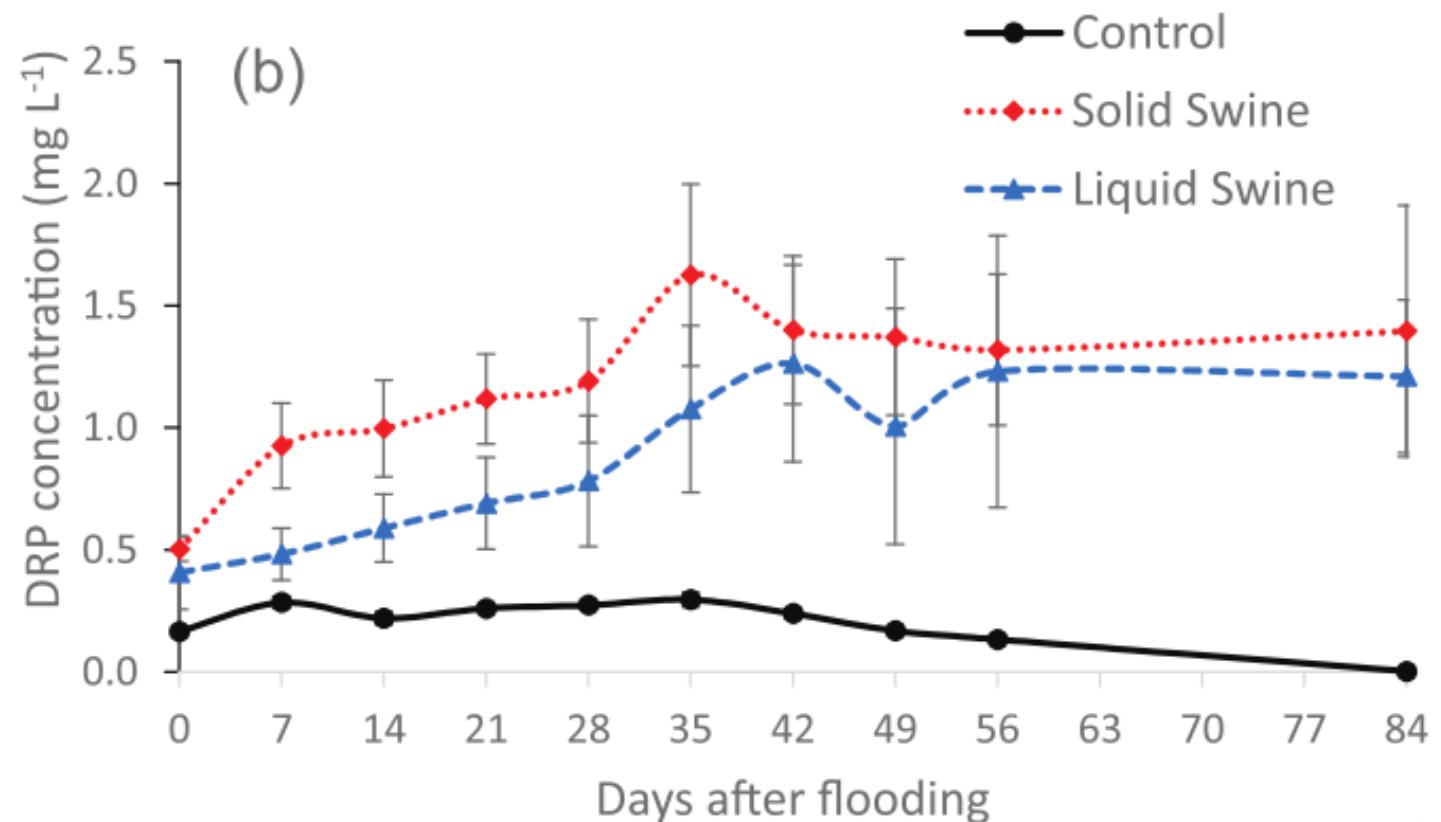
- Many lab experiments use unrealistic temperatures
 - Snow is a good insulator



Riparian areas as sources

Flooding

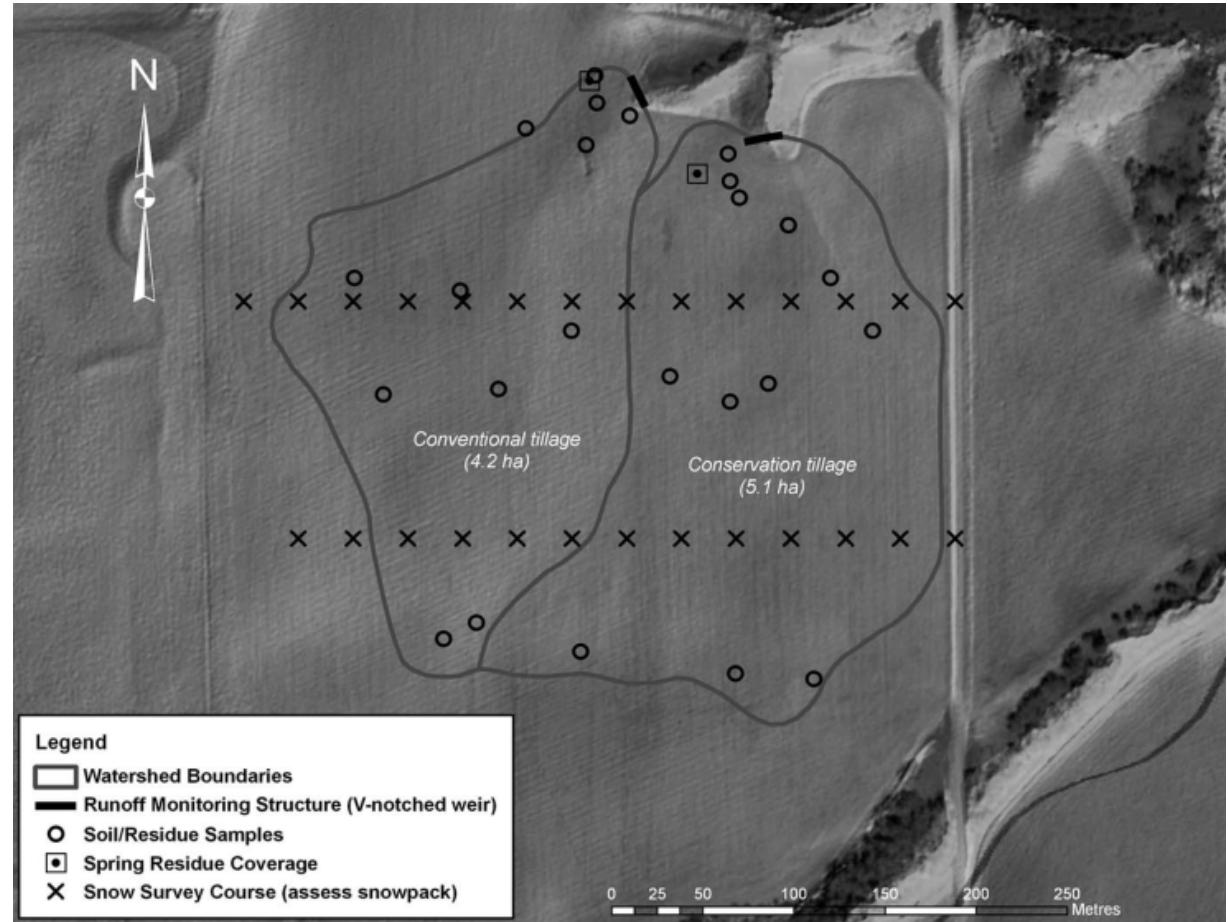
- Prolonged flooding makes the soils anaerobic
 - Can enhance P release from soils



Riparian areas as filters

Riparian areas are the LAST line of defense

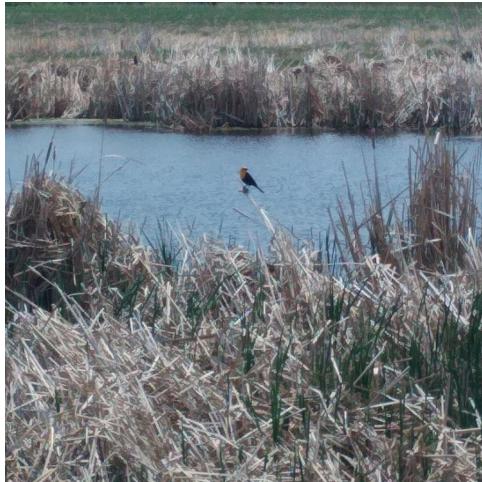
- Manage soils and crops to reduce the runoff and nutrients leaving agricultural land
 - Conservation tillage can increase dissolved P losses



Riparian areas as filters and sources

Riparian areas are the LAST line of defence

- Manage soils and vegetation in the riparian area
 - Harvest as a removal mechanism
 - Terrain can be difficult for equipment
- Riparian areas are more than just filters
 - Habitat, stream stabilization etc.



Managing riparian areas

Cattle grazing

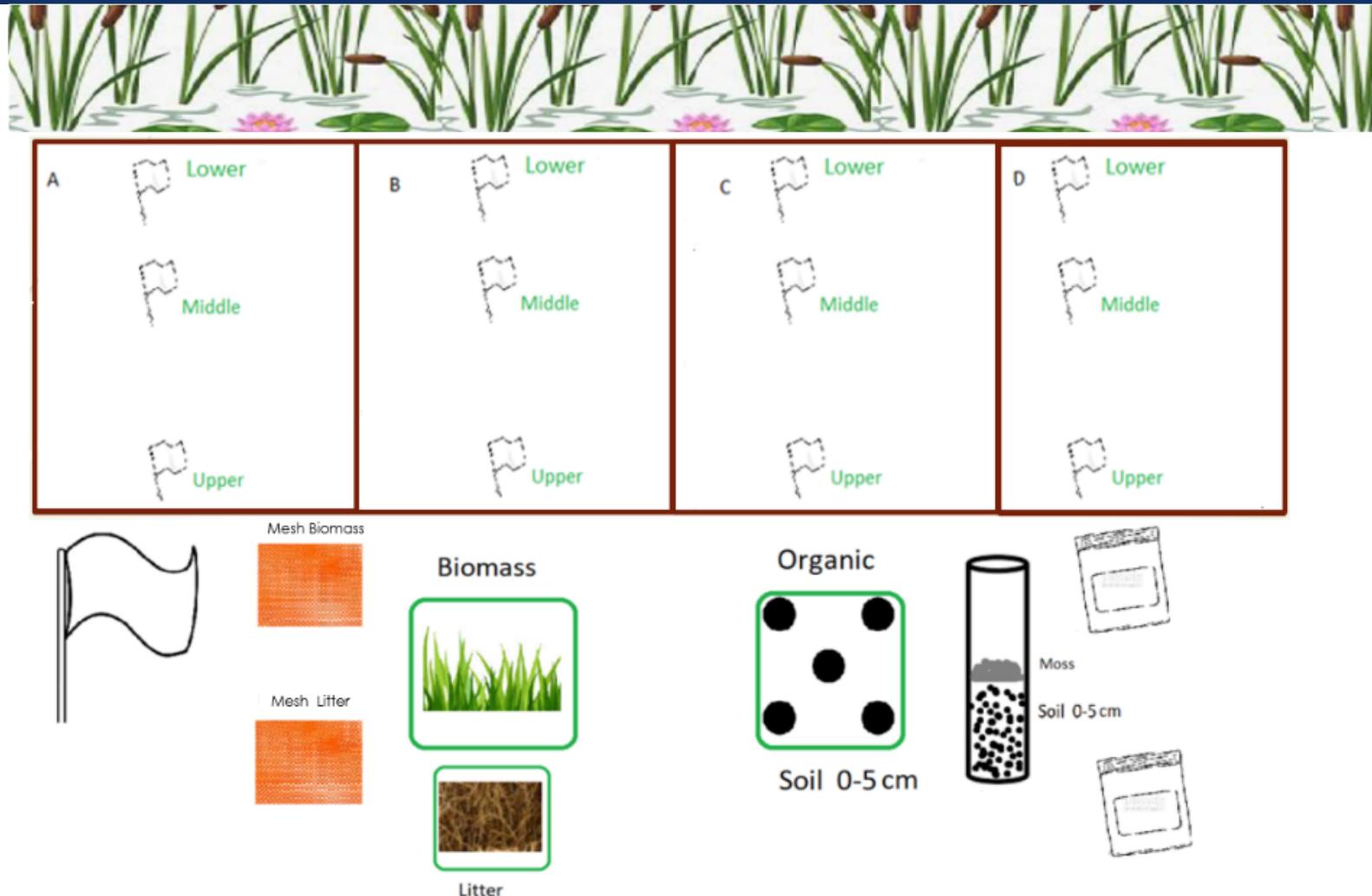
- Fall grazing
 - Drier soils (less compaction)
 - Limit disturbance to active nests
 - Extending the gazing season
 - Remove vegetation prior to winter



Managing riparian areas

Cattle grazing

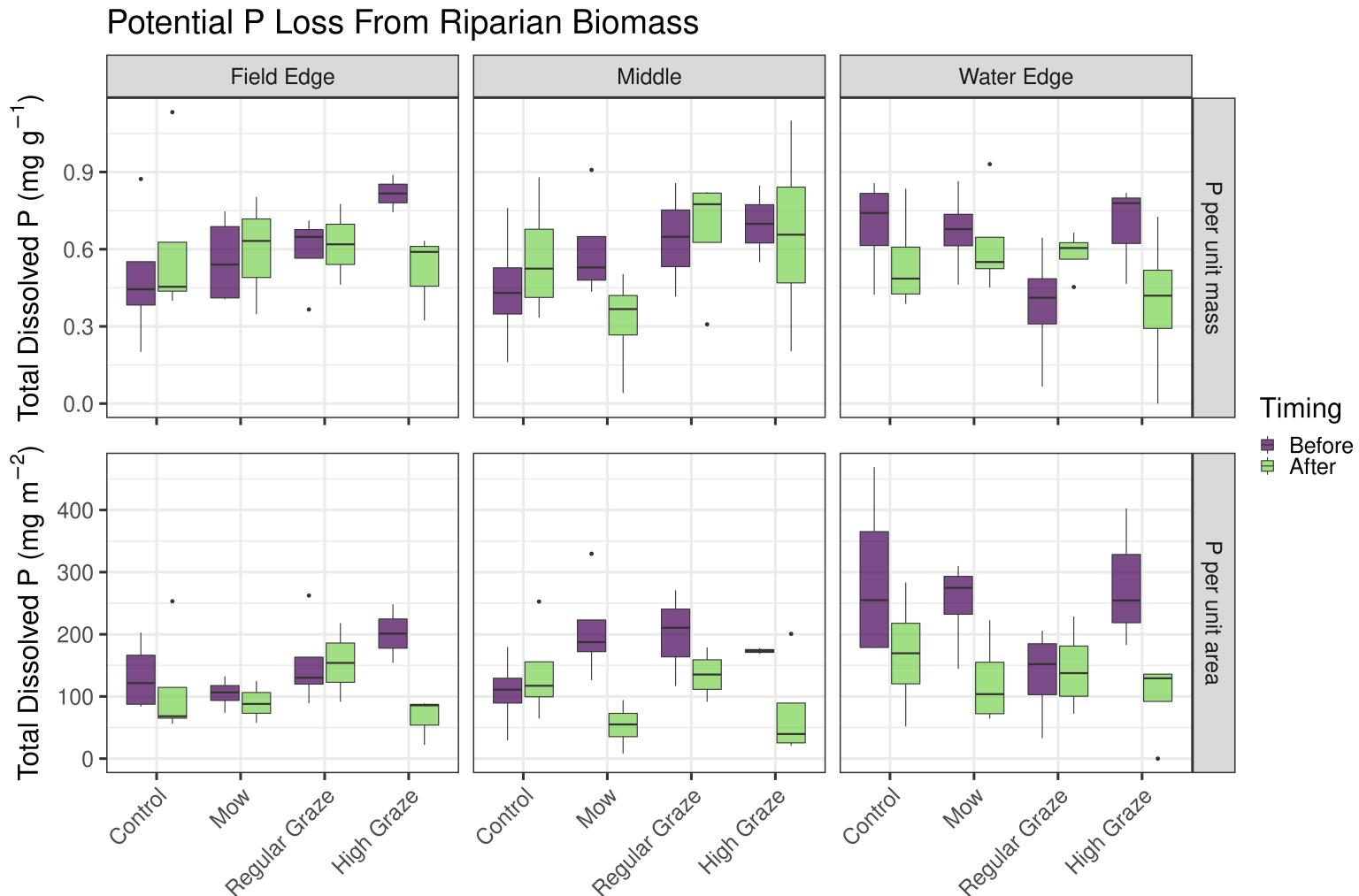
- 4 treatments
 - Control (do nothing)
 - Regular graze
 - High graze
 - Mow
- Distribution of P
 - Biomass
 - Litter
 - O horizon
 - Mineral soil



Managing riparian areas

Cattle grazing

- Preliminary results



Whats next?

Challenges and opportunities

- Addressing water quality and quantity before it gets to the riparian area
 - Remember riparian areas are the last line of defense
 - Practices that promote efficient use of water and nutrients should remain a priority

Easier said than done!

- Management practices to address one issue may have unintended consequences

Whats next?

Challenges and opportunities

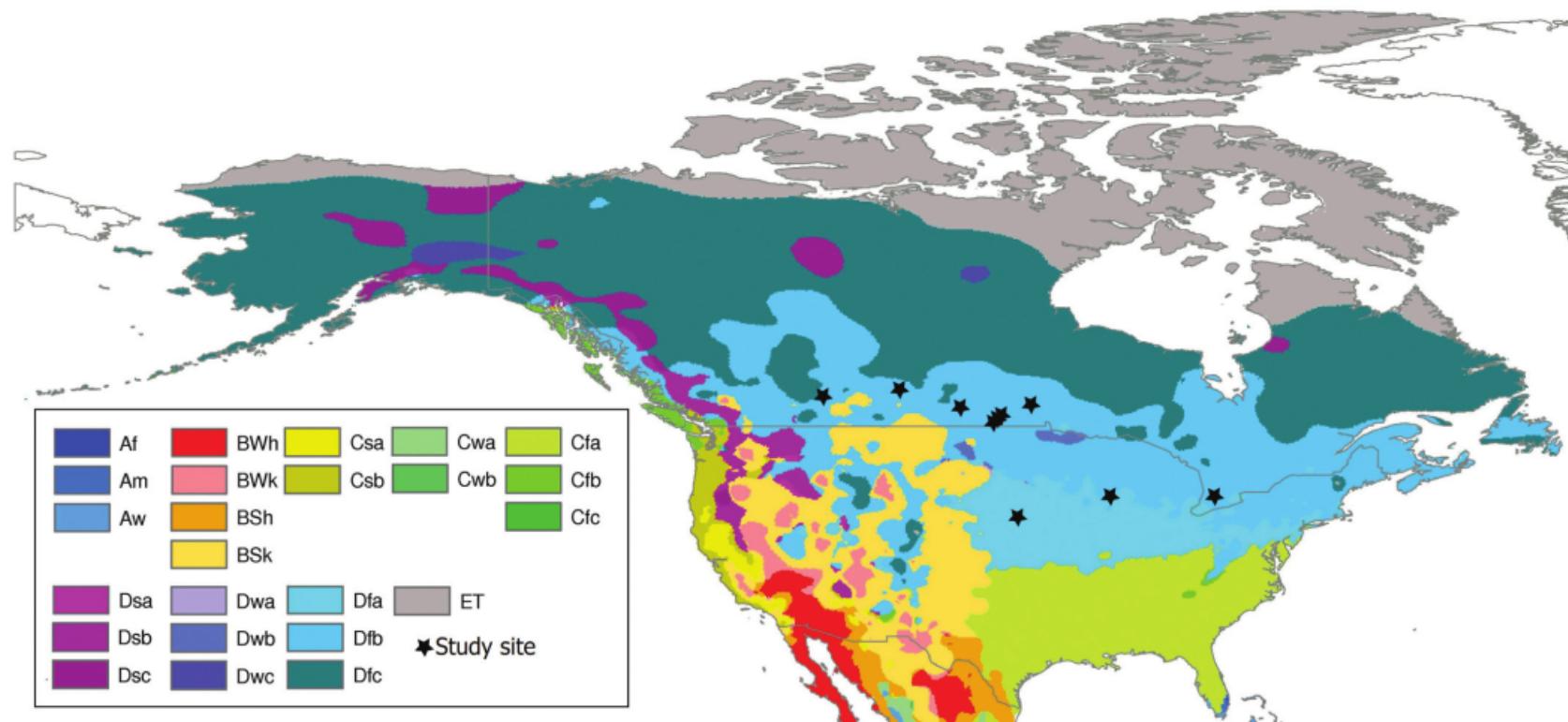
- The concepts of healthy soils and crops should be extended beyond the fence line
 - Farm doesn't end at the field edge
 - Need to balance other riparian functions



Whats next?

Challenges and opportunities

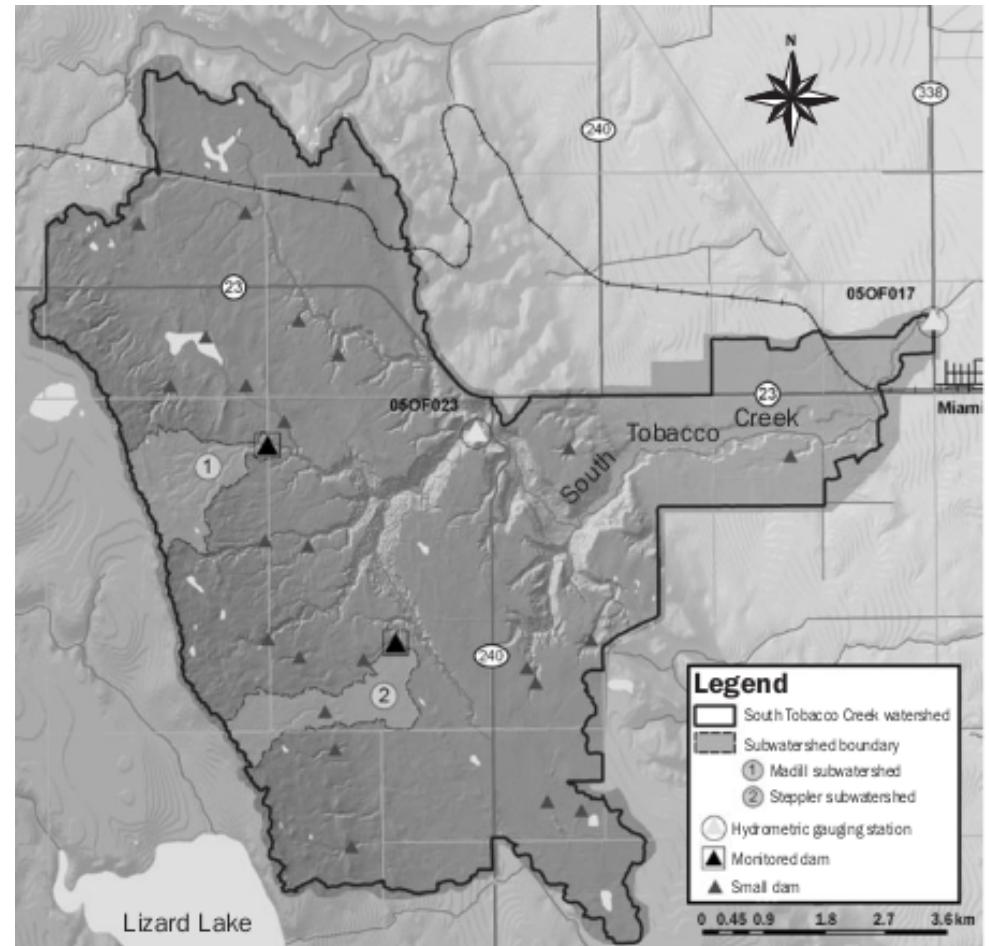
- Need home-grown cold-climate research to support decision making



Whats next?

Challenges and opportunities

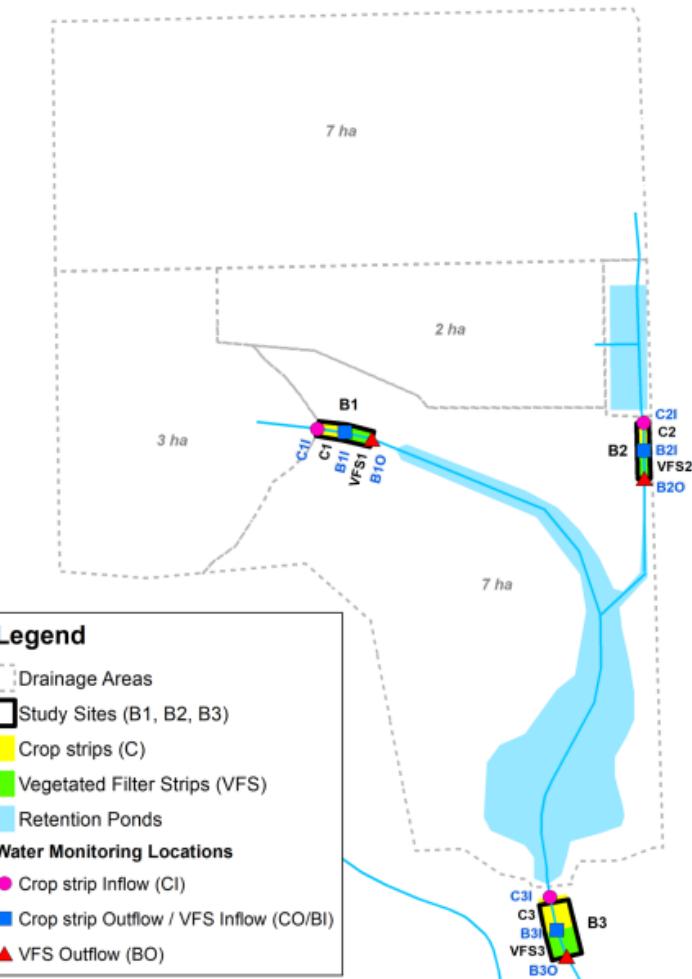
- Cold climate and snowmelt driven hydrology in the prairies means we can't completely depend on riparian areas to improve water quality
 - Other management options should be explored



Whats next?

Challenges and opportunities

- Cold climate and snowmelt driven hydrology in the prairies means we can't completely depend on riparian areas to improve water quality
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Whats next?

Challenges and opportunities

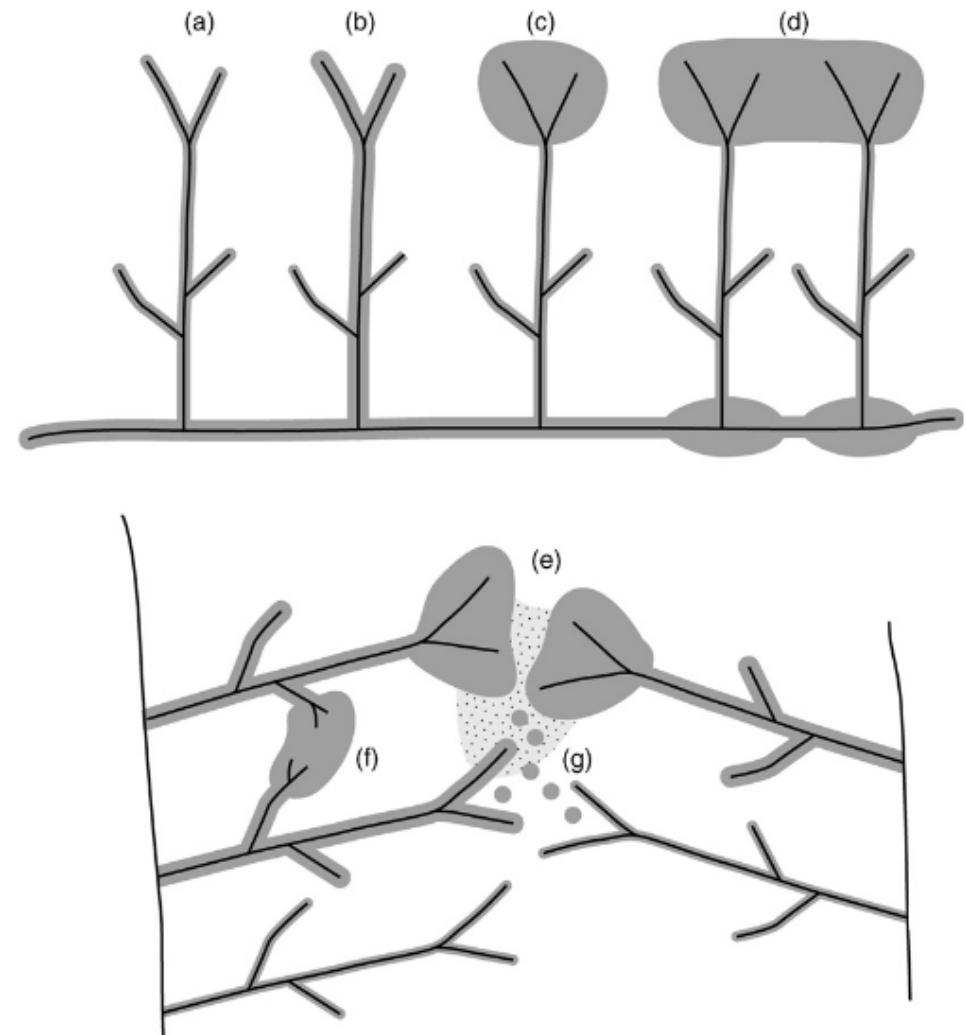
- Increases in the frequency of severe weather and flooding
 - Are riparian areas designed and maintained to accommodate this?
 - This is when we need riparian areas the most!



Whats next?

Creative designs will likely take a team

- Producers
- Indigenous leaders and community
- Engineers
- Hydrologists
- Biogeochemists
- Pedologists
- Biologists
- Ecologists
- Economists



Whats next?

Challenges and opportunities

- If you have had good success, or challenges, with building, maintaining, and using riparian areas please come and chat with me
- It's a great way for me to:
 - Learn what others are doing (no need to reinvent the wheel, or make the same mistakes)
 - Explore the questions and directions research should be addressing
 - Make new collaborations

Take home messages

- Multiple functions
- Cold climate & snowmelt driven hydrology
- Concentrated flow paths
- Part of the farm

Thank you!



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Slides: <https://github.com/alex-koiter/presentations> (PDF)

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