Sphagnum farming initiatives in Canada : an overview

M. Guêné-Nanchen, S. Hugron, C. Brown, M. Strack, J. Price and L. Rochefort

This presentation participates in OSPP

EGU Outstanding Student Poster & PICO Contest

1. What is it?

2. The past

3. The present

4. Vegetation

5. Hydrology

Navigation

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2-minutes madness

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More on the Peatland Ecology Research Group...

Sphagnum farming initiatives in Canada : an overview

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1. What is it ?

Paludiculture

Sphagnum farming = sustainable production of non-decomposed *Sphagnum* fiber biomass on a cyclical and renewable basis on a peatland

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2. The past

Small and large-scale trial

What we have learned

- *Sphagnum* farming is feasible but results are variable
- Better to:
  - Control water irrigation **actively**

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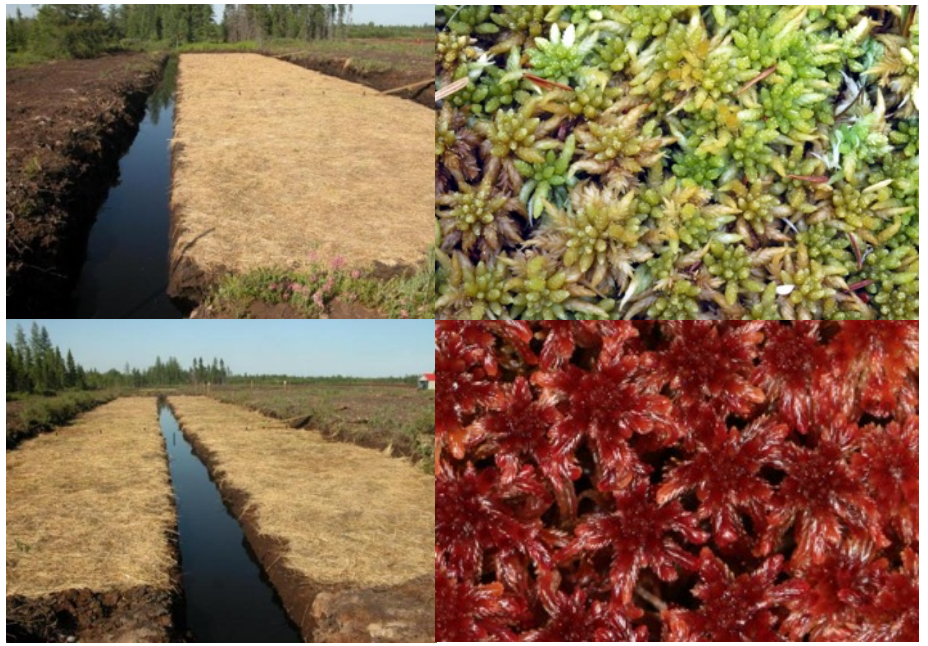
3. The present

2 large-scale stations with **automated irrigation**

- Different basin design
- Different *Sphagnum* species reintroduced
- Different water table targets



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4. Vegetation

- Irrigated basins **are more productive** than unmanaged basins
- Wetter basins **yields 1.5 times more biomass** than drier basins

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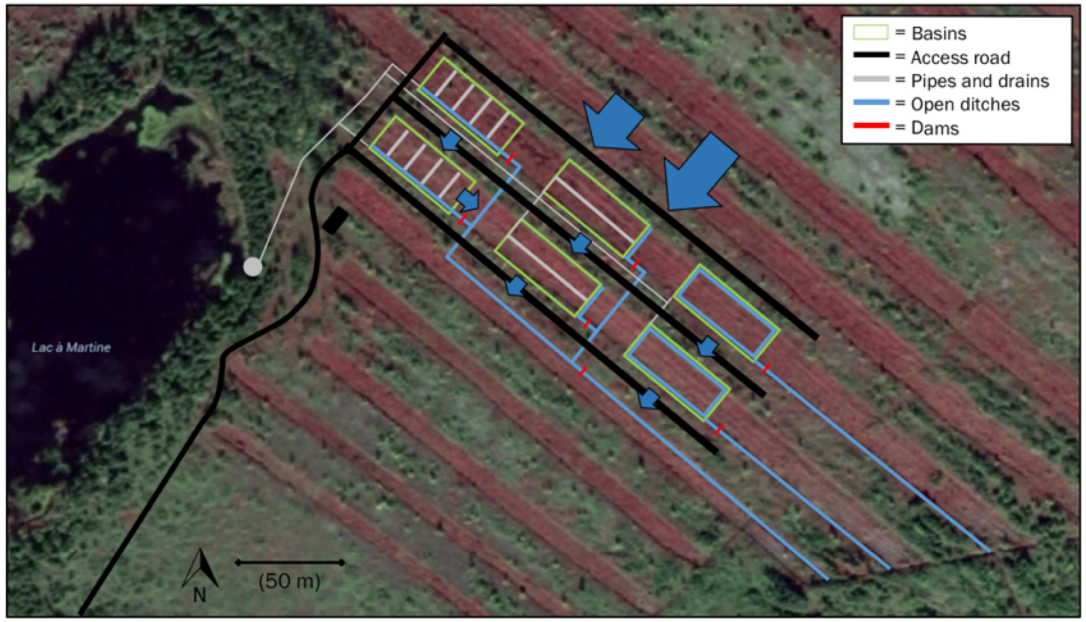
5. Hydrology

- Basin water management design affected by **site scale hydrological processes**
- **Fluctuations in water table** (range) were more important for limiting/ increasing CO_2



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1. What is it?

***Sphagnum* farming** = sustainable production of non-decomposed *Sphagnum* fiber biomass on a cyclical and renewable basis on a peatland

Canada's context

What for?

- Growth substrates
- Packaging
- Specialized products
- Green walls
- Specialized gardening
- Peatland restoration

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2. The past

First small-scale trials (before 2000):

- Better in basins than flat peat fields
- Avoid inundations
- Surface irrigation = No, if water loaded with organic matter

Rochefort and Bastien 1998, Campeau et al. 2004

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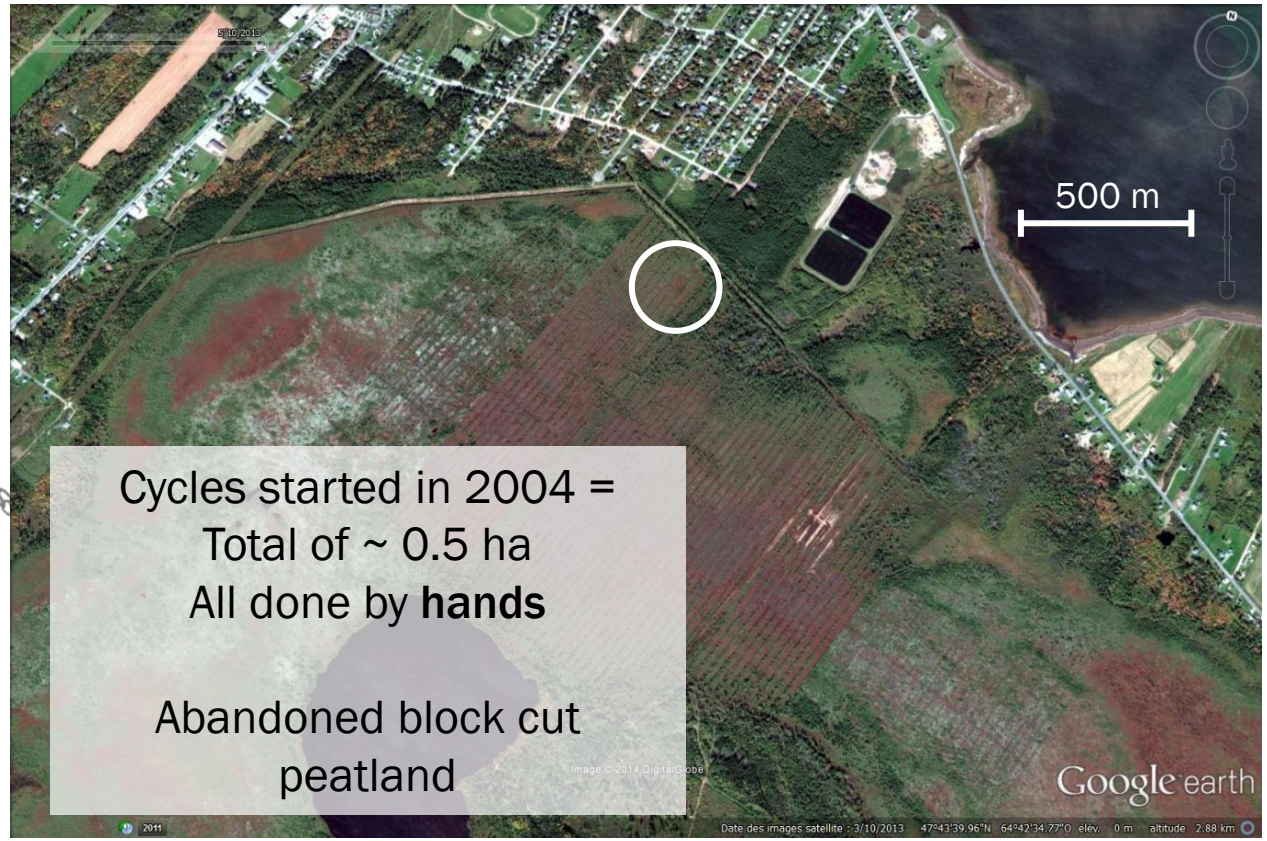

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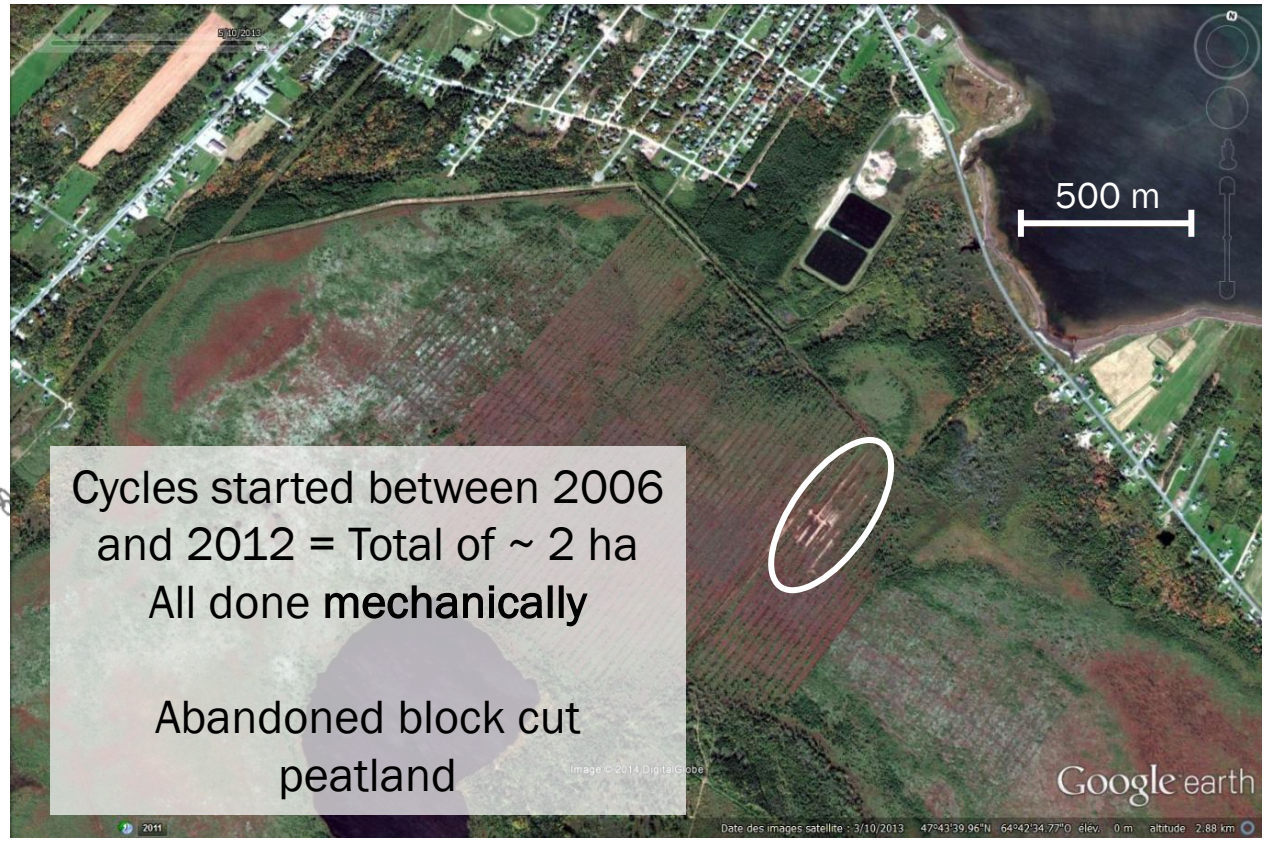

Cycles started between 2006 and 2012 = Total of ~ 2 ha
All done **mechanically**

Abandoned block cut peatland

Navigation

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Mechanized implementation of *Sphagnum* farming

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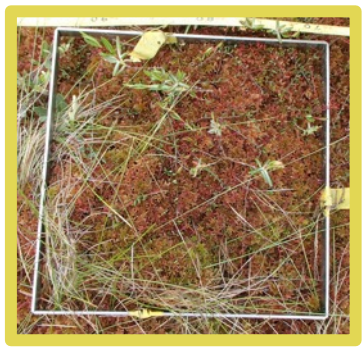
2. The past

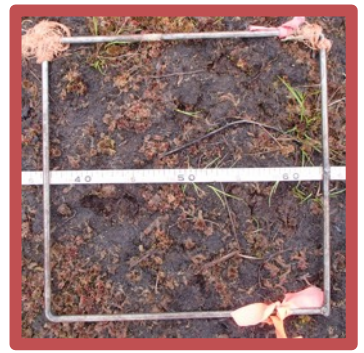
What have we learned?

- *Sphagnum* farming is feasible

After 4 growing seasons

Production cycle	*Sphagnum* biomass per year (tons/ha)	*Sphagnum* cover (%)
2006	0.4	44 ± 6
2008	0.3	34 ± 4
2009	0.04	7 ± 2





- But variability among cycles is high…

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What have we learned?

- Climate of the first growing season critical
- Even distribution of water (topography)
- Minimize water fluctuation during growing season

Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

Sphagnum farming: A long-term study on producing peat moss biomass sustainably

Rémy Pouliot [a,*], Sandrine Hugron [a], Line Rochefort [a]

[a] Peatland Ecology Research Group and Centre d'Études Nordiques, Université Laval, 2425 Rue de l'Agriculture, Quebec City, Québec, G1 V 0A6, Canada

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Pouliot et al 2015, Chirino et al. 2006, Campeau et al. 2004, Price et al. 1998

Sphagnum farming initiatives in Canada: an overview

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What have we learned?

- Mowing dominant vascular plant (*Eriophorum angustifolium*) is **not necessary**
  - If low production of litter
- Mowing does not increase *Sphagnum* **cover** nor **biomass**

Guêné-Nanchen et al. 2017

Navigation

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3. The present

Large-scale trials with automated irrigation

- Quebec
  - 0.3 ha, started in 2013
- New Brunswick
  - 0.6 ha, started in 2014

Navigation

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3. The present

- **Automated** irrigation system →

- **Basin design**
  - Quebec
    - Peripheral and central ditches
  - New Brunswick
    - Peripheral ditches and underground drains

Navigation

- Click buttons for more information
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Navigation

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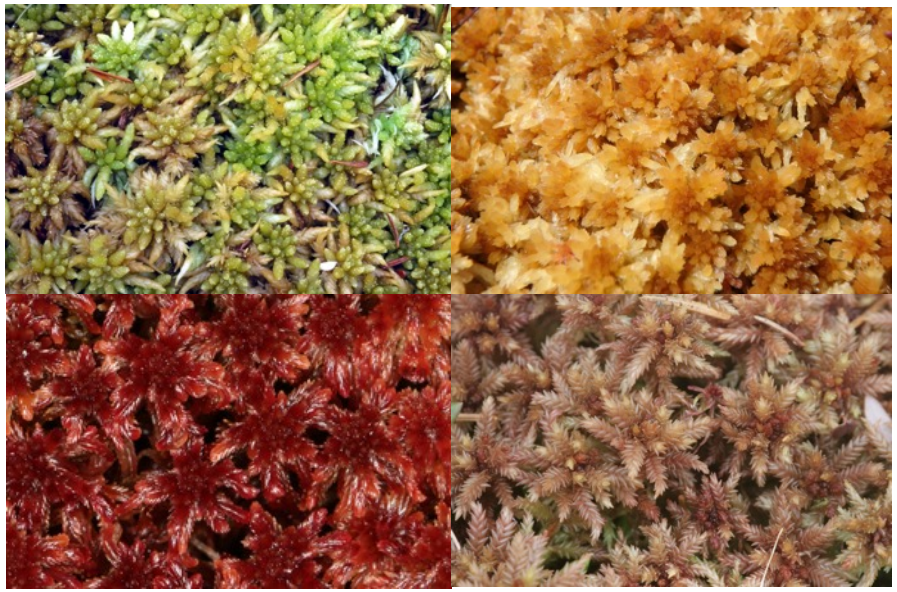
3. The present

Treatments tested

- Vegetation
  - Different *Sphagnum* species reintroduced
- Water targets
  - -10 cm
  - -20 cm



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4. Vegetation

Results

Irrigated basins **are more productive** than unmanaged basins

- **Cover**: 2 to 3 times higher
- **Biomass**: 1.5 to 2 times higher

Same tendencies observed in the two sites

Sphagnum farming initiatives in Canada: an overview

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4. Vegetation

Results

-10 cm target **yields 1.5 times more biomass** than -20 cm target

Same tendencies observed in the two sites

In comparison to the results obtained in Germany

Navigation
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5. Hydrology

Results

- Basin water management design affected by **site scale hydrological processes**

Sphagnum farming initiatives in Canada: an overview

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Results

- CO_2 uptake **was not limited** by either water target treatments
- **Fluctuations in water table** (range) were more important for limiting / increasing CO_2
- Δ15 cm = threshold for increasing productivity

Navigation

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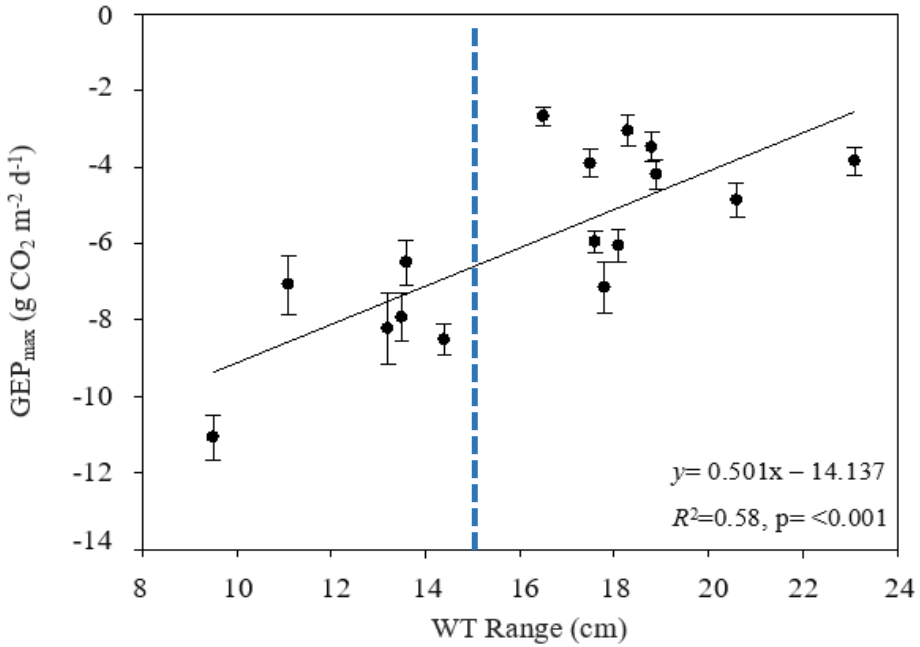

Brown et al. (2017)

Sphagnum farming initiatives in Canada: an overview

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5. Hydrology

To maintain target water table levels:

- **Combination** of underground drains and ditches to increase water distribution, and reduce water table fluctuations
- Use **water table levels in basin**, and not ditches, to monitor when to activate irrigation

Navigation

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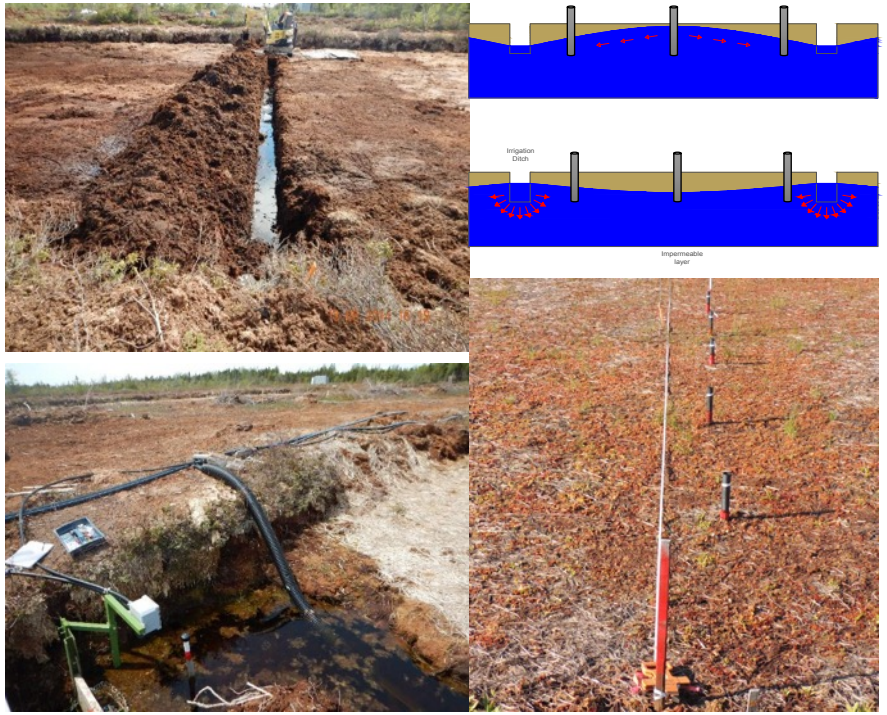

Sphagnum farming initiatives in Canada: an overview

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The future

1. Scale up for better economic assessment
2. Re-design irrigated basins for optimal water budget
3. Initiate new cycles
4. Develop further automatization and remote control of irrigation system

1. What is it?
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More on the Peatland Ecology Research Group...

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References cited →

Acknowledgments

All field/lab assistants who have worked on the experimental *Sphagnum* farms.

Thanks to Canadian peat industry for financially supporting this project within an industrial research chair program from the Natural Sciences and Engineering Research Council

More on the Peatland Ecology Research Group…

The **Peatland Ecology Research Group (PERG)** was formed through the partnership of the university scientific community, the Canadian peat moss industry and federal and provincial agencies. Our common objective is the integrated sustainable management of Canadian peatlands.

The research team is headed by **Dr. Line Rochefort** of Université Laval (Québec, Canada). Since 1992, this research group has lead many projects, dealing with:

- The development of restoration techniques after peat harvesting; → Moss Layer Transfer Technique
- Natural plant recolonization after harvesting;
- Hydrology, geochemistry, microbiology of natural, harvested and restored peatlands;
- Peatland conservation strategies;
- The peatland populations of arthropods, amphibians, birds, and mammals;
- *Sphagnum* ecology and productivity.

NSERC's Industrial Research Chair in Peatland Management

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Groupe de recherche en écologie des tourbières — Peatland Ecology Research Group

www.gret-perg.ulaval.ca

close

Non restored

Restored (15 yrs)

Video of the restoration process

close

Press play

close

Sphagnum carpet after one growing season

close

Passive water management

Dams at the end of each basin

- Open during the snow melt
- Close during the summer

Active water management

Dams at the end of each basin + irrigation ditches or drains

- Level of the dams controllable according to the water level target

close

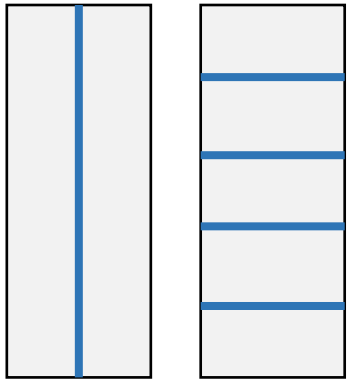
Basin design

Quebec

Peripheral ditches

Central ditch

New Brunswick



Underground drains

Peripheral ditches

close

Treatment tested – species reintroduced

Quebec

S. magellanicum

S. papillosum

S. rubellum

Rotiller harvest (*rubellum* + *Polytrichum strictum*)

New Brunswick

S. flavicomans

S. magellanicum

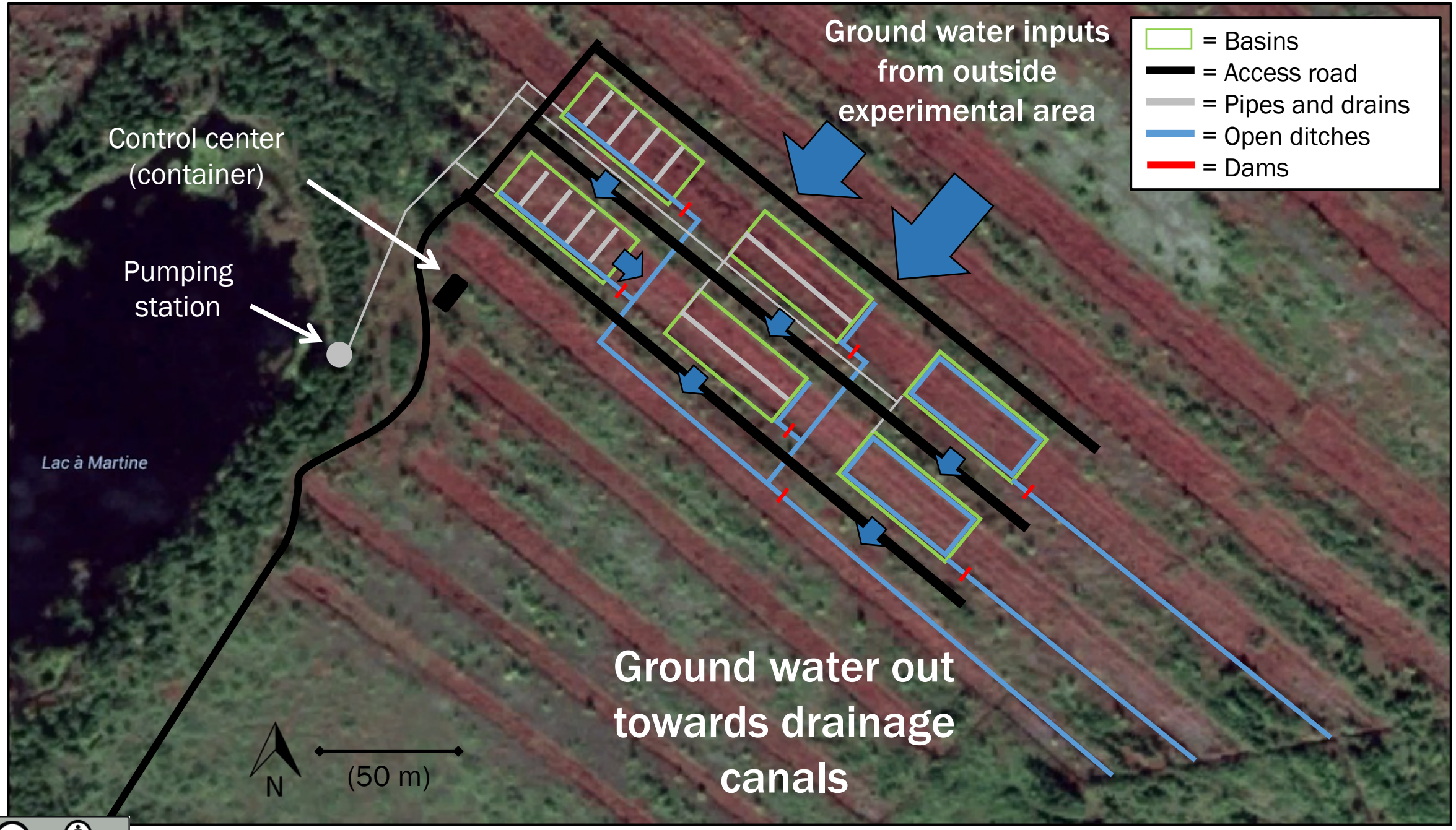
Hand harvest *(fuscum + rubellum)*

close

Water irrigation automated

Water irrigation non-automated

close


Ground water inputs from outside experimental area
= Basins
= Access road
= Pipes and drains
= Open ditches
= Dams
Control center (container)
Pumping station
Lac à Martine
Ground water out towards drainage canals
N
(50 m)

close

Canada's context →

10 m

- **Climate:**
  - 1000 mm/year
  - 6 months winter
  - Hottest month = July (average = 18°C)
- **Landscape:**
  - At or above sea level (0 to 100 m)
  - Block-cut peatland (no compaction)
- **Residual peat:**
  - Thickness = > 50 cm (up to 1.5 – 2.0 m)
  - Acid (pH = 3.6)
  - Low nutrients
  - Von Post = H3 – H4

close

Sphagnum biomass end-uses

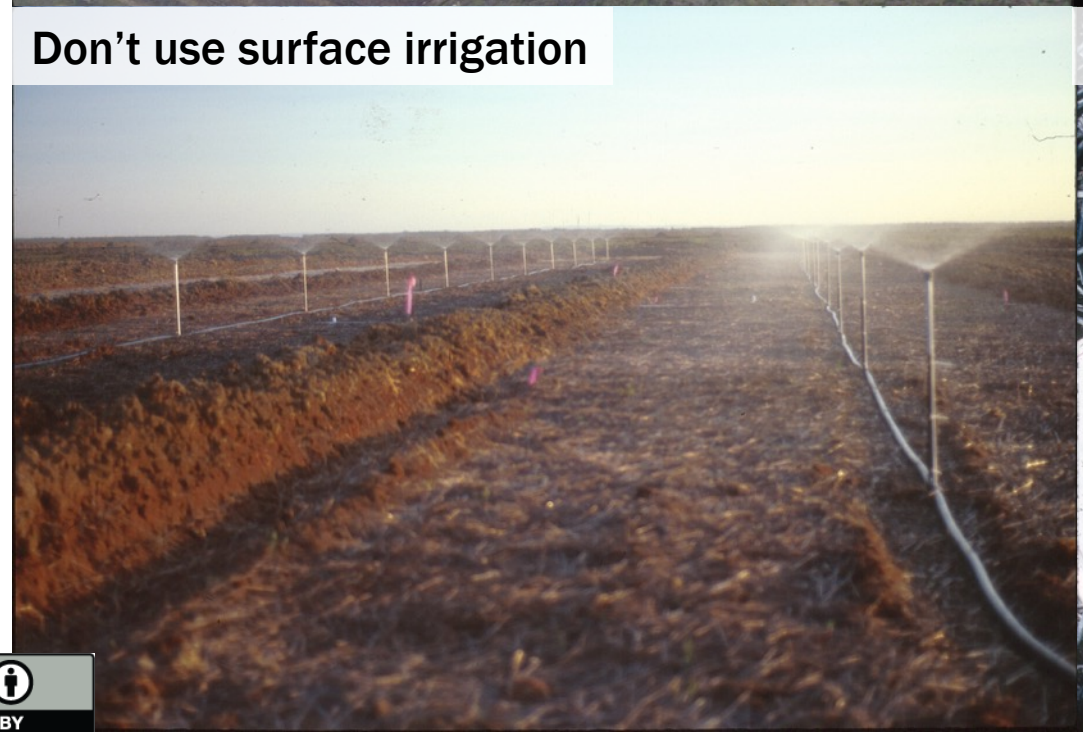
- In growing media
- As floral mosses
- As packing for mailings
- In specialized products
- In green walls
- In specialized gardening
- For peatland restoration

close

Better in basins

But avoid inundations

Don’t use surface irrigation



If water loaded with organic matter

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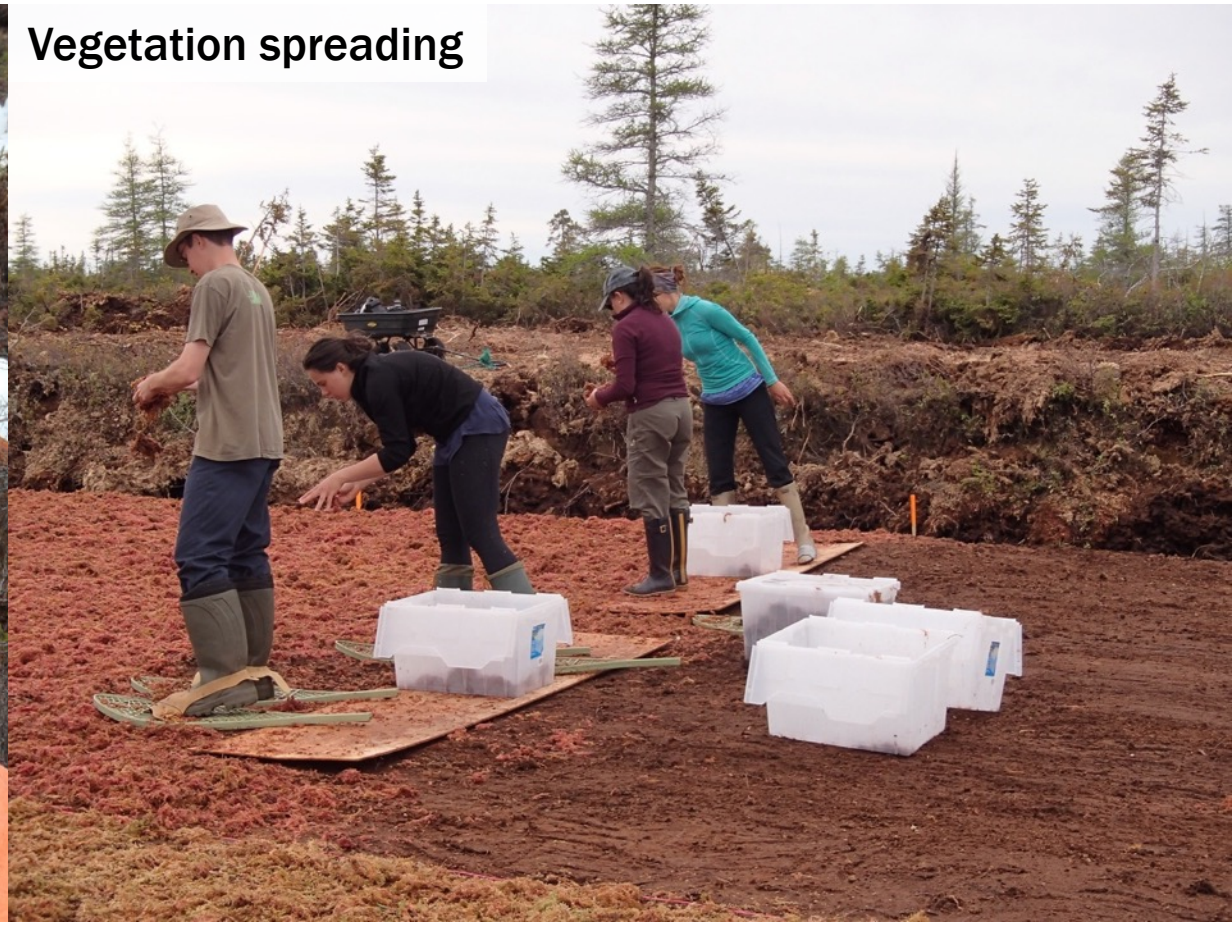
Vegetation harvesting

Vegetation spreading



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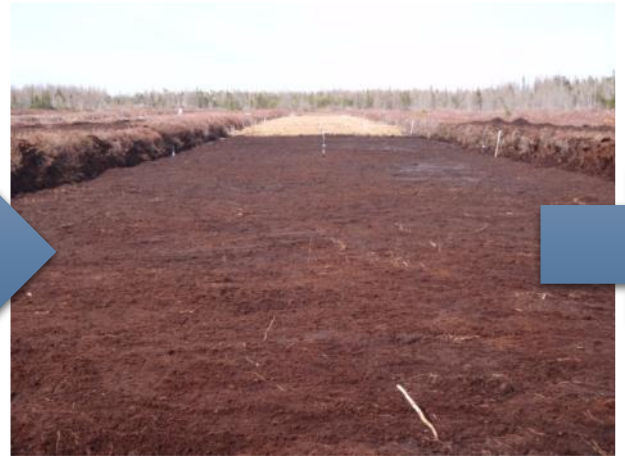
Mechanized implementation of *Sphagnum* farming

Preparation



Trench ready

Ditch

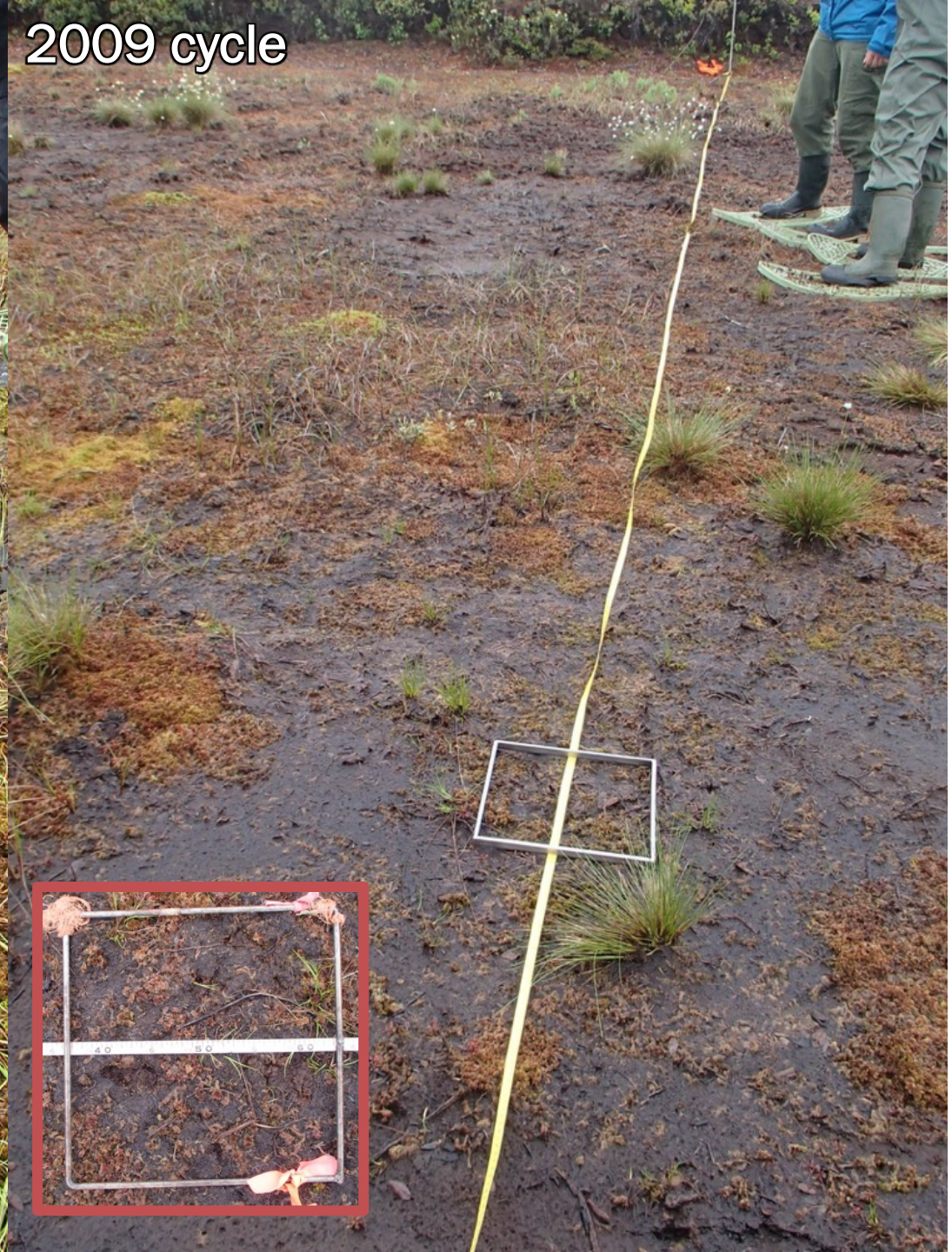
Sphagnum harvesting

Sphagnum spreading

Mulch spreading

Water management

close



close

Site preparation

The surface should be as even as possible to ensure uniform water distribution.

Passive water management

Dams at the end of each basin

- Open during the snow melt
- Close during the summer

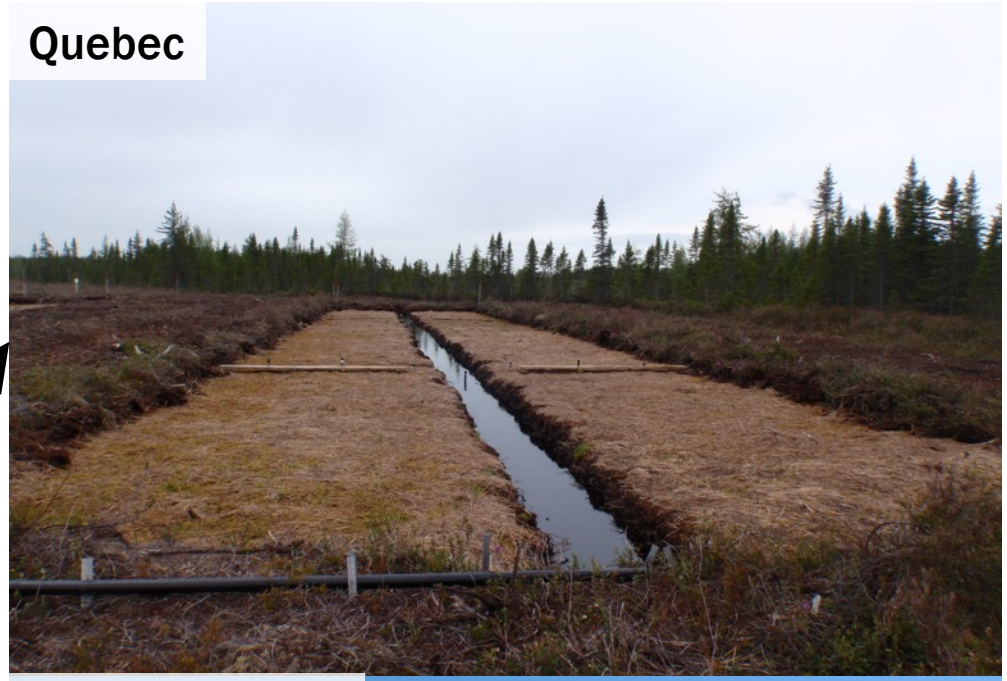
close

Eriophorum angustifolium

Guêné-Nanchen et al. 2017

close

Quebec

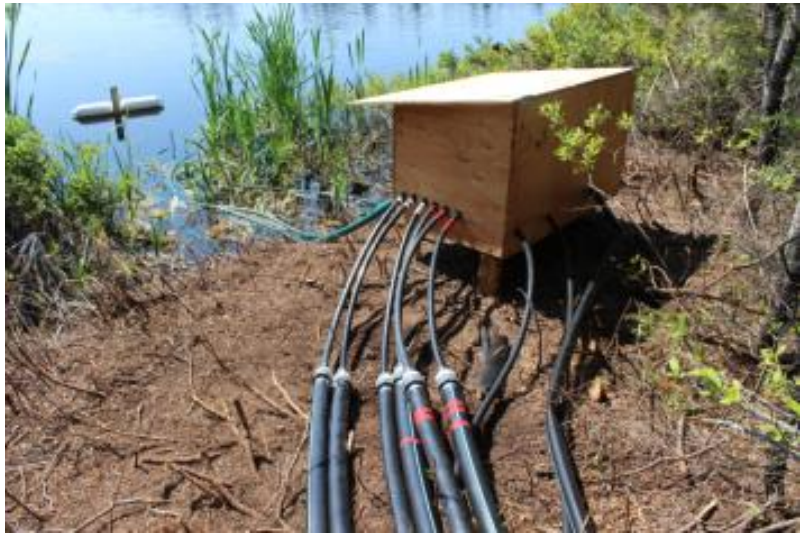


New Brunswick

close

Irrigation system

Quebec



New Brunswick

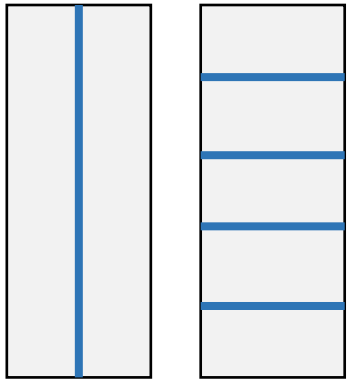
close

Basin design

Quebec

Peripheral ditches

Central ditch



Underground drains

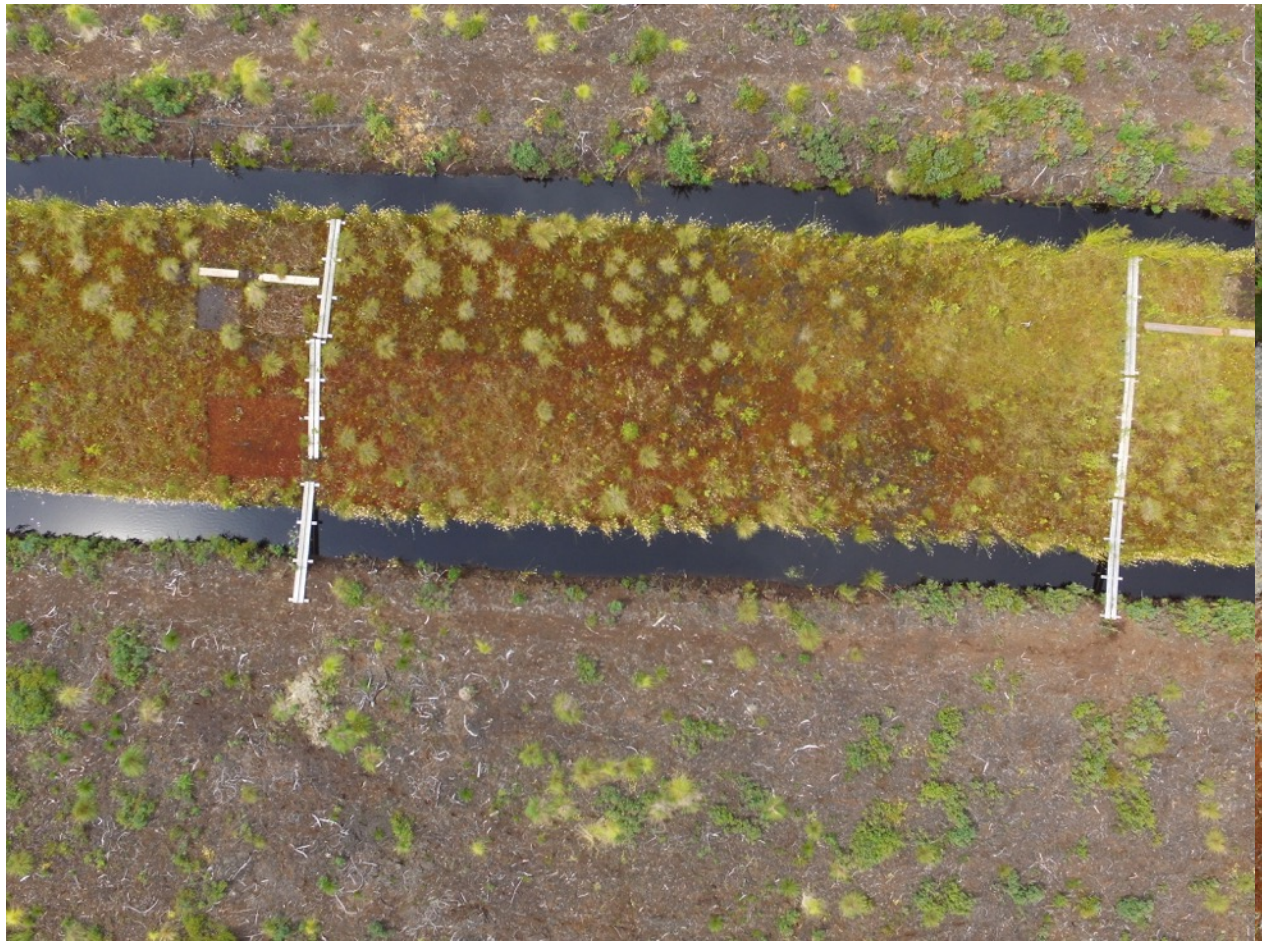
New Brunswick

Peripheral ditches

close

Quebec

New Brunswick



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Rototiller harvest (*rubellum* + *P. strictum*)

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S. flavicomans

S. magellanicum

Hand harvest *(fuscum* + *rubellum)*

close

Water irrigation automated

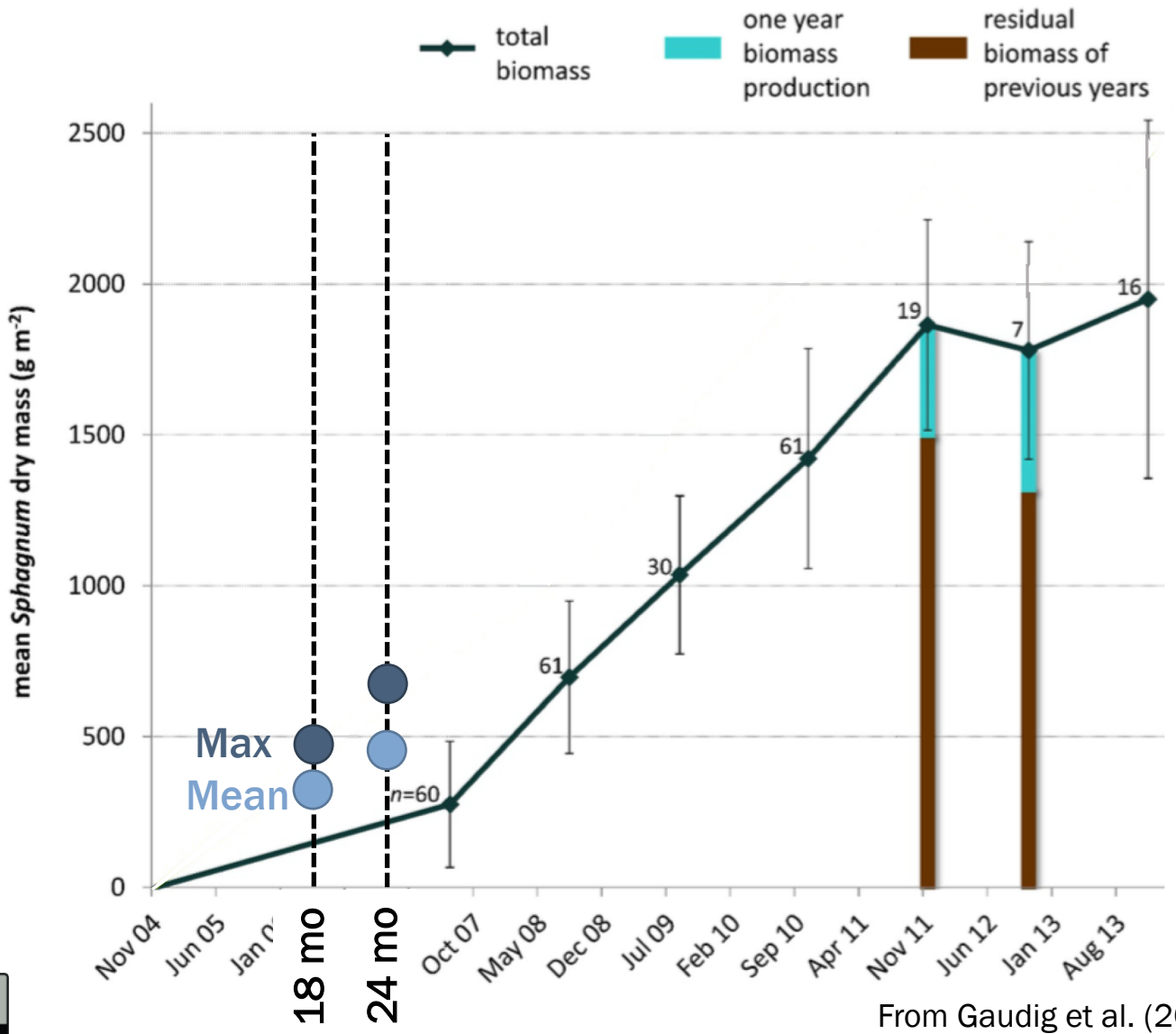
Water irrigation non-automated

close

Sphagnum carpet after 3 growing seasons

close

In comparison to the results obtained in Germany →

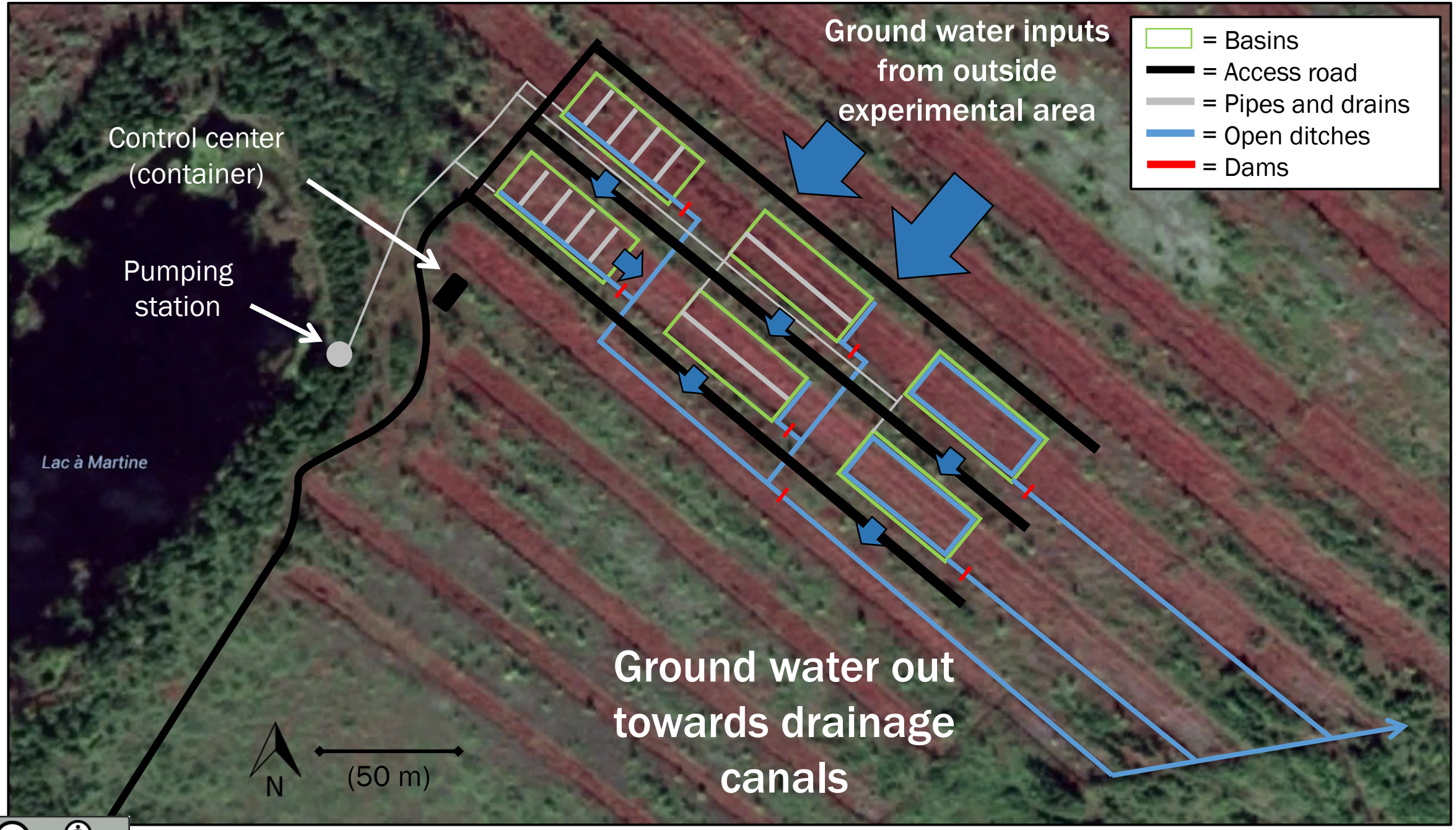


From Gaudig et al. (2017)

Growing seasons are shorter in Canada

No. of months of growing rather than no. of growing seasons

close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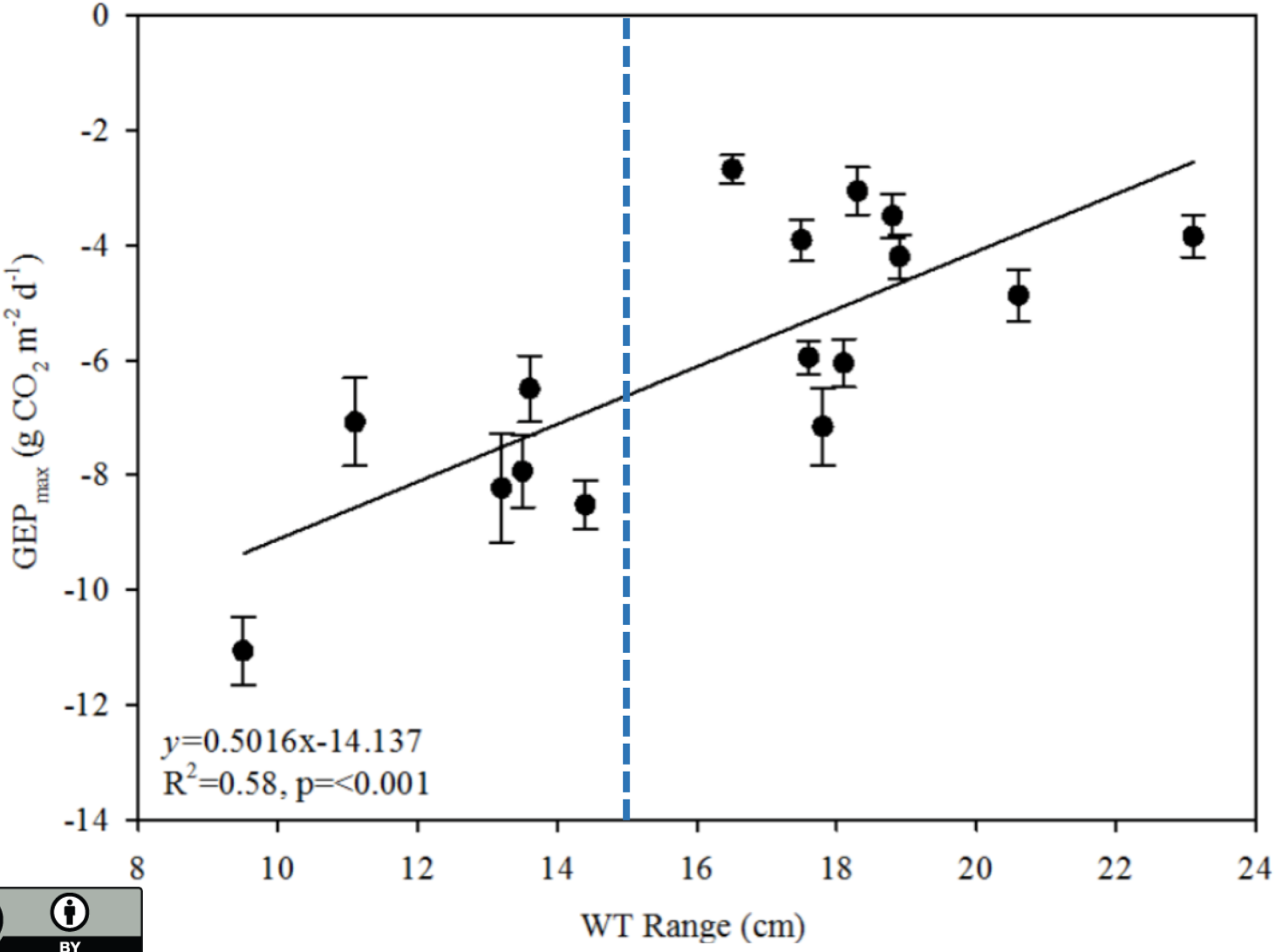
Control center (container)
Pumping station
Lac à Martine
Ground water out towards drainage canals
N
(50 m)

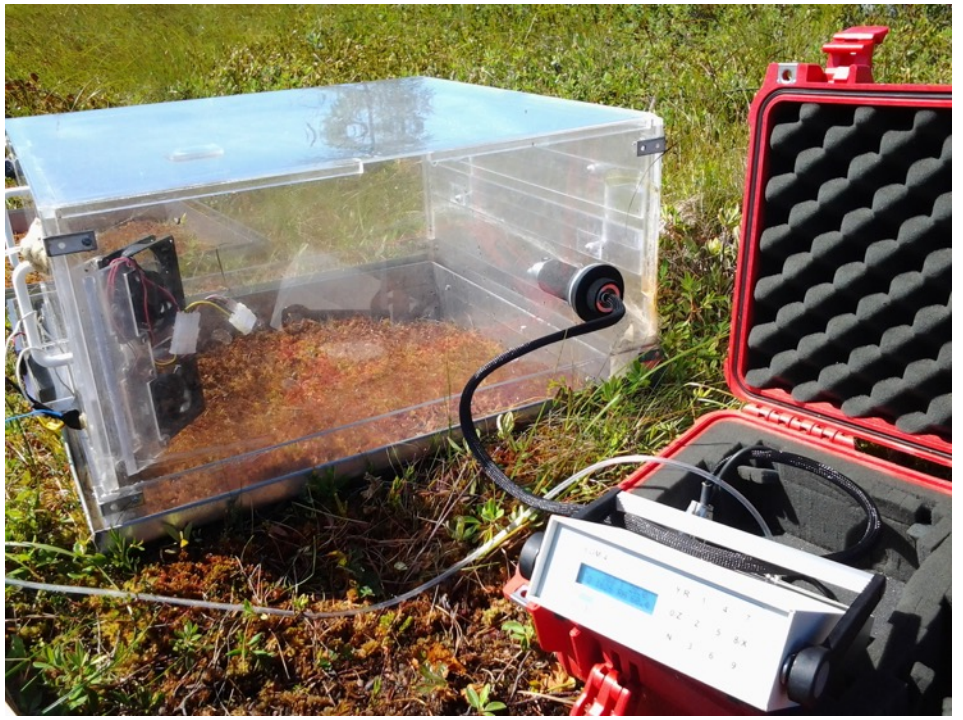
close

The effects of water management on the CO_2 uptake of *Sphagnum* moss in a reclaimed peatland

C.M. Brown, M. Strack and J.S. Price

Department of Geography and Environmental Management, University of Waterloo, Canada



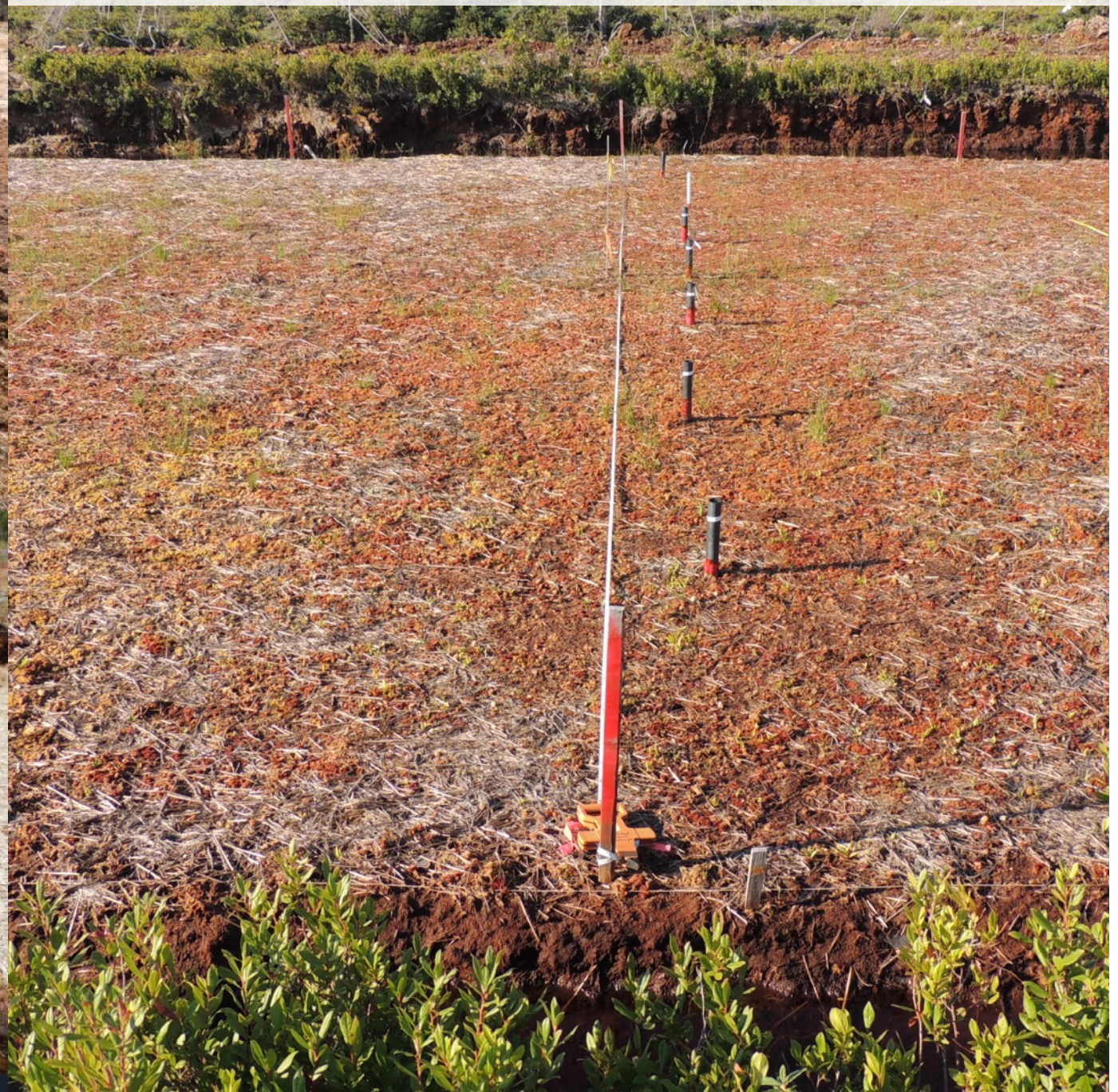


Water table (WT) range = maximum –minimum

For the growing season

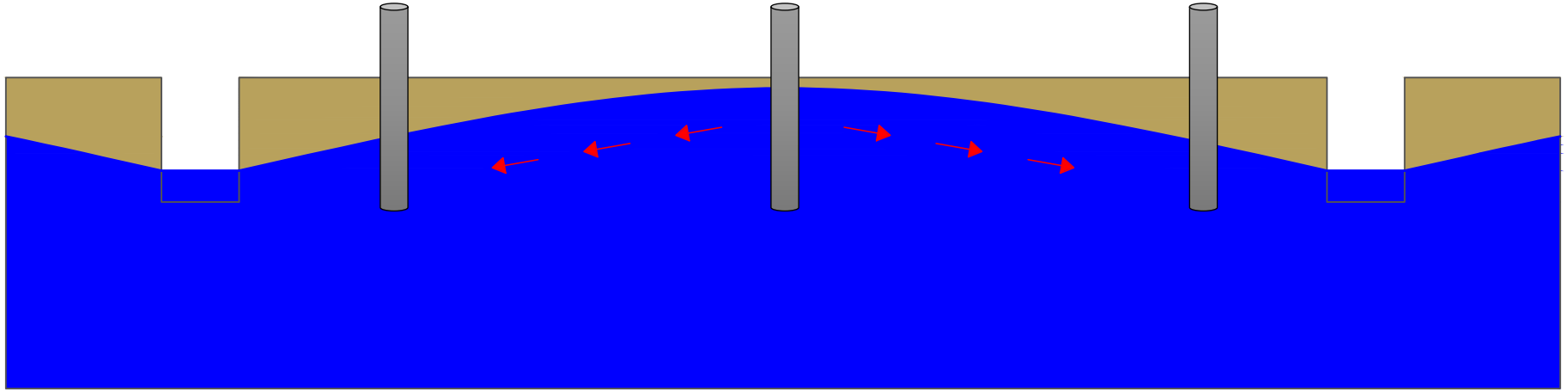
close

Water table level measurement in the basin with wells

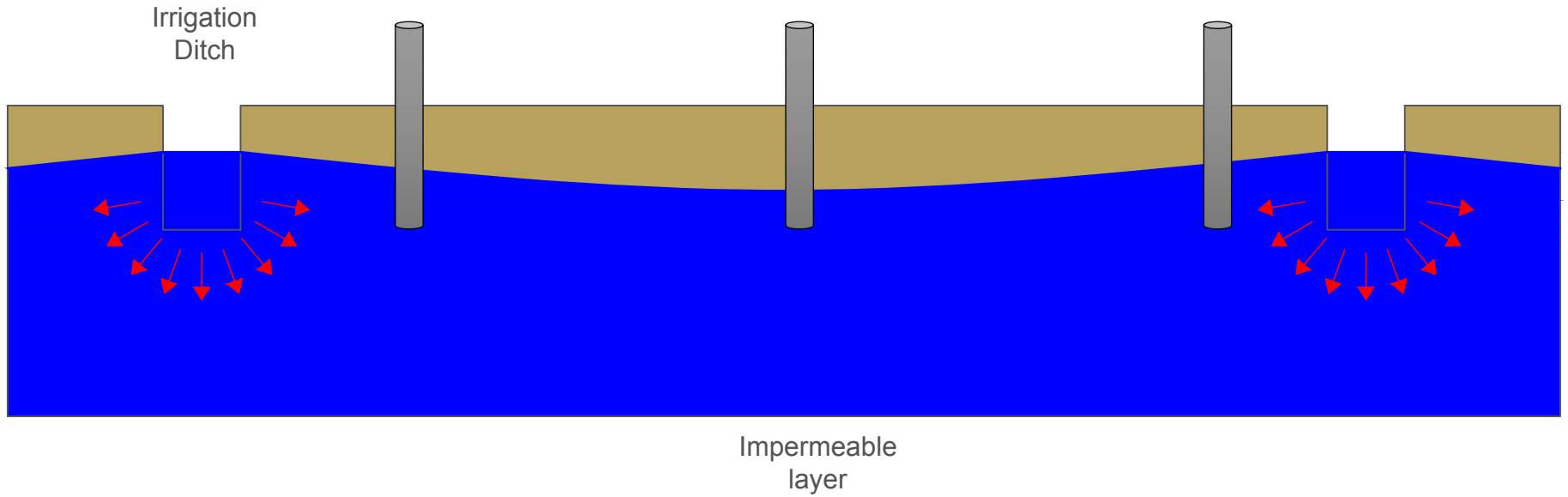


close

Drainage



Irrigation



close

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