Manitoba Soil Science Society Summer Tour

Soils of South-Eastern Manitoba

Thursday Aug 08, 2024

1 Itinerary

1. **Pick-up** 8:00am
   - Sobeys Kenaston - 1660 Kenaston Blvd, Winnipeg, MB. Please park in NE portion of the parking as indicated in the map below (Figure 1).
2. **SunGro Horticulture** 9:30 - 11:45
   - Peat extraction/harvesting
   - Environmental monitoring and mitigation measures
   - Fen restoration and reclamation
   - Organic Soil pit with pedology lesson
3. **Lunch** 12:00-1:00
   - Rivers Edge Resort
   - Catered by The Spicy Radish
   - Guest speaker: Lee Fedorchuk, Lead – Peatlands Program Forestry & Peatlands Branch
4. **OK Farms** 1:15-3:30
   - Egg production and feed mill
   - Grain and oilseed farm
   - Soil and manure management
   - Luvisol Soil pit with pedology lesson
5. **Drop-off** 5:00
   - Sobeys Kenaston - 1660 Kenaston Blvd, Winnipeg, MB

Figure 1: Bus pick-up and parking location. 1660 Kenaston Blvd, Winnipeg, MB

Thank you, from the MSSS Executive Committee!

Inoka Amarakoon, Henrique Da Ros Carvalho, Alexander Koiter, Lindsey Andronak, Megan Westphal, and Ehsan Chatraei

Many thanks to guides and instructors!

Tim North (Sungro), Andrew Toews (OK Farms), Megan Westphal (MB Agriculture), Gladys Mumbi, and Collins Chilaka (Brandon University)

Thank you to our sponsers!

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2 Tour Map

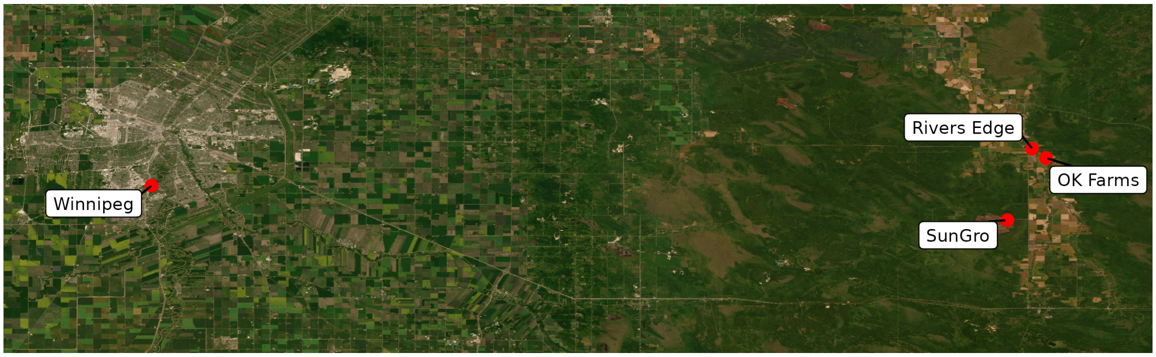


Figure 2: Overview of the tour stops in southeastern Manitoba. Maps made from Esri Imagery.

3 Regional Climate and Soil Information

3.1 Regional Climate and Weather

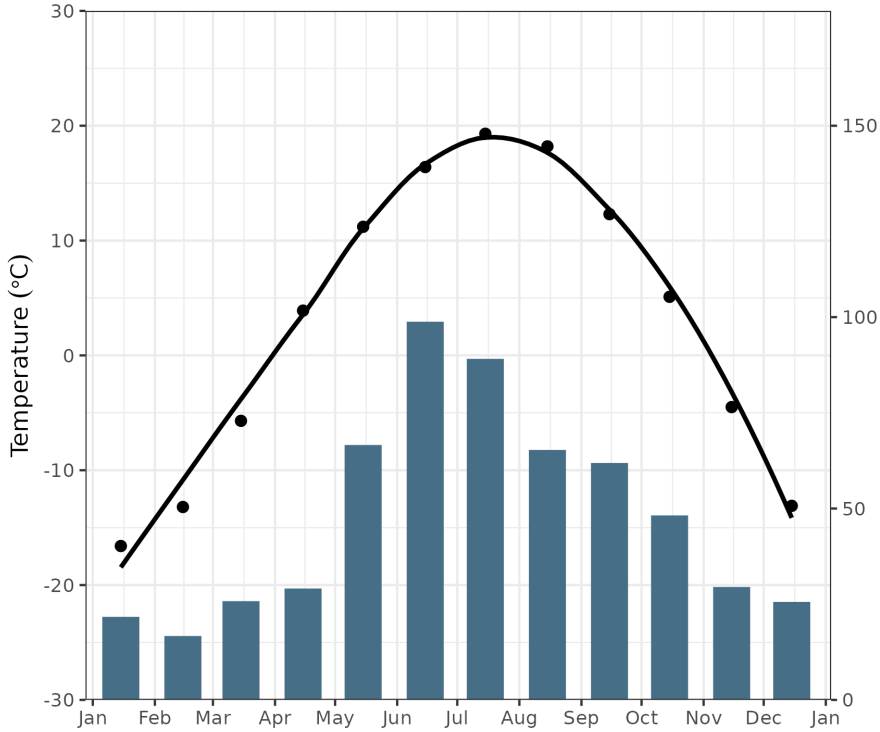


Figure 3: 1981-2010 climate normals for Pinawa MB. Data from https://climate.weather.gc.ca/climate_normals.

Parameter	Winnipeg	Pinawa
Annual total precipitation (mm)	521.1	578.3
Snowfall (snow melt equivalent)(mm)	113.7	113.9
Growing season precip (May – August)(mm)	303.2	319.8
Average annual temperature (℃)	3.0	2.8
GDD (base 5℃)	1820.7	1744.0
Average last spring frost	May 23	May 27
Average first fall frost	Sept 22	Sept 19
Frost free days	121	113

Table 1: Overview of climate for Winnipeg and Pinawa MB

3.2 Soil Chraracteristics

Additional soil and terrain information for the RM of Whitemouth can be found at https://publications.gc.ca/collections/collection_2018/aac-aafc/A58-2-99-24-eng.pdf

3.2.1 Soil Texture

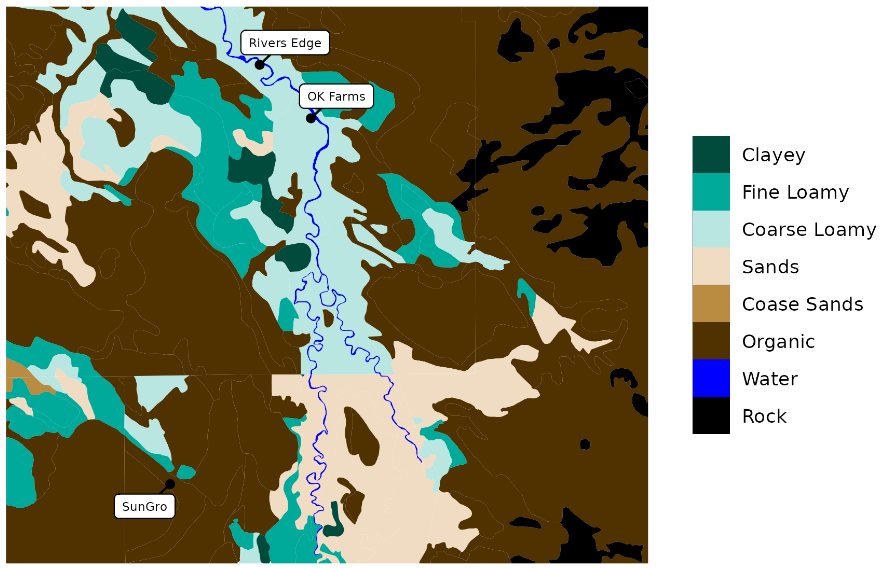


Figure 4: Surface soil texture groups for the tour area

3.2.2 Drainage Class

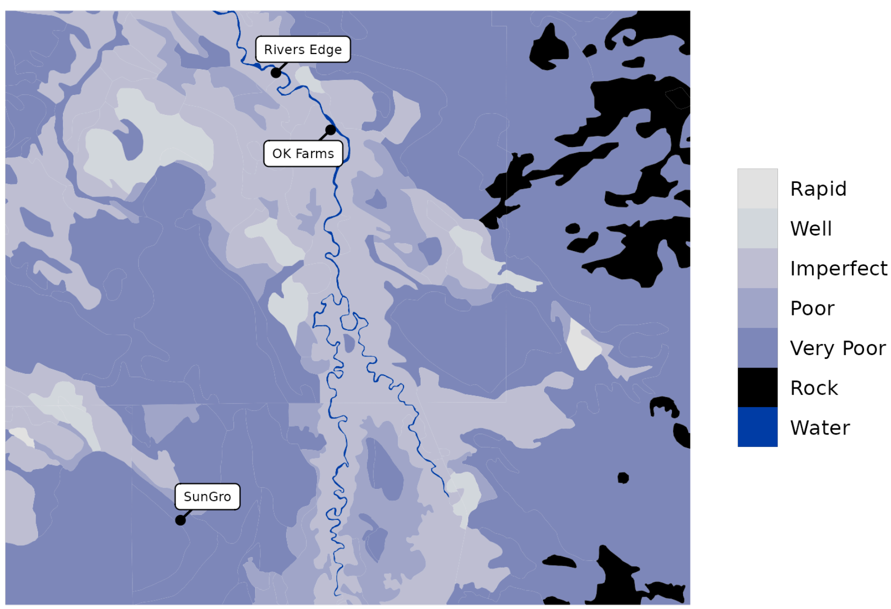


Figure 5: Soil drainage classes for the tour area

3.2.3 Soil Salinity

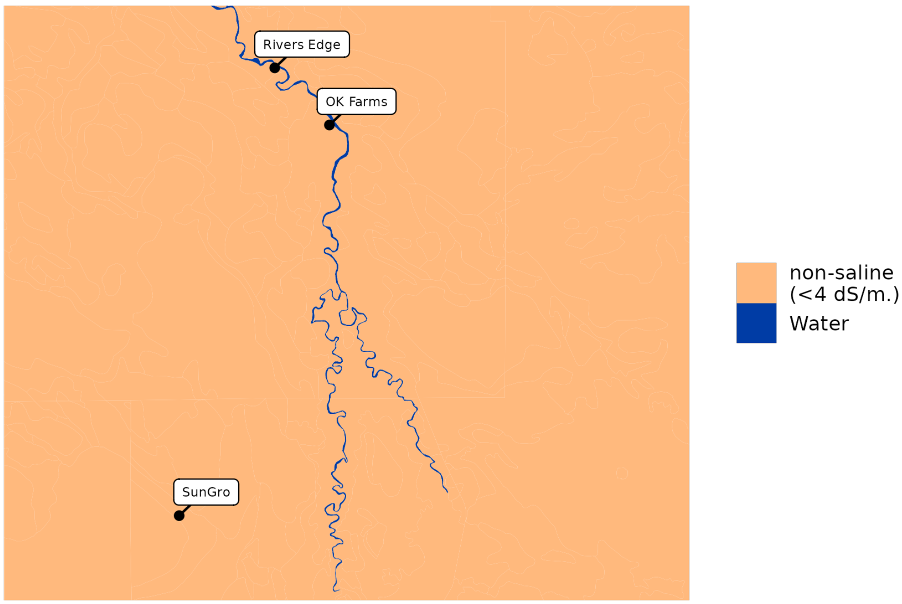


Figure 6: Soil salinity classes for the tour area

3.2.4 Agriculture Capability

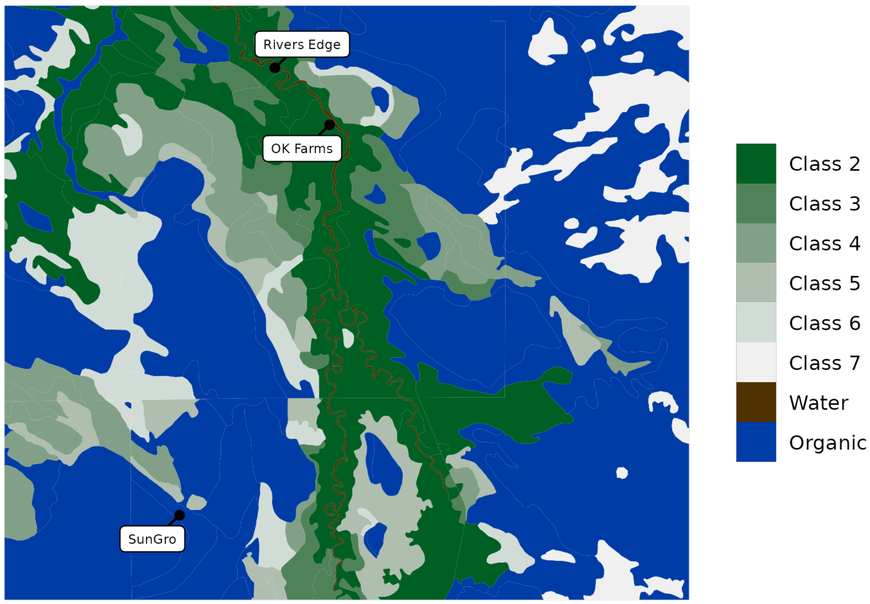


Figure 7: Agriculture capability for dryland agriculture. Class 1 = Most capable; Class 7 = Least capable.

3.3 Whitemouth River Watershed Natural Area

Below is a description of the Whitemouth River Watershed reproduced from Nature Conservancy Canada (www.natureconservancy.ca).

The Whitemouth River Watershed (WRW) represents a hot spot for species diversity in Manitoba. This landscape is the meeting place of the boreal coniferous forest, the eastern Superior mixed forest and vast peatland complexes. Peatlands store more carbon per unit area than any other terrestrial ecosystem on Earth and, along with other wetland types, extends across almost half of the WRW. Carbon accumulation occurs in organic matter that has built up as peat over thousands of years.

The Whitemouth and Birch rivers wind their way, generally north, through the natural area towards their confluence with the Winnipeg River. Large peatland expanses dominate the southern portion of the watershed and seepage slopes along the Whitemouth River "valley" in the northern portion. Bands of rich riparian gallery forest occur immediately adjacent to the Whitemouth, Birch and Boggy rivers and Whitemouth Lake. Mixed deciduous and upland coniferous forest occurs on better-drained soils. The largely flat landscape typical of land formed under the influence of glacial Lake Agassiz is punctuated by bedrock outcrops of the Canadian Shield in the northeastern part of the Natural Area and by a series of sandy and gravelly morainal and beach deposits along the western side.

Gray wolf and the globally uncommon mottled duskywing still roam the natural area's large blocks of relatively intact forest. The rivers of the WRW are characterized by a fauna that is unique among Canadian rivers and support one of Canada's only populations of the threatened carmine shiner. Hardwood-dominated eastern deciduous floodplain forests extend over a small portion of the landscape but support a unique species assemblage, including several provincially rare species more typical of eastern North America (e.g., Bloodroot and Dutchman's Breeches).

Figure 8: Boreal forest marsh, Whitemouth, Manitoba (Photo by NCC)

4 SunGro Tour Stop

4.1 Objectives

1. Understand the formation of the peatland complexes in south-eastern MB
2. Overview of the peat harvesting operations at Elma MB
3. Overview of the environmental monitoring and mitigation
4. Learn about current projects
5. Organic soil pedology lesson

4.2 Formation of Peatlands in Eastern MB

Written by Collins Chilaka

Peatland complexes are intricate networks of bogs and fens, each a unique ecosystem characterized by the accumulation of peat which is a dense organic material formed from partially decomposed plant matter (in these ecosystems, typically Sphagnum mosses). These complexes in eastern Manitoba developed roughly about 5-6,000 years ago and is influenced by a combination of geological, climatic, hydrology, and vegetation factors. Glacial activity during the last Ice Age changed the region's environment, leaving behind a variety of landforms, including depressions and basins that are favorable to the development of peatlands. At its simplest, peatlands need an area that is cold, flat, wet and plugged. The cold climate of Manitoba limits evaporative losses, and the flat landscape delays lateral runoff (streams). Sufficient precipitation helps maintain high water tables, while the glacial Lake Agassiz clays prevent vertical seepage losses (plugged).

Peat accumulates in these ecosystems because the rate of addition of new material (Sphagnum moss litter) exceeds the decay/loss through dissolved organic carbon export and losses to the atmosphere (CO_2 and CH_4). The slow decomposition of organic matter allows peat to accumulate over time; a rough estimate is about 0.5 to 1 mm of peat is created each year. The vegetation in peatlands is typically dominated by mosses, particularly Sphagnum moss, which plays a key role in peat accumulation. Other common plants include sedges, shrubs, and trees such as black spruce and tamarack. There are several types of peatlands found in Eastern Manitoba, each with distinct characteristics. The two main types are bogs and fens. Bogs are ombrotrophic peatlands, meaning they receive water primarily from precipitation. They are typically acidic and nutrient-poor, with vegetation dominated by Sphagnum mosses. Fens, on the other hand, are minerotrophic peatlands that receive water from precipitation, as well as surface and groundwater (Landry and Rocherfort, 2012) sources. Fens tend to be less acidic and more nutrient-rich than bogs, supporting a more diverse range of plant species.

These peatlands play a vital role in the region's ecology, providing habitat for diverse plant and animal species and storing significant amounts of carbon. Canada's total peatland area is approximately 113 million hectares, with Manitoba constituting 17%, or 19.2 million hectares (Daigle and Gautreau-Daigle, 2001). Understanding the formation and function of peatlands is essential for their conservation and the mitigation of climate change.

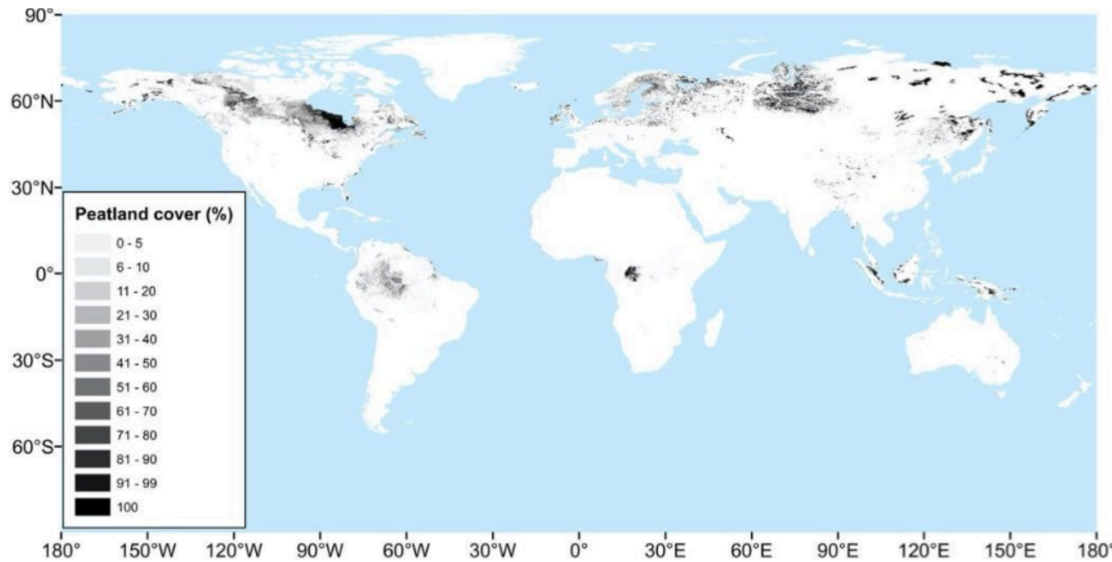


Figure 9: Global peatland distribution (from Xu et al., 2018). The black shading classes are applicable to Canada and some smaller areas as shown. Elsewhere, black = peat and white = no peat.

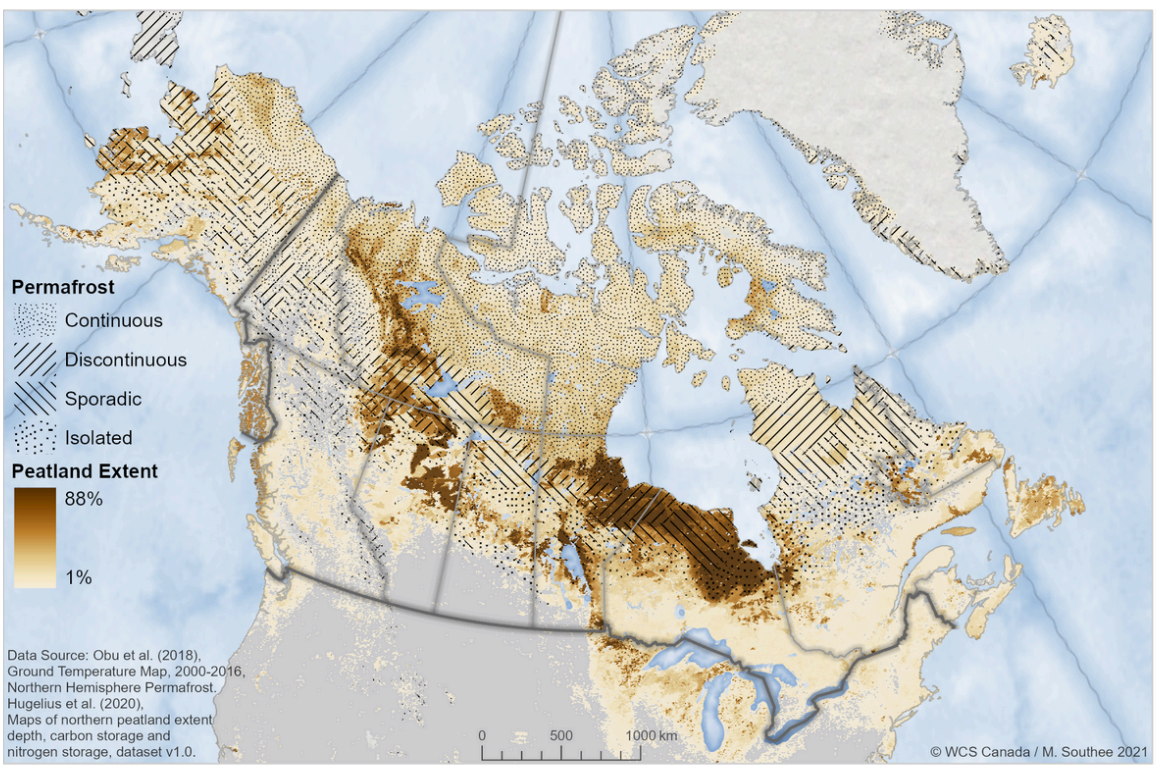


Figure 10: Map showing peatland area and permafrost zones across Canada

4.3 Peat Extraction

- Elma bog is located in the Lake of the Woods Ecoregion of the Boreal Shield Ecozone
  - Total of 818.853 hectares of harvestable area
- Original Quarry Lease issued 1992-05-12
- Operations began in 1974
  - Elma processing plant was constructed in 1974
- Operations progressively ceased from 1991 to 2017

4.4 Environmental Monitoring and Mitigation

- Water quality was tested during harvest operations every week to monitor pH and total suspended solids
- Peatland Management Plan approved in September 2019
  - A minimum of 0.5m residual peat once harvest is complete
- Effects, monitoring and mitigation measures of the peat harvesting area can be found in Figure 11

Water Quality		
Erosion of Peat and Sedimentation in Water	Weekly water quality monitoring program testing for: • pH • Total suspended solids Three times per year (spring freshet, late-summer and autumn base-flow): • Nutrients: calcium, phosphorus, potassium, sodium, total Kjeldahl nitrogen, nitrate and nitrite-nitrogen, ammonia nitrogen, total organic carbon, sulphates (as Sulfur) • Physio-chemical: pH, total alkalinity, electrical conductivity, total dissolved solids, total suspended solids, 5-day biological oxygen demand, hardness, turbidity, dissolved organic carbon • Total and dissolved metals and metalloids: aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, magnesium, manganese, mercury (cold vapour), molybdenum, nickel, rubidium, selenium, silicon, silver, strontium, tellurium, thallium, thorium, tin, titanium, tungsten, uranium	• 150 m buffer area maintained around riparian areas of lakes, rivers, creeks streams and beaver habitat • Slow-flowing perimeter and outlet ditches allow peat particles suspended in perimeter ditches to settle out of water before flowing out of the project area through ponding and low slopes • Ditches are dredged as needed, generally annually, to ensure that there is a minimum depth of water entering the pond outlet and to prevent flooding. Ditch cleaning occurs during low flow periods (winter or late-summer) to minimize sedimentation in outflowing water • Culverts with sliding gates are used to control flow in the event that flow rates exceed design criteria. Water is not released from a final discharge point if the pH is less than 5.0 or if total suspended solids is greater than 30 mg/L • If water quality is impacted by pH, a limestone or carbonate-lined drainage ditch may be installed in perimeter or outlet ditches
Contaminant Spills	Regular inspections	• Fuel is stored on a clay pad in the staging/laydown area in Underwriters Laboratories of Canada Inc. (ULC) Certified double-walled fuel storage containers with protective barrier • Transportation of fuel, lubricants and other potentially hazardous materials adheres to all applicable provincial and federal regulations (*Manitoba Regulation 188/2001 regarding Storage and Handling of Petroleum Products and Allied Products* , the Office of the Fire Commissioner for the province of Manitoba and *The Dangerous Goods Handling and Transportation Act*) • Appropriate waste disposal • Spill contanment supplies on-site • Addressing immediately following Sun Gro protocol • Emergency response: 24-hour emergency response line 204-944-4888 or toll-free at 1-855-944-4888
Air Quality		
Airborne Peat Particulate Matter	N/A	• Roads are sprayed with water to suppress dust as needed • Vacuum harvesters are equipped with adequate dust control equipment such as dust collectors and modifications to the exhaust system to direct airflow to the ground • A buffer of undisturbed vegetation outside the perimeter ditch buffer has been left intact to act as a windbreak around peat fields • Peat stockpiles are kept low and covered with tarps or snow fences if necessary • Bulk peat transport trucks are covered with tarps • Peat burning activities are not practiced at Sun Gro operations
Soils		
Compaction Under Roads and Staging Areas	N/A	• Corduroy road base: road construction follows best management practices laid out in the *Resource Roads and Wetlands: A Guide for Planning, Construction and Maintenance* (FPInnovations, 2016) wherein cleared trees and roots are placed along road alignments (corduroy) and topped with clay and gravel
Contaminant Spills	N/A	• See above
Wildlife		
Habitat Loss and Fragmentation	Pre-construction habitat surveys	• Revegetation (see Peatland Recovery Plan) • Sensitive species and habitat avoidance and setbacks • Wildlife safety on-site (Sun Gro Horticulture Inc., 2018a)
Changes in Water Quality	See water quality monitoring	• See water quality mitigation measures
Vegetation		
Clearing and Removal of Plants	N/A	• Revegetation (see Peatland Recovery Plan)
Habitat Loss	N/A	• Revegetation (see Peatland Recovery Plan)
Colonization By Non-peatland, Non-native (Weed) Species	Regular inspections	• Sun Gro weed control procedure (Sun Gro Horticulture Canada Ltd., 2017a) • Cleaning all equipment prior to arrival onsite and after cultivation of weeded areas • Harrowing fields regularly to discourage establishment and growth of non-peatland species • Hand-picking in areas inaccessible to mobile equipment or for very small populations • Dark coloured barrier such as geotextile or shade cloth • Cleaning internal and perimeter ditches at minimum once per year, preferably by mid-July • Avoiding activity on areas with weeds or agronomic species until they are controlled • Utilizing materials that are weed or agronomic seed free • Non-selective (Glyphosate) herbicide is applied on weeds on main road and yard areas. No herbicide is used on peat fields, ditches, internal field roads or anywhere peat is stockpiled • Restricting recreational or third party activity

Figure 11: Effects, monitoring and mitigation measures

4.5 Restoration

- Reclamation began in 1991 on field 6 South
  - To date 240 hectares have been reclaimed to various stages.
- Checkerboard reclamation project led by Peatland Ecology Research Group (PERG) completed in September 2015
  - Tree plantation and fertilization were added to the checkerboard reclamation area in July 2016

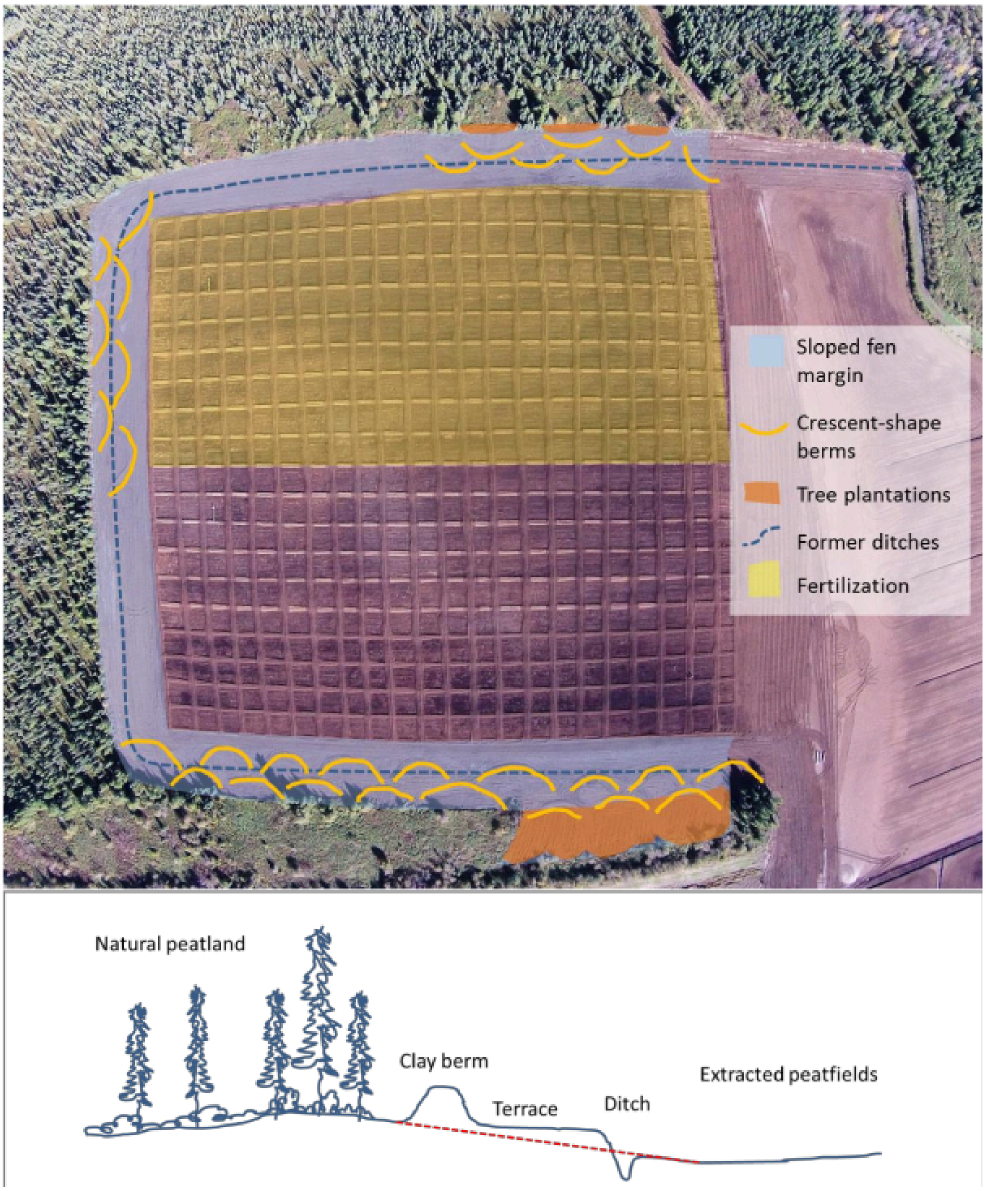


Figure 12: Top: Final configuration of the Elma North experimental sector. Bottom: Profile view of the transition zone sloping after restoration (in red). Information from Fen restoration in Manitoba – Final Report. Peatland Ecology Research Group, Université Laval, Québec.

- Active restoration being completed using the Moss Layer Transfer Technique

(a) The visible difference between donor moss and straw spread (photo taken from AB for visual purposes only)

(b) Manure spreader spreading donor moss (photo taken from AB for visual purposes only)

(c) Mulching donor

(d) Windrowed donor material

Figure 13: Active restoration

4.6 Research Projects

4.6.1 Summary of research approach towards fen restoration of a peatland

Written by Collins Chilaka

Despite covering only 3% of the Earth's surface, peatlands store more carbon than all of the world's forests combined (Kimmel and Mander, 2010). Peatlands cover almost one-third of Manitoba's land area (Tanorcai 2000); bogs and fens are the two most common types of peatlands. Bog peatlands obtain all of their water from precipitation, and, as such, typically are oligotrophic with low pH (<4.5); fens, however, can receive their water from additional sources such as streams and groundwater discharge, and tend to be more minertrophic with higher pH.

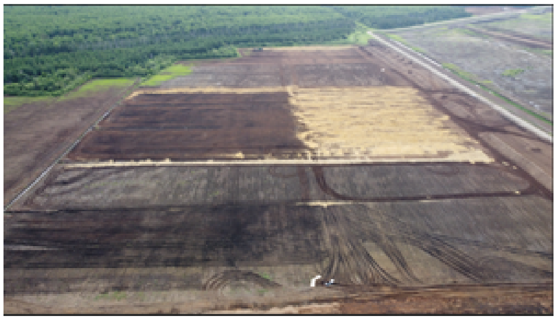
Some of these peatlands, often bogs, are utilized for horticultural peat, which is typically used to grow vegetables and flowers in gardens or commercial greenhouses. Bog peatlands are the most commercially viable peatland type because of the abundance of Sphagnum peat, as Sphagnum mosses are the dominant peat forming species and are more prevalent in bogs than fens. Canada's abundance of peatlands has made it one of the world's leaders in harvested peat production. Once the peat has been extracted, prompt and active restoration is critical (Nugent et al., 2019) so that the sites can resume carbon accumulation again. Most extracted peatlands in Canada have been restored to a bog peatland; but, depending on the qualities of the residual peat (such as pH) in the extracted field, it may be more appropriate to restore these sites to fen peatland. In addition, much of the Canadian research in peatland restoration occurred in Quebec which is a different climate than Quebec. Thus, considering Manitoba's colder and drier climate (than Quebec), other approach to restoration may be needed.

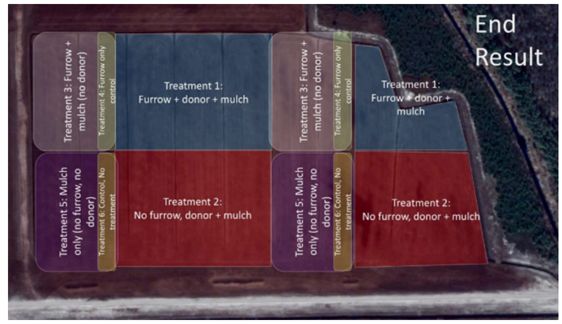
My research is on restoring the impacted peatland operated by SunGro Horticulture, to a fen-based peatland due to its hydrological advantage for the success of the restoration project, using a method known as the Moss Layer Transfer Technique (MLTT). The Moss Layer Transfer Technique (MLTT) developed by the Peatland Ecology Research Group (PERG, Université Laval) for the restoration of peatlands (bogs, poor fens and moderate-rich fens) is based on active reintroduction of peatland plant species combined with rewetting through hydrological management.

It is improbable that peatlands will spontaneously reestablish the appropriate hydrological conditions after harvesting to sustain native peatland vegetation and sequester carbon. Harvested sites rarely return to functional ecosystems after abandonment because drainage and peat extraction lower the water table and expose relatively decomposed peat, which is hydrologically unsuitable for Sphagnum moss reestablishment. Line Rochefort and her research group in 2003, who are the proponents of the MLTT proposed a specific set of restoration measures for North American bog peatlands. These measures include ditch blocking and constructing bunds along elevation contour line to retain and direct water flow over the site and creating microtopography variation to give the reintroduced vegetation localized habitat for regeneration. The success of the Moss Layer Transfer Technique is largely related to how well the restoration work is done, as well as the meteorological and hydrological conditions prevailing while the work is carried out.

The Elma study site has been divided into 12 plots, with 6 treatments (with duplicates) to be applied across the site. These treatments are applied in combination with other treatments and some stand alone, which range from furrow diking or ridging parts of the site to help re-establish the natural water flow and retention, to the application of donor moss material especially sphagnum moss, and straw mulch, to help re-establish the native vegetation, which is essential to peat formation, amongst other benefits, regulating temperature conditions and preventing erosion respectively. There are also some sites that has no treatment applied which would serve as a control to monitor ongoing developments.

Since we are concerned about the water budget of the peatland, climate data (temperature, precipitation) is being monitored and collected from a weather station on site. Monitoring wells were constructed and installed on selected locations to understand the water table level and flow direction of the ground water. Water pressure is also being monitored as well as soil moisture along transects. Evaporation is being measured with weighing lysimeters. The overall goal of the research is to see if a modified MLTT approach would be suitable to the restoration of the peatland to a fen at the edge of the Canadian prairies.





An overview of the study site showing different segments for treatment Elma North

Figure 14: Applying mulch to parts of the treatment site

4.6.2 Fen restoration in SE MB: Important of ecotones

Written by Gladys Mumbi

Canadian peatlands have been receiving considerable attention because of their importance to climate change mitigation. Peatlands ecosystems are terrestrial environments where over the long term, net primary production exceeds organic matter decomposition, leading to a substantial accumulation of a deposit rich in incompletely decomposed organic matter or peat (Joosten, 2000). One-third of global peatlands are found in Canada's arctic, subarctic and boreal regions spreading over 1.1 million square km. They store about 150 billion tons of carbon, about 30% of the world's peatland carbon. In Canada, a very small percentage of these peatlands (0.03%) are used for horticultural peat production (Walters and Shrubsole, 2003) In the mid to late 90s, Canadian universities and Canadian peat producers launched a research collaboration aimed at developing techniques to restore harvested/extracted peatlands to bog ecosystems (Quinty and Rochefort, 2003). The project was to be conducted by Peatland Ecology Research Group (PERG) The nature of a peatland is largely controlled by hydrological processes, particularly water table position (Charman, 2002). The Canadian peat restoration approach, called the Moss Layer Transfer Technique, is based on the introduction of peat plant species and hydrological management to raise and stabilize water levels. It involves the following: surface preparation, plant collection, plant spreading, straw spreading, fertilization and blocking drainage ditches This study at Elma in Manitoba breaks new ground in peatland restoration in various aspects:

1. Application of Moss Layer Transfer Technique for the restoration process in a much drier climate. Manitoba is hotter, drier and has more evaporation demand than Quebec
2. Restoring a fen rather than a bog because of the unique characteristics of the peatland after peat harvesting. The MLTT has been focused on bog restoration, not fen restoration
3. Largest single restoration project PERG/Canadian Sphagnum Peat Moss Association (CSPMA) as more than 1000ha is to be restored
4. Incorporating ecotone creation and management as a core component of the restoration process, moving beyond traditional approaches that primarily focus on the peatland core. As fens have more complicated hydrology naturally, efforts to recreate this as part of the restoration process have been included

Ecotones

These are transition zones between two different ecosystems that allow for movement of water, nutrients and energy between them. Their characteristics and functions include:

- Increased biodiversity or edge effect (Kark et al, 2006)
- Habitat connectivity (Ries et al, 2004)
- Increased hydrological connectivity (Kark et al, 2006)

To assess the ecohydrological functioning of ecotones, I have instrumented the following treatments:

- Water table monitoring- wells and data loggers for continuous monitoring
- Soil moisture profiling- use of soil moisture probes at different depths on all transects
- Evapotranspiration measurements- lysimeters weight is recorded for ET
- Hydraulic conductivity to quantify groundwater flows
- Elevation measurements- use smart level at different heights on the transects
- Vegetation surveys

The creation of ecotones as part of peatlands restoration is a relatively newer concept that is gaining more attention due to increased awareness of the ecological functions of these transition zones. More and more projects are beginning to incorporate this idea as seen in Haapalehto et al, 2017

References

Joosten and Clarke, 2002. Peatlands and the Boreal forests

Dan Walters, Dan Shrubsole, 2003. Agricultural Drainage and Wetlands Management in Ontario

Quinty, F. and L. Rochefort, 2003. Peatland Restoration Guide, second edition. Canadian Sphagnum Peat Moss Association and New Brunswick Department of Natural Resources and Energy. Québec, Québec

Charman, D. (2002) Peatlands and Environmental Change

Kark, S., & van Rensburg, B. J. (2006). Ecotones: marginal or central areas of transition

Ries, L., Fletcher Jr, R. J., Battin, J., & Sisk, T. D. (2004). Ecological responses to habitat edges: mechanisms, models, and variability explained. Annual Review of Ecology, Evolution, and Systematics

Haapalehto, T., Juutinen, R., Kareksela, S., Kuitunen, M., Tahvanainen, T., Vuori, H., & Kotiaho, J. S. (2017). Recovery of plant communities after ecological restoration of forestry-drained peatlands. Ecology and evolution

4.7 Organic Soil Order

Soils of the Organic order are composed largely of organic materials. They include most of the soils commonly known as peat, muck, or bog and fen soils. Most Organic soils are saturated with water for prolonged periods. These soils occur widely in poorly and very poorly drained depressions and level areas in regions of subhumid to perhumid climate and are derived from vegetation that grows in such sites. However, one group of Organic soils (Folisols) consists of upland (folic) organic materials, generally of forest origin. These Folisols are well to imperfectly drained, although they may become saturated after rainfall or snowmelt. Wetland organic soils are largely composed of organic materials and commonly referred to as peat or muck soils. Bogs, fens, swamps and marshes are wetland forms that accumulate organic (peat and muck) materials.

Peatland classes	**Nutrient status**	**Hydrology**	**Type of peat**
Bog	Ombotrophic; nutrient-poor	High water table Isolated from mineralized ground water	Acid, weakly to moderately decomposed moss (sphagnum) or woody peat
Fen	Mesotrophic; nutrient rich waters originating form mineral soils	High water table low internal drainage	Slightly acid to neutral, moderately well to well decomposed sedge or brown moss
Swamp	Nutrient rich groundwater and peat	Standing or gently moving waters; may also have subsurface flow of mineralized water	Neutral to slightly alkaline; well decomposed woody peat
Marsh	Rich in nutrients; inundated by standing or slow moving nutrient rich water	Fluctuating seasonal surface water levels	Neutral to slightly alkaline; well decomposed peat with variable amounts of mineral materials

Table 2: Chemical and physical properties of wetland classes. Reproduced from: Kroetsch DJ, Geng X, Chang SX, Saurette DD (2011) Organic Soils of canada: Part 1. Wetland Organic soils. Can J Soil Sci 91:807–822. https://doi.org/10.4141/cjss10043.

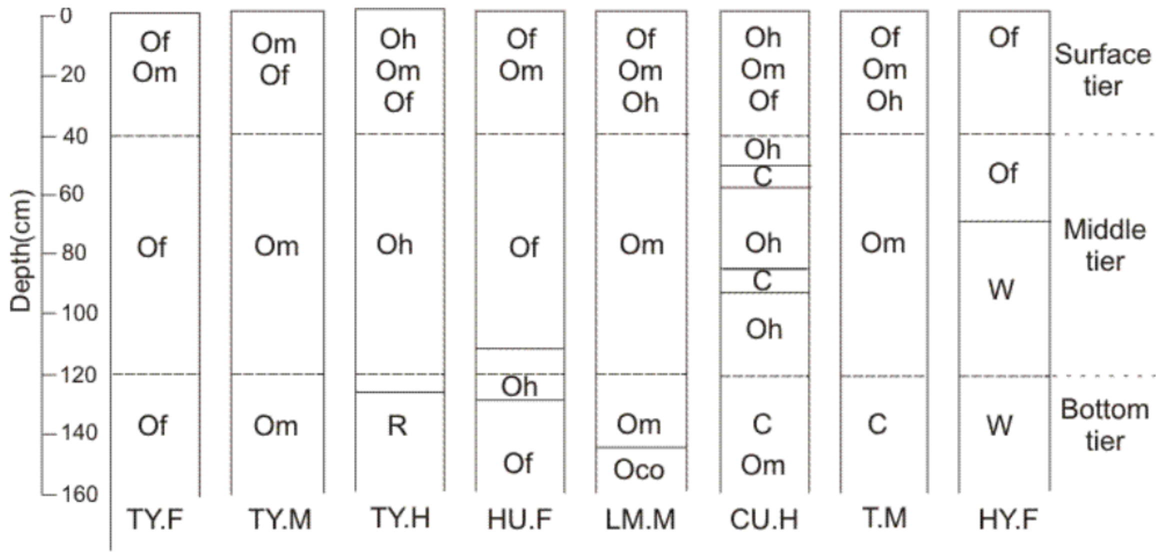


Figure 15: Diagrammatic horizon pattern of some subgroups of the Fibrisol, Mesisol and Humisol great groups. See below for a descriptions of tiers, horizons, great groups, and subgroups. Reproduced from the Canadian Guide to Soil Classification

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4.7.1 von Post scale of decomposition

In this field test squeeze a sample of the organic material within the closed hand. Observe the color of the solution that is expressed between the fingers, the nature of the fibers, and the proportion of the original sample that remains in the hand. From the Canadian System of Soil Classification the ten classes are defined as follows:

1. Undecomposed; plant structure unaltered; yields only clear water colored light yellow-brown.
2. Almost undecomposed; plant structure distinct; yields only clear water colored light yellow-brown.
3. Very weakly decomposed; plant structure distinct; yields distinctly turbid brown water, no peat substance passes between the fingers, residue not mushy.
4. Weakly decomposed; plant structure distinct; yields strongly turbid water, no peat substance escapes between the fingers, residue rather mushy.
5. Moderately decomposed; plant structure clear but becoming indistinct; yields much turbid brown water, some peat escapes between the fingers, residue very mushy.
6. Strongly decomposed; plant structure somewhat indistinct but clearer in the squeezed residue than in the undisturbed peat; about one-third of the peat escapes between the fingers, residue strongly mushy.
7. Strongly decomposed; plant structure indistinct but recognizable; about half the peat escapes between the fingers.

8. Very strongly decomposed; plant structure very indistinct; about two-thirds of the peat escapes between the fingers, residue almost entirely resistant remnants such as root fibers and wood.
9. Almost completely decomposed; plant structure almost unrecognizable; nearly all the peat escapes between the fingers.
10. Completely decomposed; plant structure unrecognizable; all the peat escapes between the fingers.

4.7.2 Tiers

The control section for Fibrisols, Mesisols, and Humisols extends from the surface either to a depth of 1.6 m or to a lithic contact. It is divided into tiers, which are used in classification. The tiers are layers based upon arbitrary depth criteria as outlined in the Canadian System of Soil Classification.

- **Surface tier:** The surface tier is 40 cm thick exclusive of loose litter, crowns of sedges and reeds, or living mosses. Mineral soil on the surface of the profile is part of the surface tier, which is used to name the soil family. Shallow lithic organic soils may have only a surface tier.
- **Middle tier:** The middle tier is 80 cm thick. It establishes the great group classification if no terric, lithic, or hydric substratum is present. Otherwise the dominant kind of organic material in this and the surface tier establishes the great group classification. The nature of the subdominant organic material in the middle or bottom tier assists in establishing the subgroup classification.
- **Bottom tier:** The bottom tier is 40 cm thick. The material in this tier establishes in whole or in part the subgroup classification.

4.7.3 Horizons

- **Of:** This O horizon consists largely of fibric materials that are readily identifiable as to botanical origin
- **Om:** This O horizon consists of mesic material, which is at a stage of decomposition intermediate between fibric and humic materials
- **Oh:** This O horizon consists of humic material, which is at an advanced stage of decomposition
- **W:** This layer of water may occur in Gleysolic, Organic, or Cryosolic soils.
- **C:** This mineral horizon is comparatively unaffected by the pedogenic processes operating in A and B horizons

4.7.4 Great Groups and Subgroups

Fibrisol: Soils of this great group are composed largely of relatively undecomposed fibric organic material. Fibric material is usually classified on the von Post scale of decomposition as classes 1-4.

- Typic Fibrisol (TY.F)
- Humic Fibrisol (HU.F)
- Hydric Fibrisol (HY.F)

Mesisol: Soils of this great group are at a stage of decomposition intermediate between Fibrisols and Humisols. Mesisols have a dominantly mesic middle tier or middle and surface tiers if a terric, lithic, or hydric contact occurs in the middle tier.

- Typic Mesisol (TY.M)
- Limnic Mesisol (LM.M)
- Terric Mesisol (T.M)

Humisol: Soils of this great group are at the most advanced stage of decomposition of the great groups of Organic soils. Most of the material is humified with few recognizable fibers.

- Typic Humisol (TY.H)
- Cumulic Humisol (CU.H)

Sketch	Horizon	Depth	Colour	Texture	Notes

Figure 16: Sketch the SunGro soil profile

5 OK Farms Tour Stop

5.1 Objectives

1. Overview of farm and farming practices
2. Discuss the challenges and success of poultry manure management
3. Overview of feed mill operations
4. Luvisol soil pedology lesson

5.2 OK Farms

OK farms is a 3rd generation farm located along the banks of the Whitemouth River. This 240 ha (600 acre) farm grows a variety of row crops including soybeans and corn. OK farms also produces poultry (eggs) with approximately 32,000 hens and has recently transitioned to a free-run operation. This farm comes equipped with an onsite feed mill and they use their own corn as part of the feed ingredients. The poultry manure produce is used on farm as part of their soil fertility management plan.

5.3 Egg Production in Manitoba

- The egg industry in Manitoba includes production and processing
- There were roughly 2.6 million egg-laying hens and 2.9 million egg-type pullets in Manitoba in 2021
- An egg layer farm in Manitoba typically houses 15,000 hens that lay about 380,000 dozen eggs per year
- Egg production in Manitoba generated $157 million in farm cash receipts in 2022, worth 20.04% of total livestock farm cash receipts
- Manitoba has seen significant growth in egg production in recent years, with about 2.7 million laying hens and 6.6 million dozen eggs sold in 2021
- Manitoba produces 10% of Canada's eggs, with provincial layer allocations controlled through a national supply-managed marketing system

5.4 Laying hen housing environments in Manitoba

Scan the QR code for information, videos, and photos on the type of layer hen housing in Manitoba!

5.4.1 Layer Hen Manure Management

Layer hen manure is an excellent nutrient resource for crops and forages, however if mis handled can pose environmental burdens for air and water quality. Proper manure management can greatly influence the amount of ammonia emissions and other losses to the environment (runoff). Managing livestock manure can be challenging due to not all animals produce the same quantity or quality of manure, diets and metabolism rates between livestock and bedding material type are a few of the causes of differences between the types of manure. Table 1 presents nutrient content for solid layer, beef and dairy manure. Poultry layer manure has a much higher nutrient content compared to pig, beef or dairy manure having approximately 4x the amount of total nitrogen and phosphorus.

Solid Manure	TKN	NH_4-N	Org N	P	K	S	DM (%)	Available $N:P_2O_5$
Layer	46.4	27.1	19.3	17.1	14.6	3.7	35.1	0.9
Beef	10.6	1.5	9	2.0	10.5	1.8	26.1	1.0
Dairy	11.5	2.3	9.2	3.2	9		26.3	0.8

Table 3: Mean for total N, ammonium, organic N, P, K, S, and available $N:P_20_5$ ratios for solid layer, beef, and dairy manures (Adapted from Properties of Manure, Manitoba Agriculture 2015)

Scan the QR code to learn more about the factors that affect manure composition, properties of manure, how to properly sample manure for analysis (Properties of Manure, Manitoba Agriculture 2015)

5.4.2 Free Run housing Manure Collection

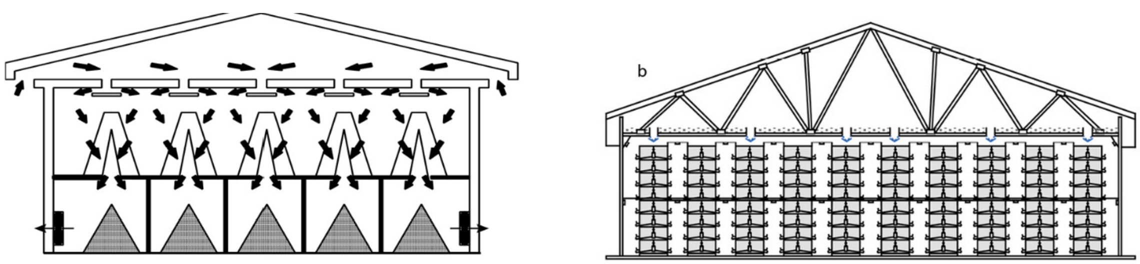
In Free Run housing systems hens have access to roam freely inside the entire barn. Some operations have slotted floors for the manure to fall through and collect beneath others have solid floors with wood shavings or straw, which may be collected multiple times a year or annually.

5.4.3 Other Laying Hen Housing Operations

Most newer operations in Manitoba are dry manure operations that use manure belts or high-rise systems. Some older or mixed livestock operations will have liquid manure collection and storage systems (Poultry Producer Oct 2021, Mississippi State University Extension Service).

Manure Belt System	High-Rise System
• Manure drops onto belt beneath cage row and is transferred end of the house and outside for removal for storage or composting • Manure is dried while carried along on manure belt • Generally better indoor air quality (NH_3) • 50% higher installation costs and Less labour intensive, but belt maintenance is crucial	• Manure drops / falls beneath the cages on to dropping boards that are cleaned 4-6x a day or into storage below the cages (can be stored for up to 1 year) • Directed flow of air over manure keeps most of the NH_3 from reaching the hens

Table 4: Comparison of manure belt and high-rise hen layer dry manure systems (Poultry Producer Oct 2021, Mississippi State University Extension Service).



(a) High-rise)

(b) Manure belt)

Figure 17: Schematic representation of high-rise (a) and manure belt (b) layer houses (Poultry Producer Oct 2021, Mississippi State University Extension Service).

5.4.4 Questions

1. How does manure collection differ between OK farms Operation and other styles of housing units?
2. How and when does OK Farms apply their manure? Do they compost first?
3. Being located along a surface watercourse what special considerations must be made for manure storage? Scan the QR code for a hint!

5.5 Luvisol Soil Order

Soils of the Luvisolic order generally have light-colored, eluvial horizons and have illuvial B horizons in which silicate clay has accumulated. These soils develop characteristically in well to imperfectly drained sites, in sandy loam to clay, base-saturated parent materials under forest vegetation in subhumid to humid, mild to very cold climates (Canadian System of Soil Classification).

5.6 Hadashville Series (HHV)

Information from the Soils of the Lac du Bonnet Area (1967) Soil Report #15

The Hadashville series consists of imperfectly drained Gleyed Dark Gray Luvisol soils developed on moderately to strongly calcareous, stratified, medium to moderately coarse textured (VFSL, L, SiL to VFS, LVFS, FSL), alluvial and lacustrine deposits. These deposits may be underlain by clay or strongly calcareous glacial till substrates. This soil type occurs in narrow strips along the Whitemouth, and Birch Rivers. Topography is level to irregular, very gently sloping. Surface runoff is slow and internal drainage is medium to moderately rapid but may be impeded by a high water-table. Native vegetation consists of aspen, balsam poplar, white spruce, elm and ash. In open stands dense shrub, herb and grass layers are found. The soils are free of stones except for scattered surface stones in areas where the underlying glacial till is close to the surface.

The Hadashville soils are characterized by a thin, very dark brown slightly acid leaf mat overlying light grayish brown Aeg horizon neutral in reaction. The dark grayish brown Btg horizon has a slight clay accumulation and is slightly acid to neutral in reaction. Occasional flooding by lime-charged water causes these soils in some areas to be mildly alkaline and calcareous to the surface. The Hadashville clay variant, HHVc, is areas of the Hadashville soils in which a deposit of weakly to moderately calcareous lacustrine clay occurs within 75 cm of the surface.

A representative Hadashville Series profile presented below:

L-H - 2.5 to 0cm, very dark brown to black (10YR2/2 to 2/1, dry) partially to well decomposed leaf litters; medium acid in reaction; abrupt, smooth, lower boundary.

Ahe - 0 to 5cm, very dark grey (10YR3.5/1, dry) loamy fine Sand; loose; slightly acid; abrupt, wavy, lower boundary.

Ae - 5 to 13cm, grey to light grey (10YR6/1, dry) fine Sand; loose; slightly acid; flecked with numerous iron mottles; clear, wavy, lower boundary.

Bt - 13 to 31cm, greyish brown (2.5Y4/2, dry) fine sandy clay loam; moderate coarse granular to moderate fine subangular blocky; moist firm, dry hard; mottled, neutral in reaction; abrupt, wavy, lower boundary.

Ck - 31 to 60cm, dark grey (5Y4/4, dry) clay; massive, breaking to moderately strong coarse granular to fine blocky-like structures; firm when moist, very hard when dry; numerous lime carbonate concretions, moderately alkaline and moderately calcareous.

Sketch	Horizon	Depth	Colour	Texture	Notes

Figure 18: Sketch the OK Farms soil profile

6 Summer Tour Evaluation Form

Please take some time and give your feedback and let us know what we did well, what needs improvement and what you would like to see next time.

Bus ride

(Not great) ___1 ___2 ___3___4 ___5 (Comfortable)

Comments: ____

____

Stop 1 SunGro

(Not great) ___1 ___2 ___3___4 ___5 (Fabulous and informative)

Comments: ____

____

Lunch

(Not great) ___1 ___2 ___3___4 ___5 (Delicious)

Comments: ____

____

Lunch Guest Speaker

(Not great) ___1 ___2 ___3___4 ___5 (Fantastic)

Comments: ____

____

Stop 2 OK Farms

(Not great) ___1 ___2 ___3___4 ___5 (Fabulous and informative)

Comments: ____

____

Information Booklet

(Not great) ___1 ___2 ___3___4 ___5 (Very informative)

Comments: ____

____

Other Suggestions and Feedback

Comments: ____

____

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Compiled with Quarto on 2024-08-06 by Alex Koiter with contributions from many!
The code to create this booklet can be found at https://github.com/alex-koiter/2024-MSSS-Tour