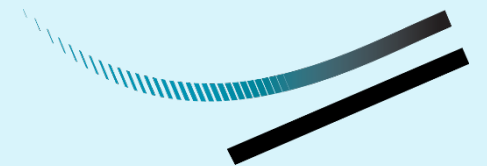


Hydrological Impacts on Neighbouring Properties and Cumulative Impact in the Willow Creek Watershed

Harbour Colony Lagoon File 6193.00

Presented by Indra Kalinovich, Ph.D., C.Chem., P.Eng., FEC



DILLON
CONSULTING

Regulatory Framework & Mandate for Lake Winnipeg



Lake
Winnipeg

Image Source (09/25/2023): <https://science.nasa.gov/earth/earth-observatory/emerald-swirls-of-algae-in-lake-winnipeg-151918/>

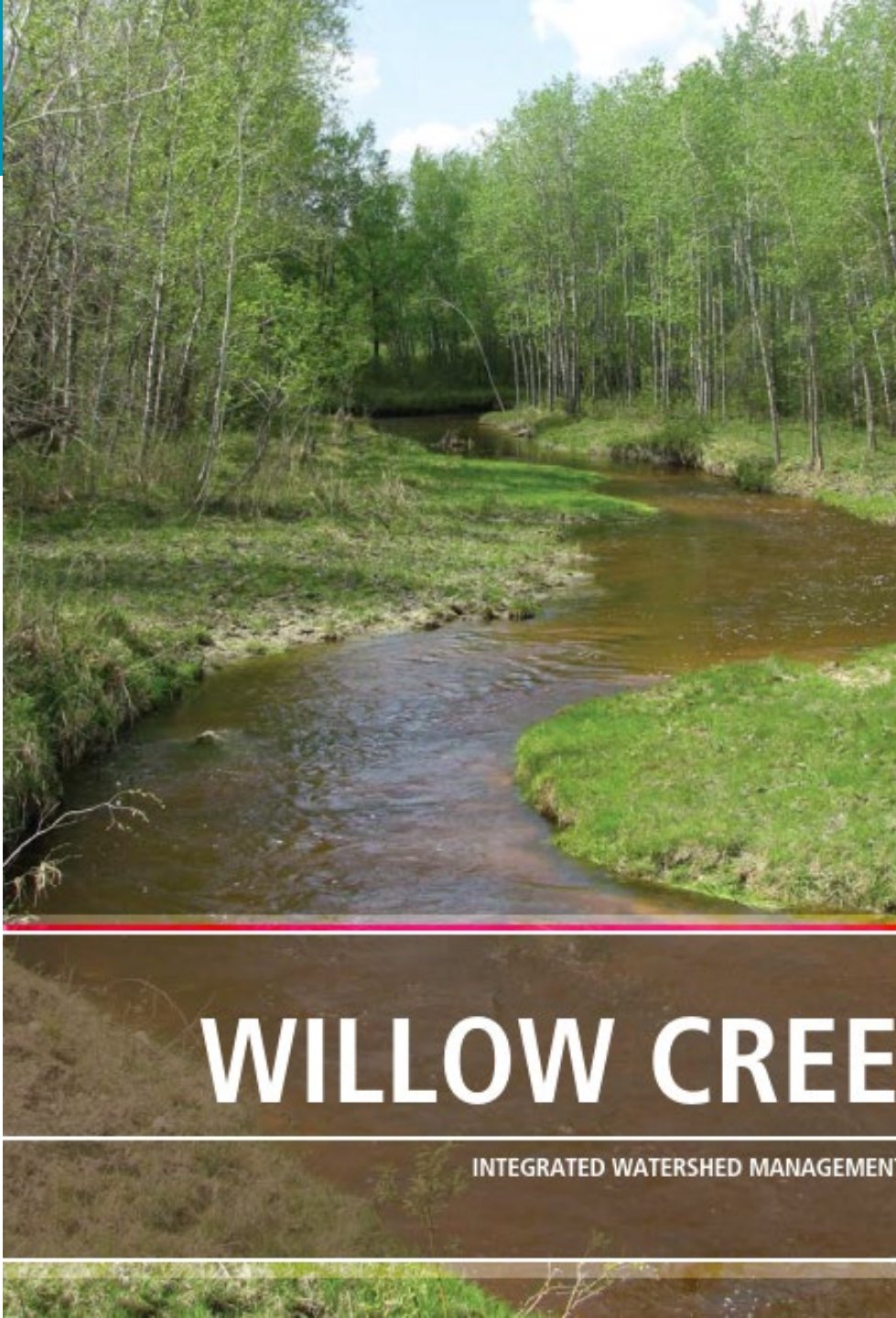
- Sections 4.0.1 (1) - 4.0.2 (5) of *The Water Protection Act* mandates **nutrient targets for Lake Winnipeg and its tributaries** and reporting on progress every four years.
- Provincial Nutrient Targets Regulation (formalized into the *Water Protection Act* in August 2024) **establishes loading targets for the Red, Winnipeg, Saskatchewan and Dauphin rivers, including Lake Winnipeg.**
- Total phosphorous and nitrogen outcome limits were set for Lake Winnipeg to restore and maintain ecosystem integrity.



Integrated Watershed Management

- Under the *Water Protection Act*, Watershed Districts lead the development of Integrated Watershed Management Plans.
- Combines community input with technical expertise to prioritize local water issues.

Implementation is a shared responsibility and collective effort across all levels of government, stakeholders, and residents.



WILLOW CREEK

INTEGRATED WATERSHED MANAGEMENT

Cumulative Environmental Effects

The incremental impact of past, present, and "reasonably foreseeable" future actions.

The health of the Lake Winnipeg basin depends on multiple small decisions about point source discharges

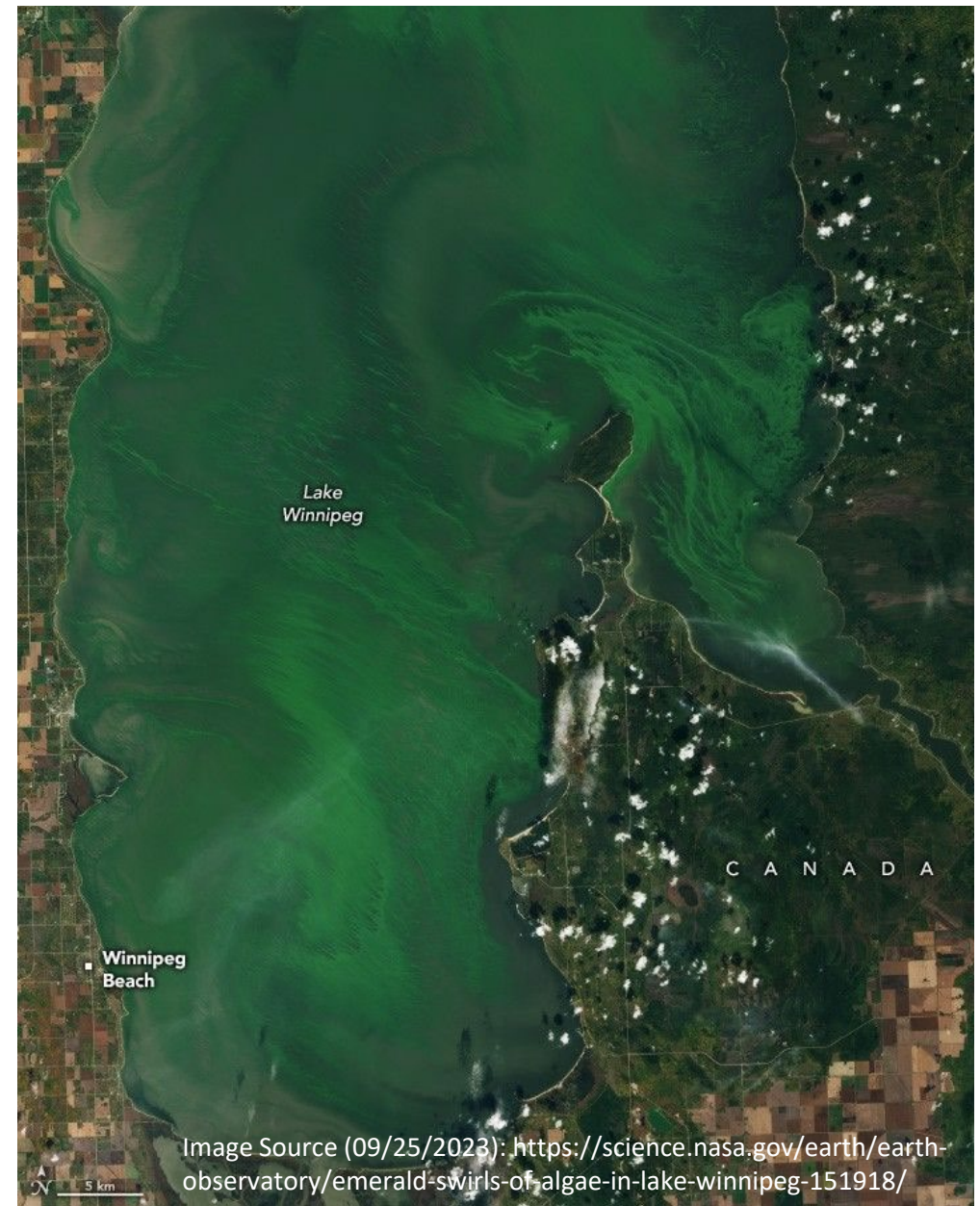
Control the controllable: Phosphorus contributions from lagoons are manageable point sources

Current State of Lake Winnipeg

- The south basin is currently phosphorus-enriched and considered **hypereutrophic**.¹
- South Basin/Narrows: 0.106 mg/L (nearly 3x higher than the north).
- **Controlling watershed-level discharges is critical** to meeting downstream provincial targets.

1. Manitoba Environment and Climate Change, 2024. Nutrient Targets Regulation: Report on Nutrient Levels Through 2023 And Action Underway. Water Science and Watershed Management Branch. December 2024. <https://www.gov.mb.ca/sd/pubs/water/lakes-beaches-rivers/report-on-nutrient-targets-and-action-underway-dec-2024.pdf>

Hydrological Impacts on Neighbouring Properties and Cumulative Impact in the Willow Creek Watershed



Evolving Discharge Standards

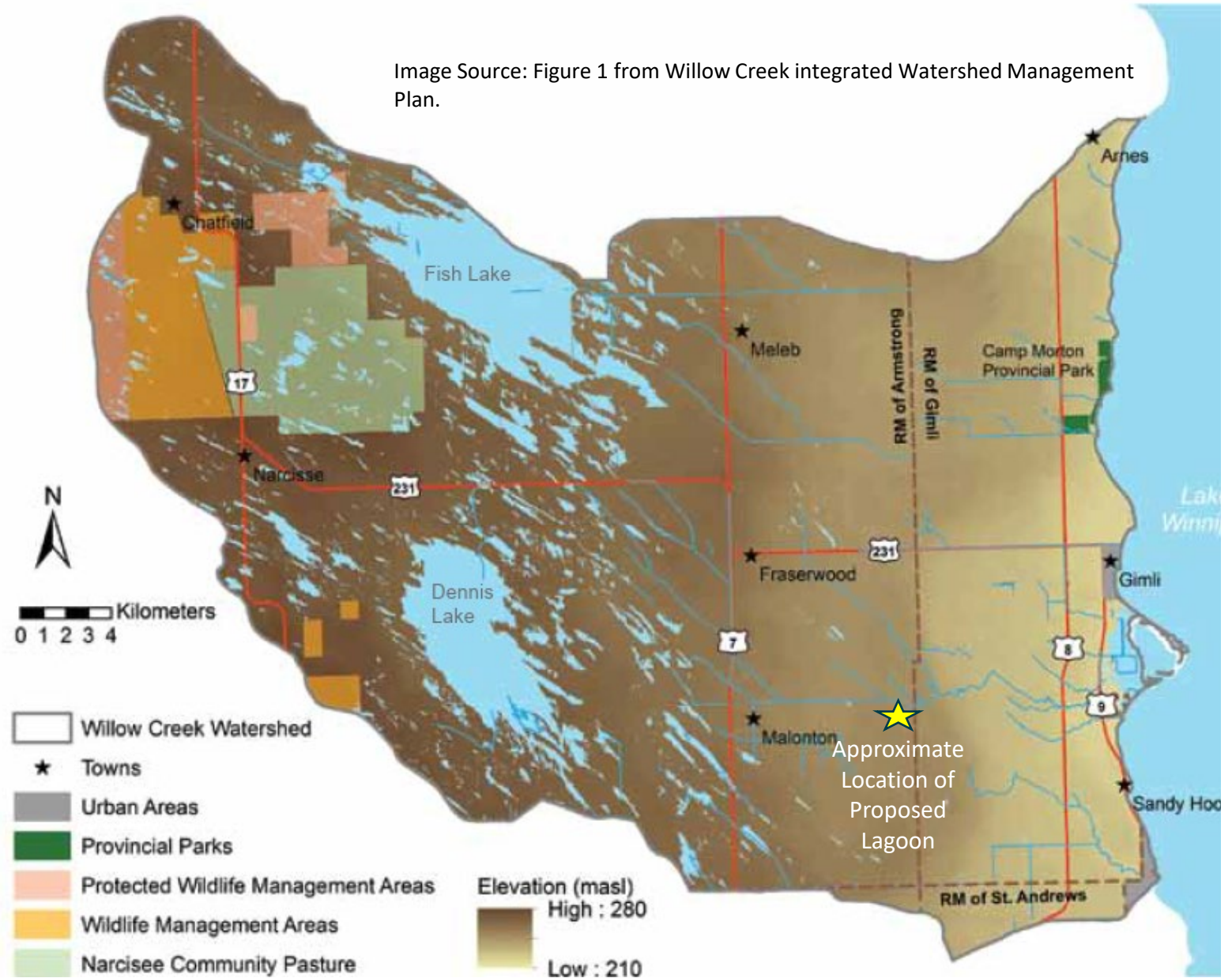
2011: **Baseline, province-wide thresholds** (like mg/L phosphorus) provided by the *Manitoba Water Quality Standards, Objectives and Guidelines*

2012: Willow Creek IWMP calls for action: “conduct environment risk assessments for all wastewater lagoons or sewage treatment plants and **establish site-specific effluent discharge objectives.**”¹

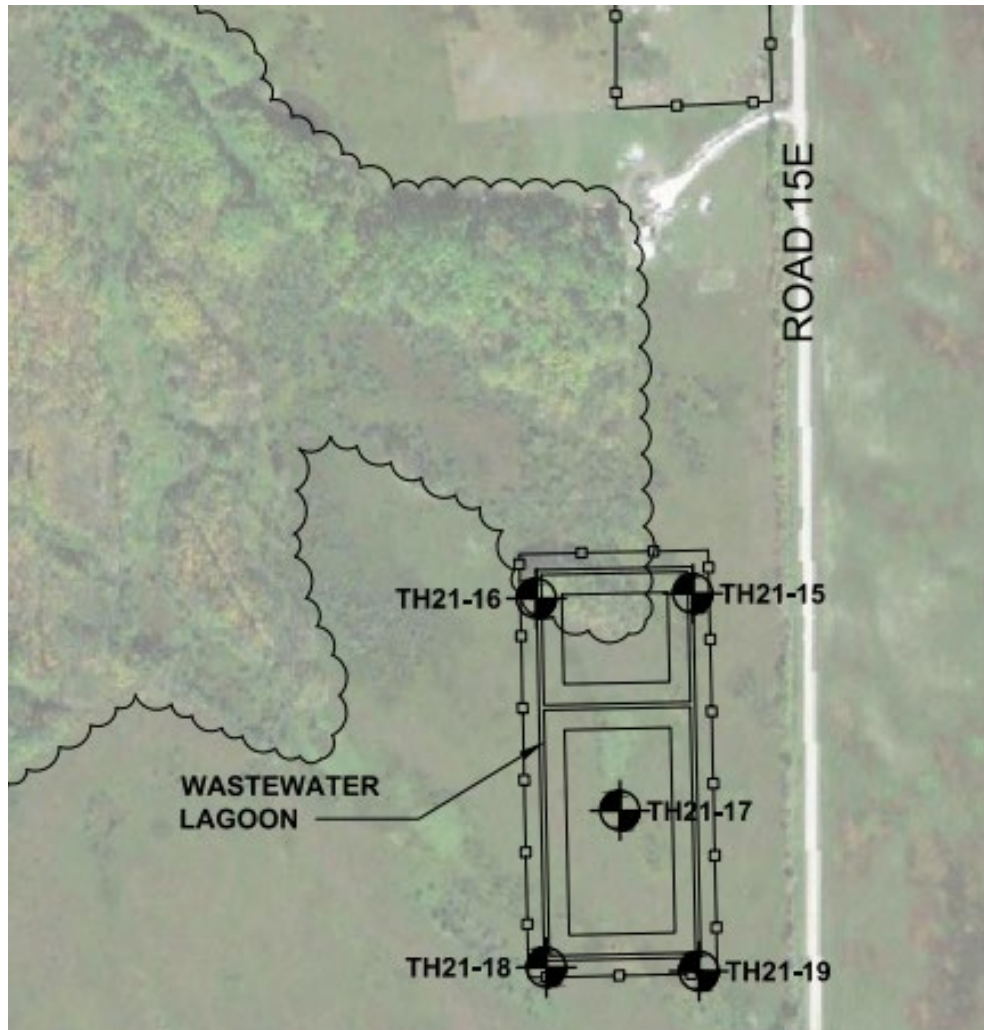
2024: New *Water Protection Act* Nutrient Targets Regulation creates a **more demanding compliance environment**; “**One-size-fits-all**” limits no longer sufficient for sensitive sub-watersheds like Willow Creek.

1. East Interlake Conservation District, 2012. The Willow Creek Integrated Watershed Management Plan. Finalized in 2016.
https://www.gov.mb.ca/sd/water/watershed/iwmp/willow_creek/documentation/willcreekplan_final_jan31.pdf

Image Source: Figure 1 from Willow Creek integrated Watershed Management Plan.

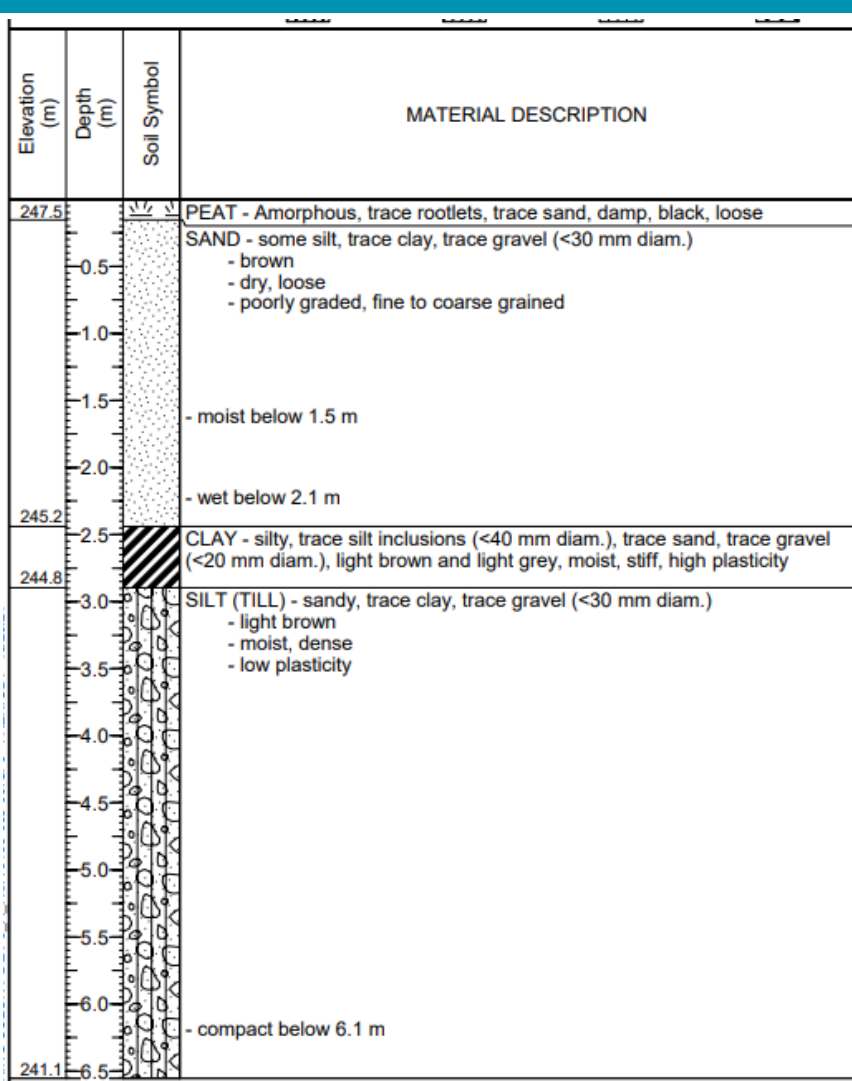


Geology at Proposed Lagoon Site (Trek, 2021)



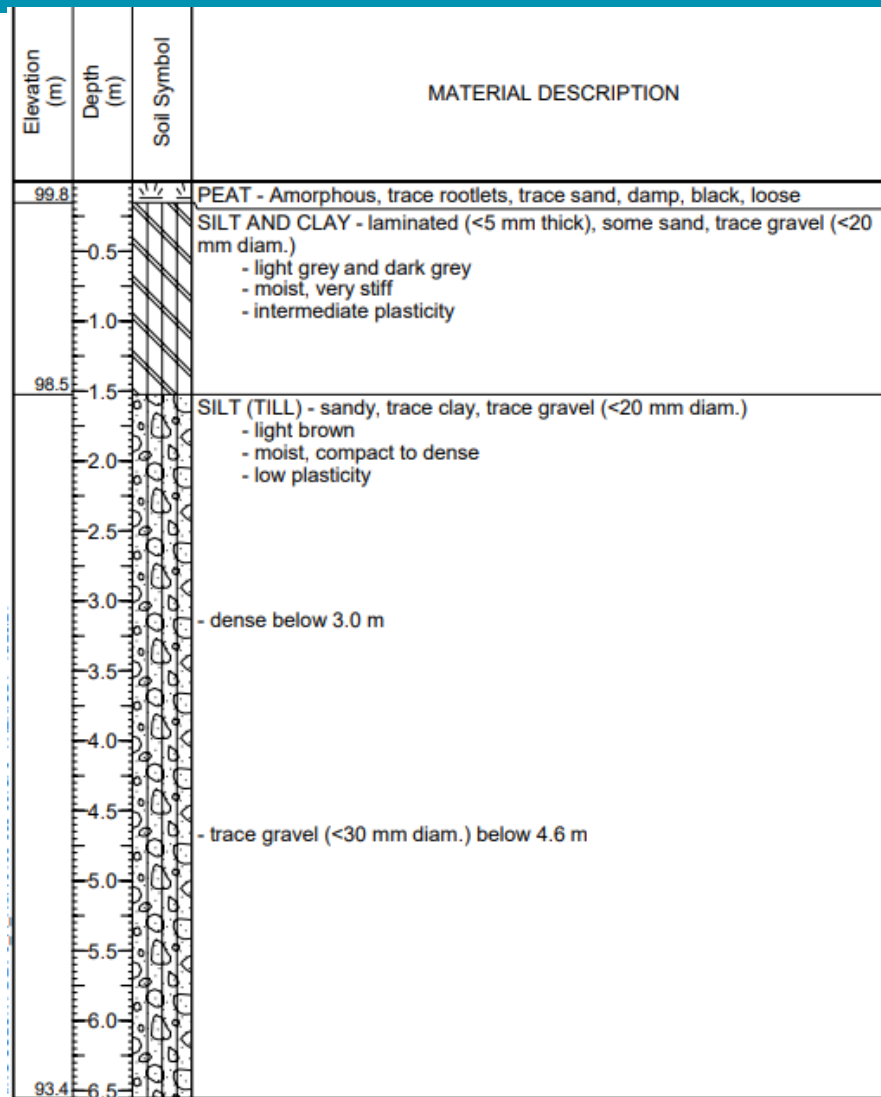
The silt and clay sample (G216) compacted to 96.5% of the SPMDD exceeded the provincial hydraulic conductivity requirements for use as a soil liner with a measured hydraulic conductivity of 1.78×10^{-8} cm/s indicating that this material will be suitable for use in a compacted liner. The permeability test results are representative of compacted silt and clay properties at a specific point and do not necessarily apply to the final properties of the silt and clay following bulk excavation, placement, and compaction. Variations in the silt and clay composition, moisture content, and compacted density can alter hydraulic conductivity properties and further testing may be required by regulatory authorities to confirm the hydraulic conductivity of the silt and clay.

Left to Right, TH21-15, TH21-16 (Trek, 2021)



Notes:

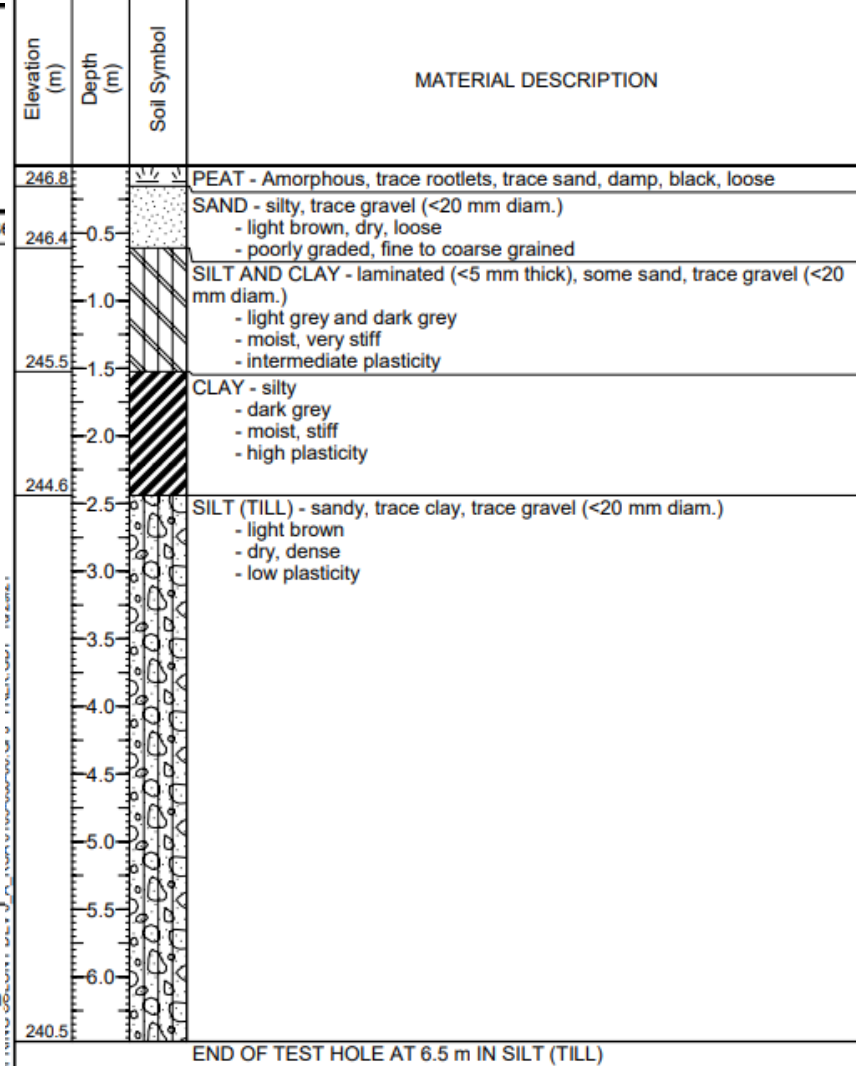
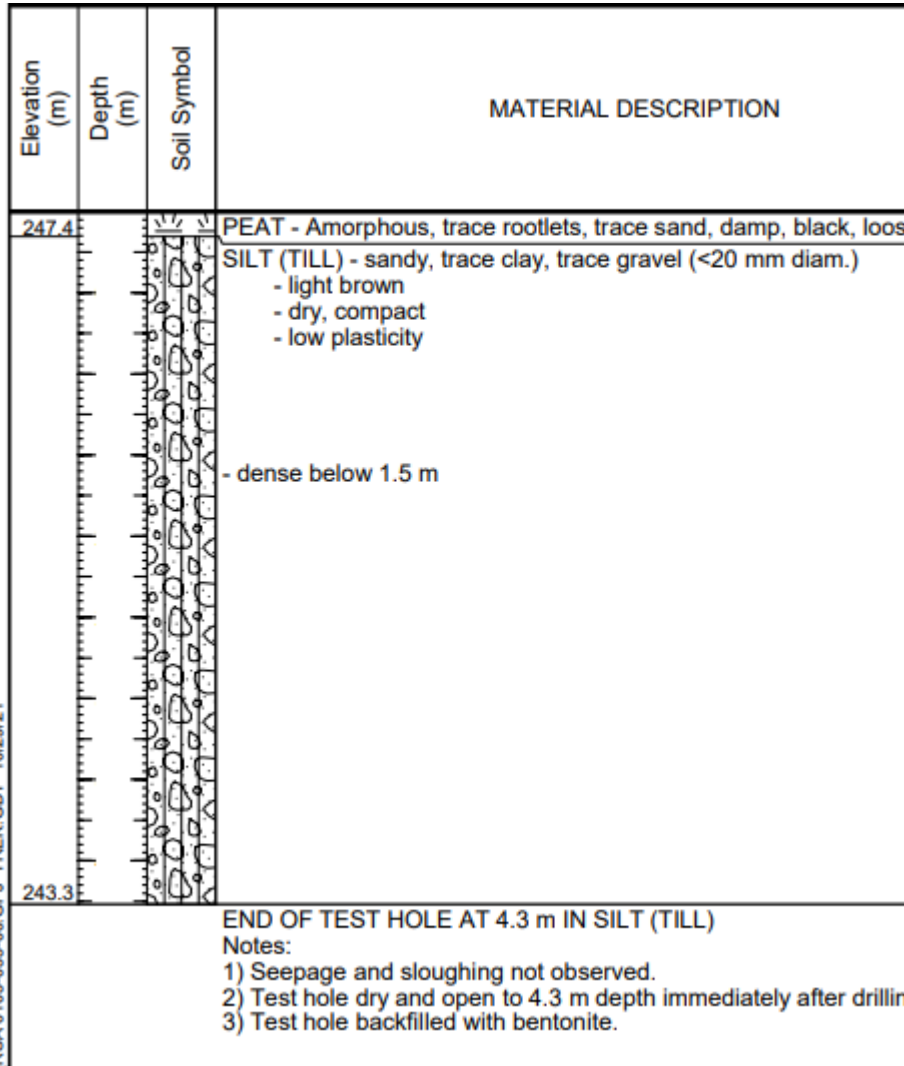
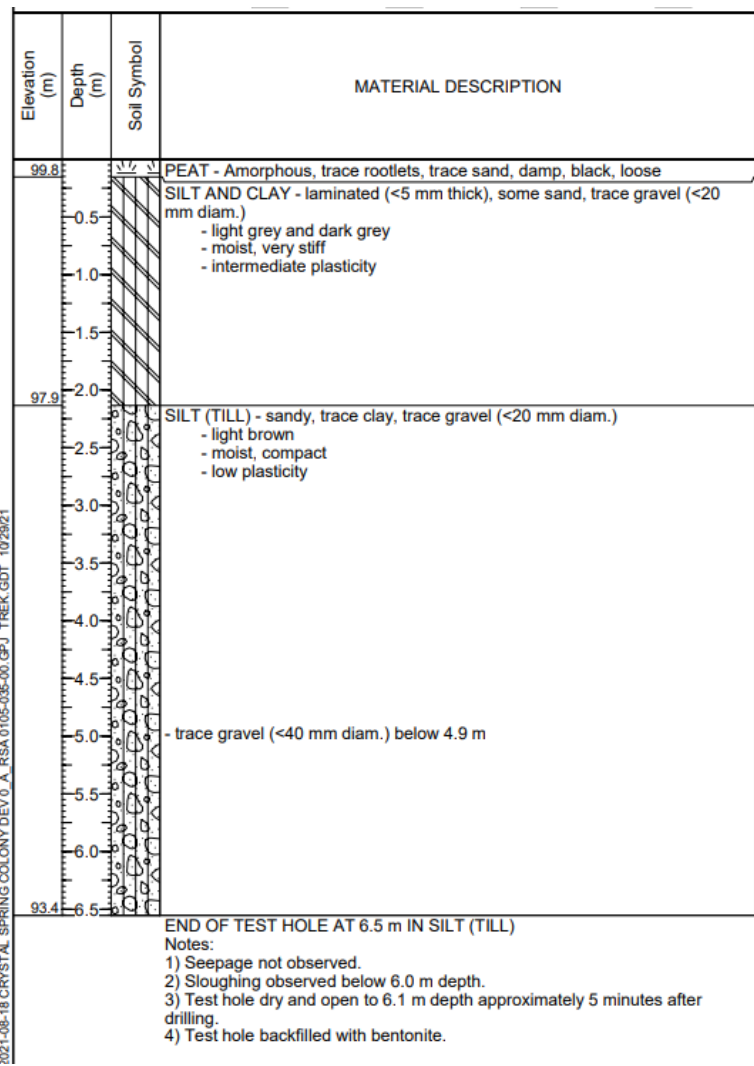
- 1) Seepage observed from 2.1 m to 2.4 m depth.
- 2) Sloughing observed from 0.1 m to 1.5 m depth.
- 3) Water level at 5.6 m depth approximately 5 minutes after drilling.
- 4) Test hole open to 5.6 m depth approximately 5 minutes after drilling.
- 5) Test hole backfilled with bentonite.



Notes:

- 1) Seepage not observed.
- 2) Sloughing observed below 5.0 m depth.
- 3) Test hole dry and open to 5.9 m depth immediately after drilling.
- 4) Test hole backfilled with bentonite.

Left to Right: TH21-17, TH21-18, TH21-19 (Trek, 2021)



Typical Hydraulic Conductivity Values of Geological Materials

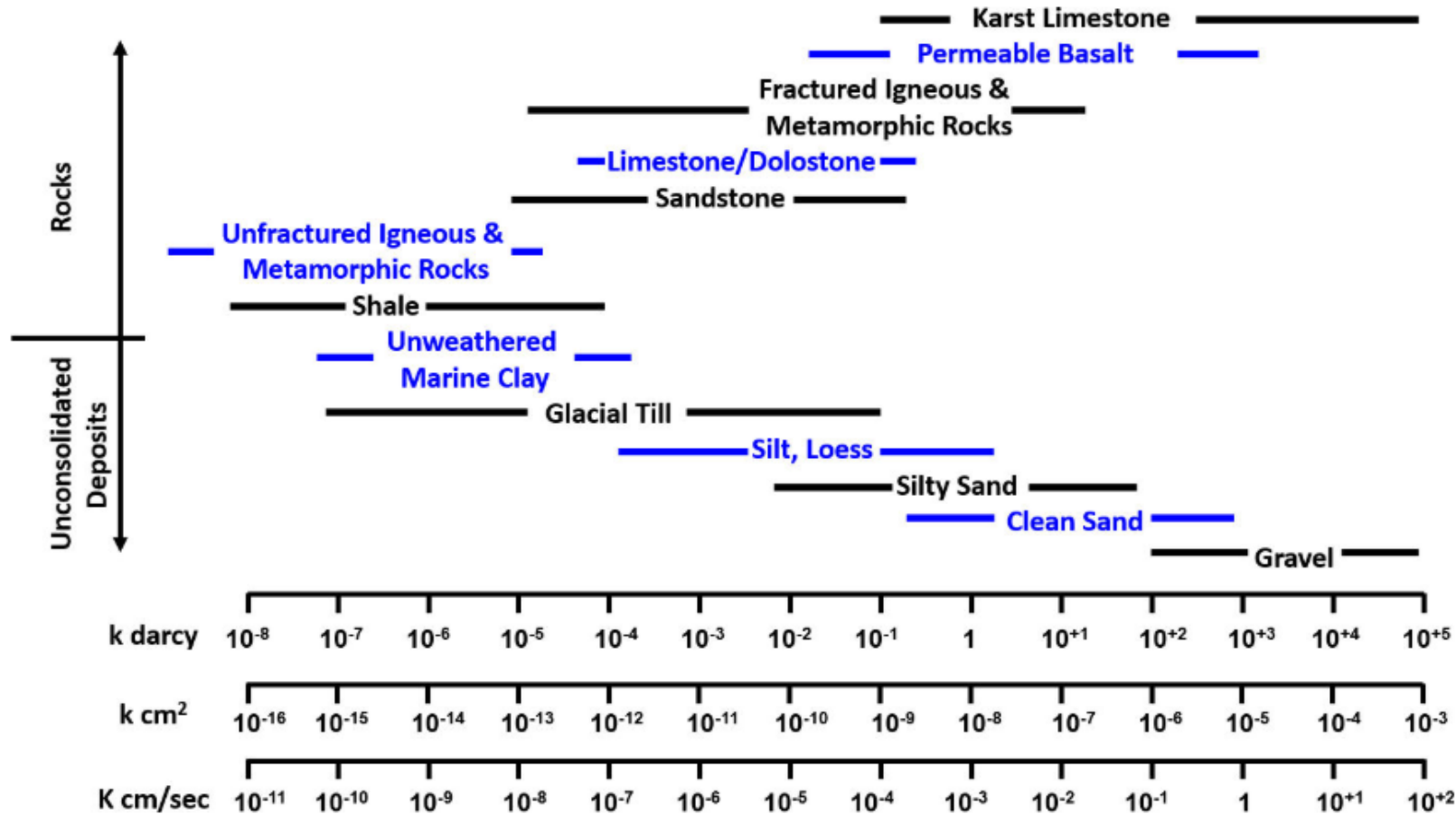


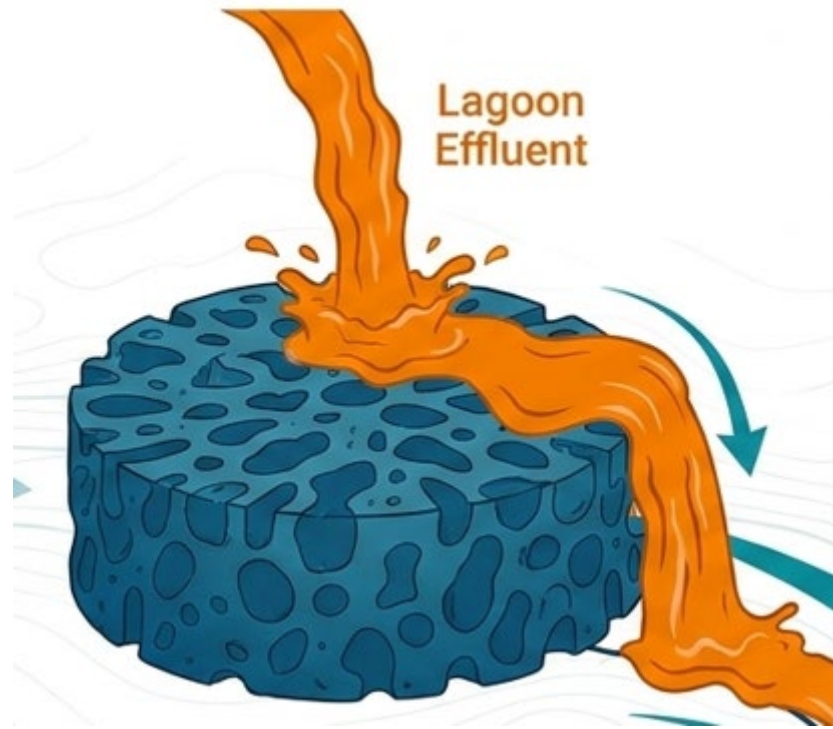
Figure 32 – Ranges of intrinsic permeability, k , and hydraulic conductivity, K , values. The alternating colors are used to make the chart easier to read. For conversion purposes, $1 \text{ cm/s} = 1.02 \times 10^{-5} \text{ cm}^2$ and $1.04 \times 10^3 \text{ darcy}$ (after Freeze and Cherry, 1979).



Photo (April 17, 2026), Facing North, from Road 106N



Wetlands Protecting Lake Winnipeg



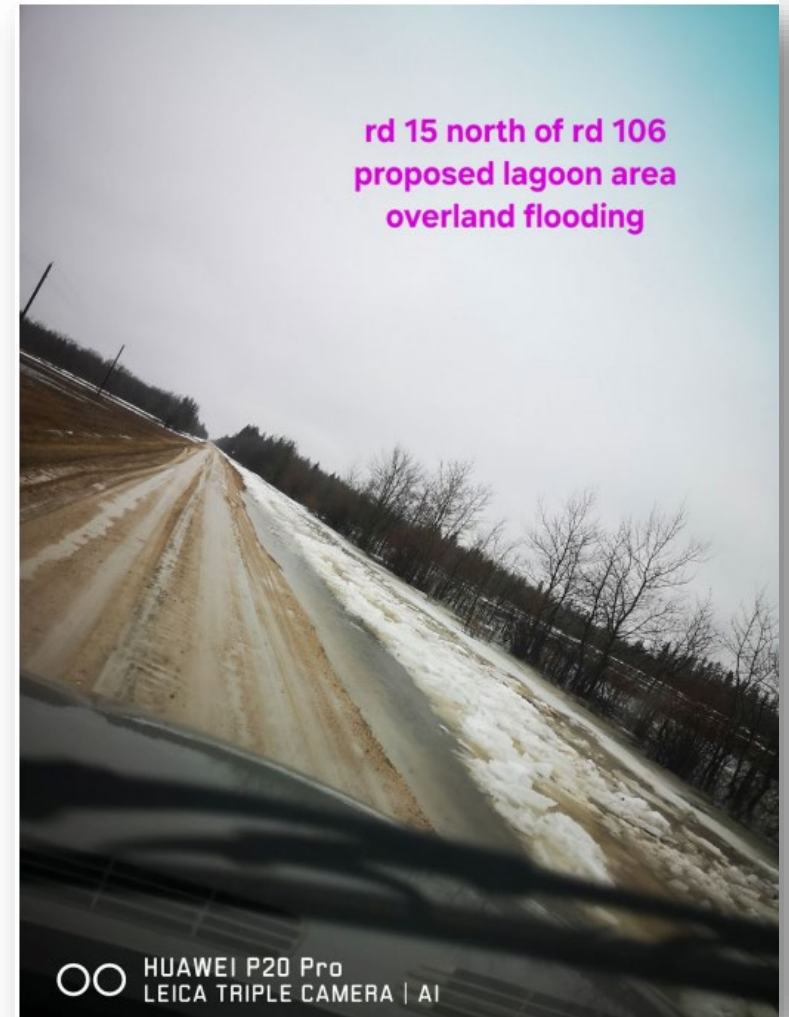
While the Husavik wetlands, when dry, can absorb limited phosphorus, **saturated wetlands (like would occur during high flow and flood years) reject new phosphorus and release old stores**

Discharge Path

Extreme hydrological events (floods, intense rains, etc.) can flush phosphorous discharged in low-flow events

- Outfall Swale to South Malonton Drain alongside Road 15E.
- 1 km North along South Malonton Drain to Willow Creek.
- 15 km East along Willow Creek to Lake Winnipeg.

Trickle discharge methodology between June 15 and November 1, releasing effluent into South Malonton Drain.



Photograph under Written Submission (WS 02 – Attachments) by T. Mishtak

Total Phosphorous – The 1.0 mg/L Regulation (2011)



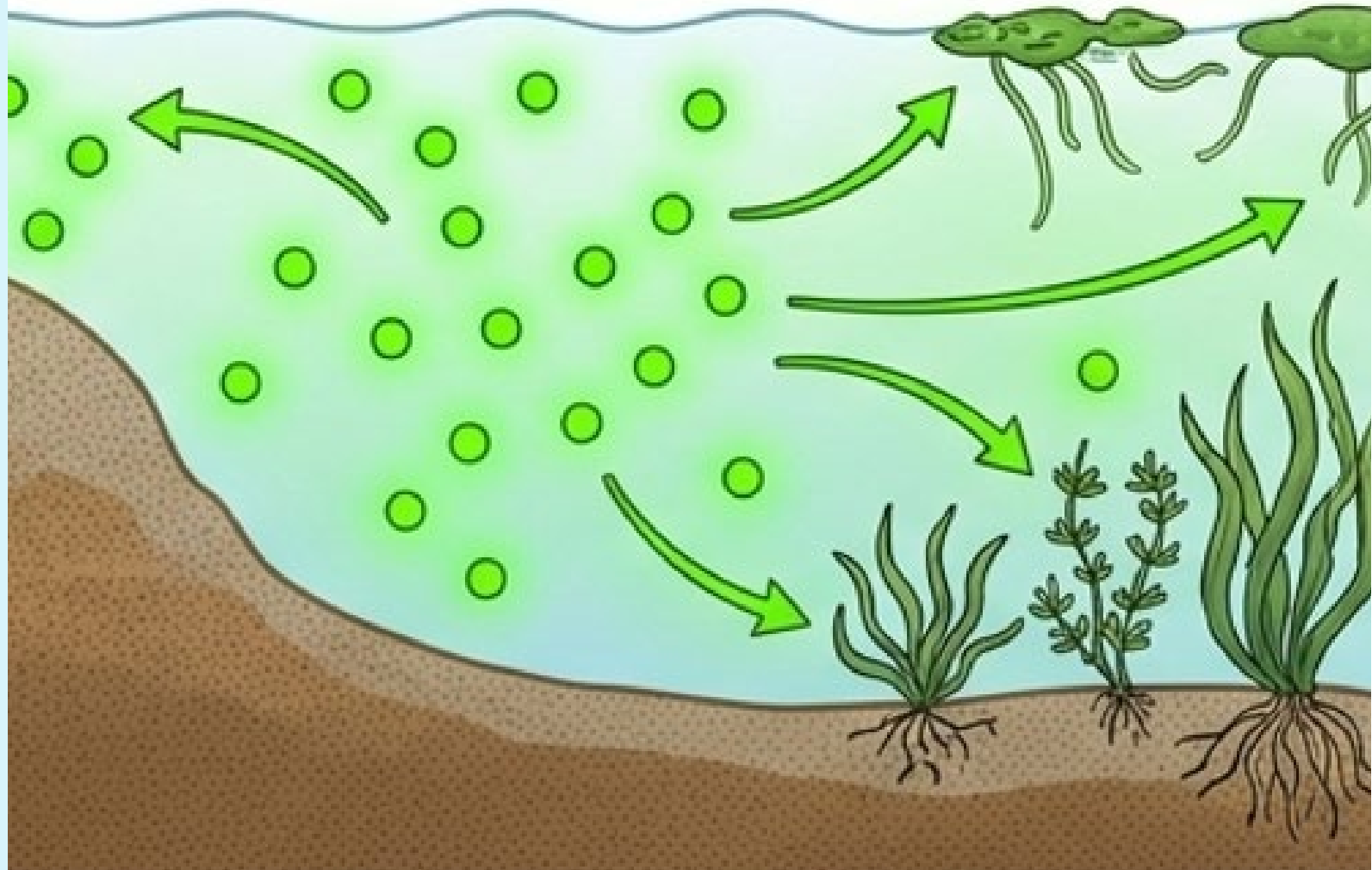
Image source : Lake Winnipeg Foundation



Technological Feasibility: At the time, 1.0 mg/L was considered "Best Practicable Technology." **Other jurisdictions with sensitive watersheds have since set more stringent watershed-specific standards (e.g., 0.5 mg/L in Ontario)**

Phosphorous Released from Wastewater Lagoons

- Effluent from municipal lagoons consists primarily of Soluble Reactive Phosphorus (SRP).
- SRP is immediately bioavailable and **accessible to primary producers like blue-green algae.**¹



1. Schindler, D. W., Carpenter, S. R., Chapra, S. C., Hecky, R. E., & Orihel, D. M. (2016). Reducing Phosphorus to Curb Lake Eutrophication is a Success. *Environmental Science & Technology*, 50(17), 8923–8929.

Effluent Discharge will Elevate Phosphorous in Willow Creek

The Proponent:	Consideration
<p><i>“In order to maintain the average total phosphorus concentration of Willow Creek of 0.06 mg/L, the maximum concentration of the lagoon effluent must also be 0.06 mg/L (or less).”</i></p>	<p>The Proponent’s proposal calls for a maximum concentration of 1.0 mg/L, above their own calculated maximum concentration to avoid increasing phosphorous in Willow Creek.</p>
<p><i>Mixing model calculations for total phosphorous in Willow Creek were carried out for the June (0.09 mg/L) and September (0.27 mg/L) discharges at 1.0 mg/L from the lagoon.</i></p>	<p>Both calculated discharges would create an increase in total phosphorous above baseline that the <i>Canadian Water Quality Guidelines for the Protection of Aquatic Life</i> (Canadian Council of Ministers of the Environment. 2004) would describe as having a high risk of observable effects and warranting further assessment.</p>

Ammonia-Nitrogen – The 1.25 mg/L Standard



Image source : Lake Winnipeg Foundation



Technological Feasibility: Traditional facultative lagoons **have inconsistent performance regarding nitrogen removal, particularly during cold-weather months** when nitrifying bacteria are less active (CCME, 2009).



Regulatory shift towards Total Nitrogen (which includes Ammonia) as a driver of cumulative impact (**including blue-green algae growth**)

Nitrogen Impacts on Willow Creek

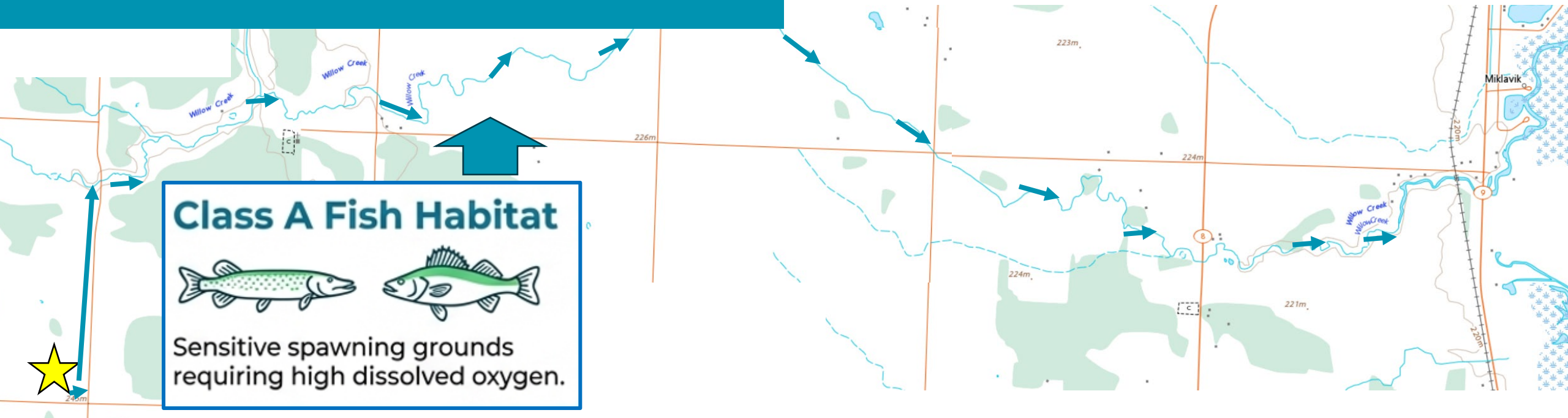
Willow Creek is designated as a Class A drain under the Manitoba Agricultural Drain Classification System. That means it:

- Has **indicator fish species** like Northern Pike and Walleye and a complex aquatic habitat (DFO & Manitoba Water Stewardship, 2013)
- Requires **stringent protection of dissolved oxygen levels and nutrient controls**
- Controls are needed to **avoid degraded spawning and nursery grounds**, particularly during low-flow summer months (Manitoba Water Quality Standards, Objectives and Guidelines, 2011)

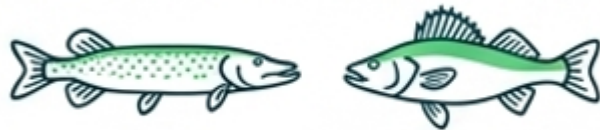
Willow Creek is a sensitive spawning ground, and Lake Winnipeg is already under duress:

- Total phosphorous concentrations above 0.05 mg/L target: **55% of times sampled**
- Total nitrogen concentrations above 0.75 mg/L target for Lake Winnipeg: **87% of times sampled.** (Water Quality Sampling Station MB05SBS279)

Distance Does Not Equal Dilution



Class A Fish Habitat



Sensitive spawning grounds requiring high dissolved oxygen.

TRANSIT TIME:
0.1 to 0.5 m/s

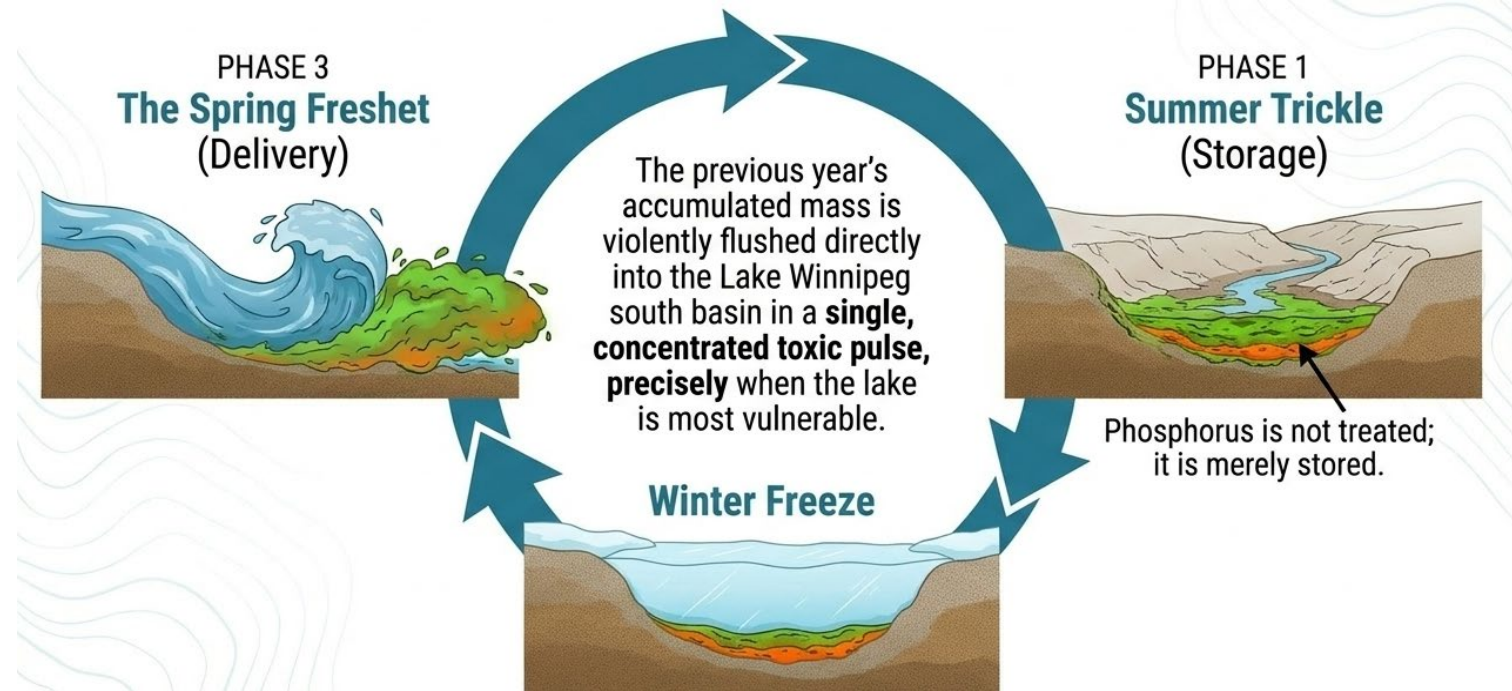
Transports dissolved constituents
9km in under 24 hours.

Discharge and the Manitoba Climate

Manitoba's climate is defined by extreme hydrological events.

Even if some phosphorus is temporarily trapped in the weeds or muck of the drain during a dry August, the Spring Freshet (snowmelt) acts as a massive "flush."

The high volume and velocity of spring runoff effectively scours the creek bed, carrying the previous year's accumulated "legacy phosphorus" into the south basin of Lake Winnipeg in a single pulse.



Willow Creek, South of Road 15E (April 17, 2026)

Willow Creek in this immediate area is susceptible to sloughing.

Following the drainage improvements for the lagoon and property, it is anticipated that increased flow will be channeled through Willow Creek. The current review has been based on topography – capacity calculations.

Increased flow will undercut the overlying soil and cause collapse.

Sediment from sloughing events can smother downstream fish spawning beds and aquatic habitats.



Hydrological Impact on Willow Creek and Adjacent Properties

ZONE 2 - PLAN IN ACTION



Land surrounding the South Malaton Drain experiences periodic flooding.

- The Province is to investigate possible upgrades along a 4 mile section of the South Malaton Drain to ensure it meets the design standard.



Land surrounding Bass Drain commonly floods.

- The Province and RM of Armstrong are to work together to complete upgrades along Bass Drain to accommodate design standard flows.



Flooding is common along the ditch on Boundary Road north of PR 229.

- RM of Armstrong is to conduct maintenance work on the ditch along Boundary Road north of PR 229.



Meleb Drain commonly experiences flooding.

- The Province is to design and complete the reconstruction of Meleb drain.



Flooding is common along PR 231 between Road 13 and Road 15.

- The Province and the RMs of Armstrong and Gimli are to investigate options to address this issue.

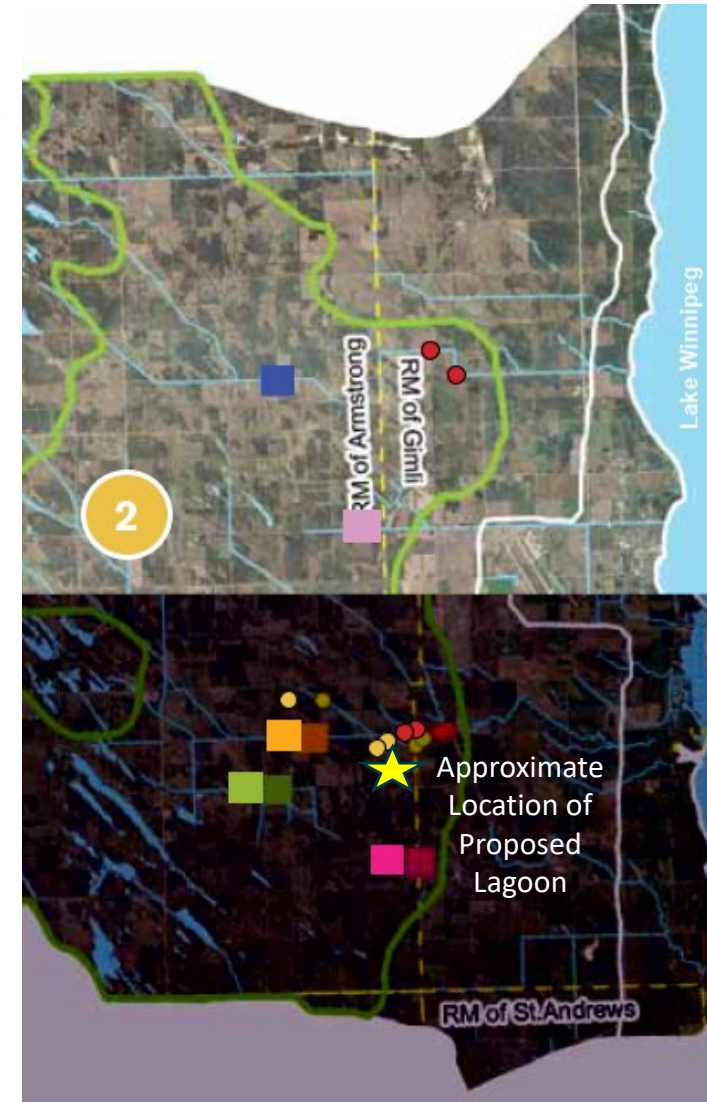


Aquatic ecosystem habitat is impaired at 7 locations within this zone. The range of impairment ranges from: minor problems like sloughing stream banks to major fish passage barriers.

- East Interlake Conservation District is to lead or facilitate the completion of these 7 projects in the order recommended in the habitat assessment.

There are a number of drains on private land that were constructed by municipalities; however, the municipalities do not have legal access to complete maintenance work.

- RMs of Armstrong and Gimli are to acquire legal access or ownership of these drains, then conduct the necessary maintenance work.



East Interlake Conservation District, 2012. The Willow Creek Integrated Watershed Management Plan. Finalized in 2016.

https://www.gov.mb.ca/sd/water/watershed/iwmp/willow_creek/documentation/willcreekplan_final_jan31.pdf

Findings following technical review of EAP File 6193.00

- **Standard Limits insufficient to meet Nutrient Targets Regulation:**
Given proximity of the lagoon and hydraulic connectivity to Lake Winnipeg, the current provincial baseline of 1.0 mg/L Total Phosphorus (TP) is insufficient alone to achieve the 2024 Nutrient Targets Regulation in the *Water Protection Act* (M.R. 77/2024).
Given that Lake Winnipeg's south basin is hypereutrophic with a target of 0.05 mg/L TP, a 1.0 mg/L discharge into a direct tributary is incompatible with cumulative loading goals.
- **It will increase algae growth in the Husavik Wetlands and residential channels:**
The lagoon's location 9 km upstream of Lake Winnipeg has high hydraulic connectivity. Even with the trickle discharge methodology, the lagoon creates a chronic supply of Soluble Reactive Phosphorus (SRP) during the peak growing season, **directly feeding algal proliferation in the Husavik Wetlands and residential channels.**
- **Effluent places fish spawning and nursery habitats at long-term potential risk:**
As a Class A drain, Willow Creek requires greater protection than a typical agricultural ditch. During low-flow periods, lagoon effluent may comprise up to 90% of the creek volume. Under these conditions, a 1.0 mg/L TP limit represents nutrient levels 20x greater than the lake's ambient objective, **posing a potential long-term risk to fish spawning and nursery habitat along the creek.**

Findings following technical review of EAP File 6193.00

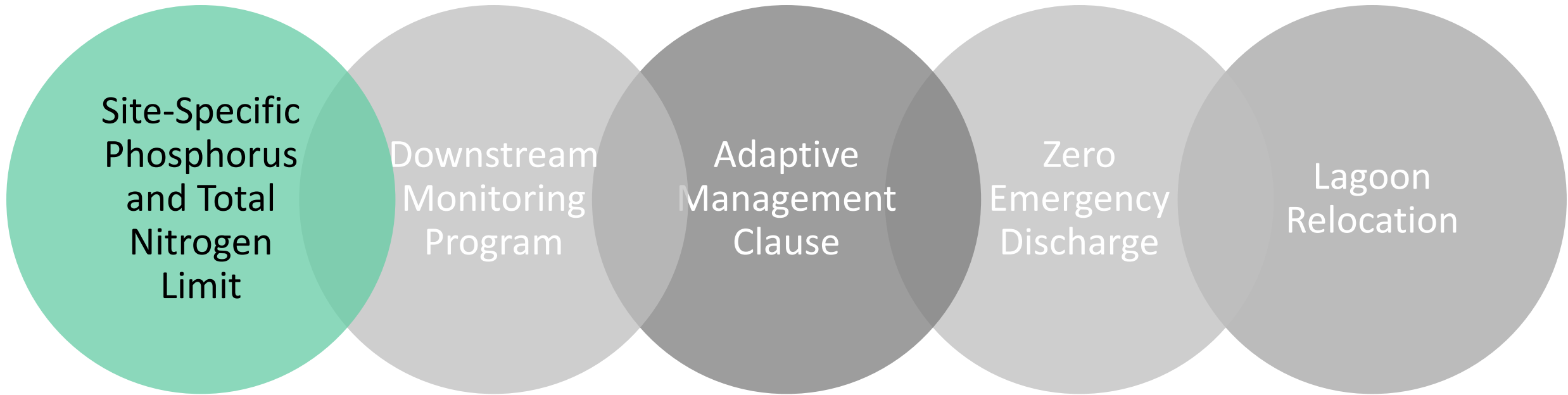
- **Abattoir waste complexity:**

The inclusion of **waste from abattoir operations** introduces a risk of Nitrogenous Biochemical Oxygen Demand (NBOD) and elevated ammonia levels that **standard facultative lagoons may struggle to treat effectively** during late-fall discharge windows.

- **No study on local hydrological impacts:**

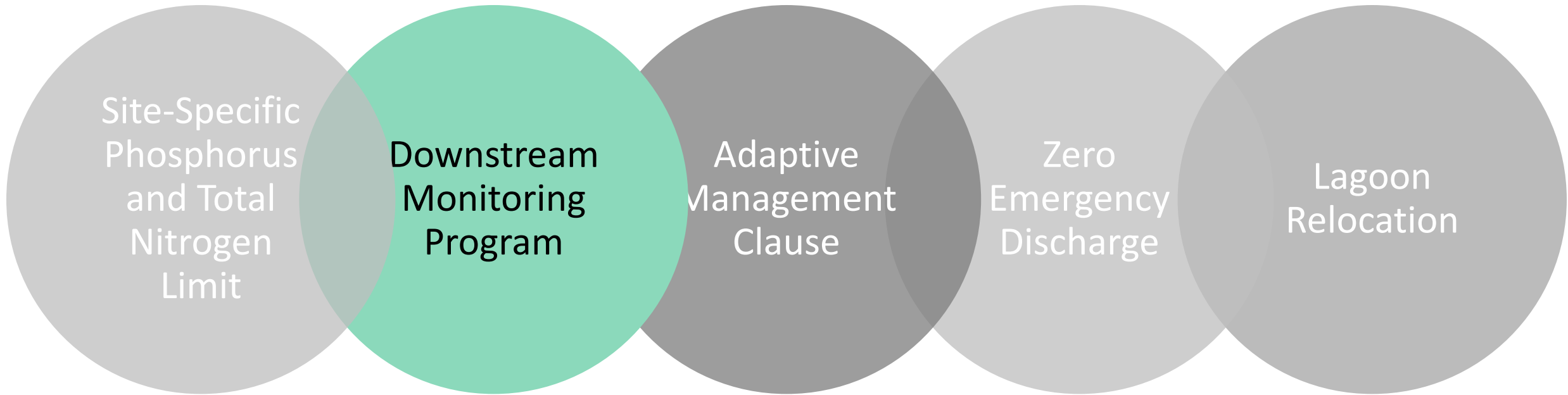
There has been **no study** on how the proposed changes to surface water drainage on the Proponent's property will impact neighbouring properties or Willow Creek.

Recommendations



The Environment Act License for File 6193.00 should mandate a site-specific Total Phosphorus and Total Nitrogen limit following a formal assimilative capacity study for Willow Creek, and the implementation of advanced tertiary treatment to meet the ambient nutrient targets in Lake Winnipeg. This aligns with best practices in comparable jurisdictions and is necessary to protect the status of the receiving environment.

Recommendations

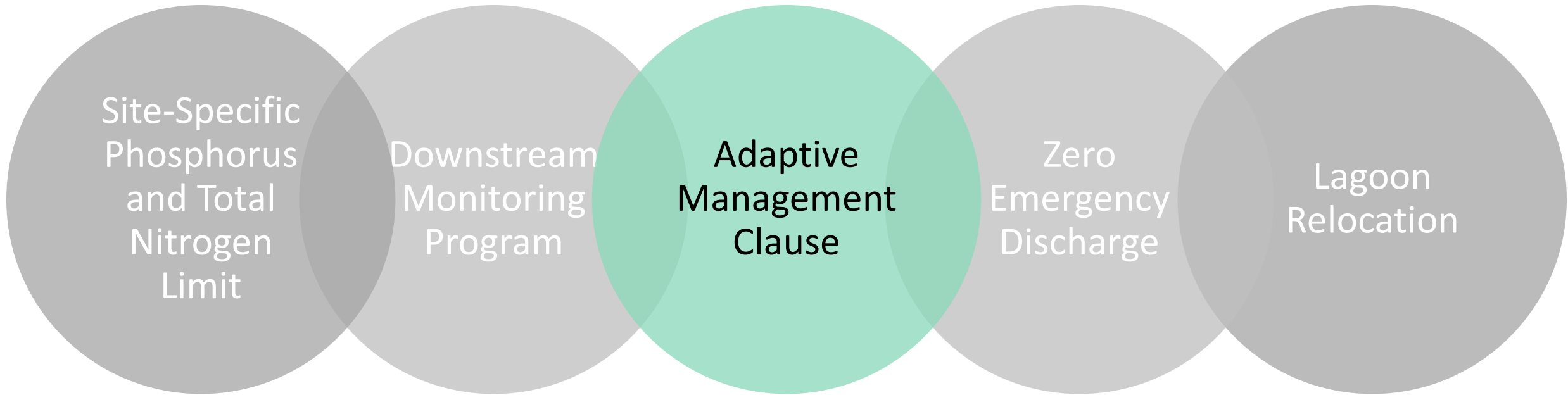


A mandatory monitoring program should be established, requiring water quality sampling at three locations:

- The lagoon discharge point (End-of-pipe).
- Willow Creek upstream of the discharge (Baseline).
- Willow Creek at the entrance to the Husavik Wetlands (Cumulative impact).
- Parameters: TP, SRP, TN, Ammonia, and Dissolved Oxygen.

Monitoring events should take place before, during discharge, and after discharge to evaluate potential migration and transport of nutrients associated with the lagoon.

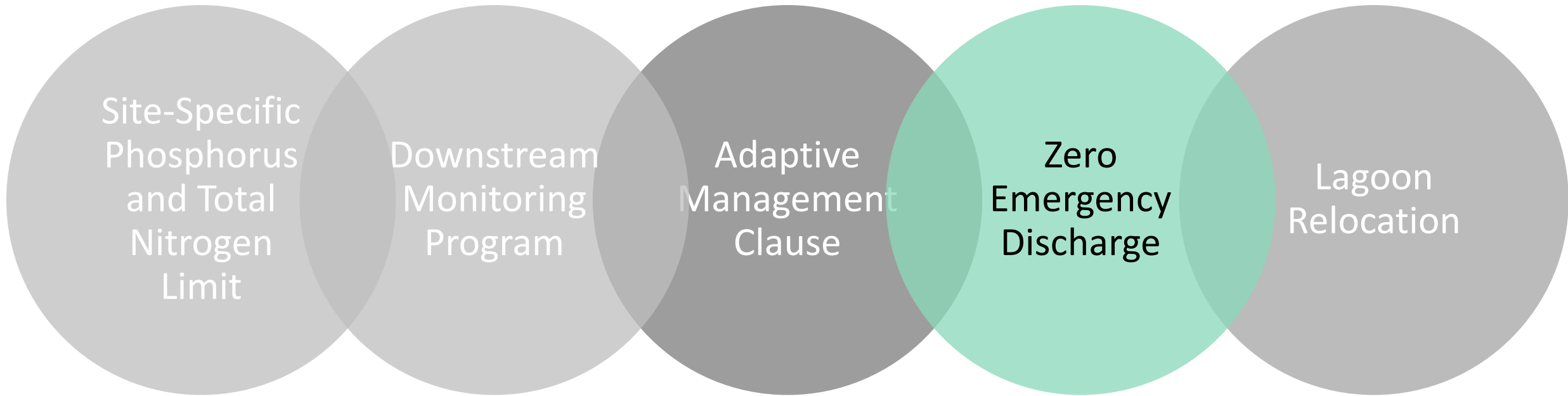
Recommendations



The license should include an Adaptive Management Clause stating that if downstream monitoring indicates a significant "Oxygen Sag" or a measurable increase in algal biomass in the 9 km reach of Willow Creek, the Proponent must further reduce discharge volumes or implement tertiary phosphorus removal technologies.

Further, annual public reporting of their "Nutrient Mass Balance," explicitly showing the phosphorus and nitrogen contributions from the abattoir separate from domestic waste.

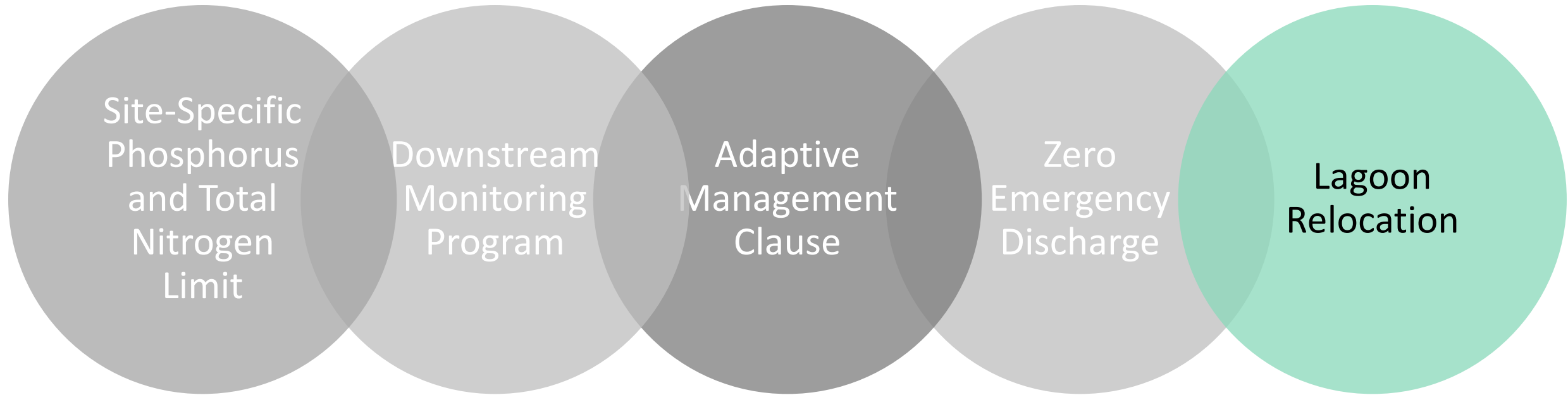
Recommendations



No emergency discharge should be permitted from the facility. The facility should have an emergency plan prepared on how they intend to deal with situations when hydraulic loading exceeds treatment capacity. One recommendation could be to truck sewage to a nearby wastewater treatment plant, alternately, a tertiary treatment could be applied at the point of discharge to meet effluent discharge limits.

We note that there is presently an Agreement between the RM of Armstrong and RM of Gimli for the wastewater treatment plant to accept RM of Armstrong's wastewater for treatment. This wastewater could be added to the existing agreement between the municipalities.

Recommendations



The lagoon should be relocated to an area of property where the setback distance does not encroach on the Rural Municipality of Gimli's potential for future development.

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