



Bremner Lagoons Site-Specific Risk Assessment

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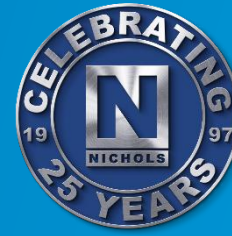
Tawnya Anderson (Nichols Environmental [Canada] Ltd.)

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Agenda



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Site Background



Risk Evaluation Approach



Risk Assessment and Results



Proposed Risk Management and Remediation Strategies





Site Background



Site Background



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- Located in Strathcona County, Alberta
- North Saskatchewan River to North
 - Groundwater flow toward the river
- Lagoon cells historically used for industrial wastewater treatment
- No new waste received since 1984
 - Currently non-operational

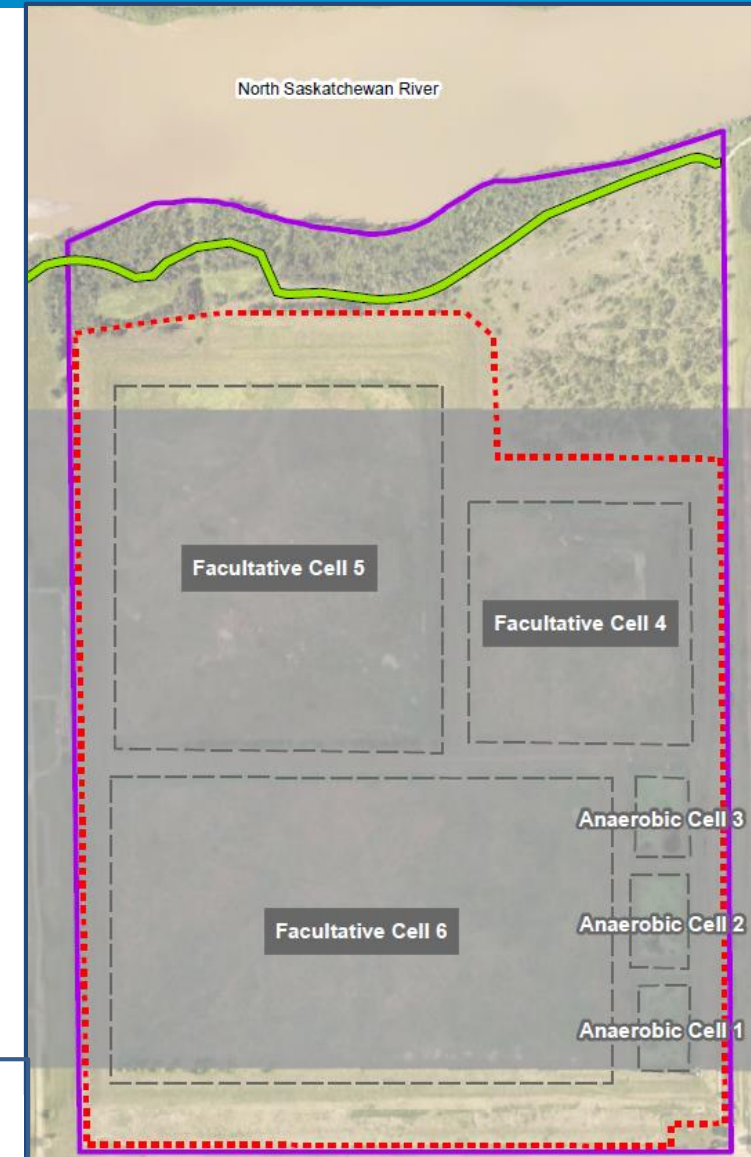


Site Background



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- **Fenced Area**
 - Contains the lagoon cells
 - Current zoning = Public Utility (PU)
 - Assumed future use = Industrial
- **River Valley Alliance Trail**
 - Crosses the north portion of the site
 - Managed by Strathcona County
 - Assumed future use = Parkland
- **Potential off-site source of contamination that is being investigated**



Legend



The River Valley Alliance Trail
(with 5m buffer)



Lagoon Cell



Property Boundary



Approximate Fence Line



Risk Evaluation Approach



Risk Evaluation Approach



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Selection of contaminants of potential concern (COPCs)



Conceptual Site Model (CSM)



Human Health Risk Assessment (HHRA)



Ecological Risk Assessment (ERA)



Assimilation analysis for groundwater to the North Saskatchewan River

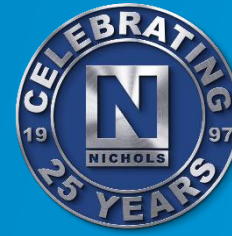




Selection of COPCs



Screening to Select COPCs

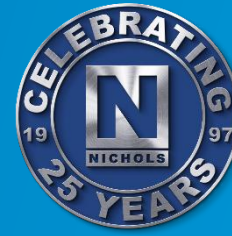


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- **Fenced Area – Public Utility/Industrial**
 - Initial Screening: Compared max parameters concentrations in soil and groundwater to **Alberta Tier 1 Soil & Groundwater Remediation Guidelines (Industrial)**
- **River Valley Alliance Trail - Parkland**
 - Initial Screening: Compared max parameters concentrations in soil to **Alberta Tier 1 Table A-3 Surface Soil Remediation Guidelines (Residential/Parkland)**



Results of COPC Screening



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Fenced Area - Soil COPCs:

- 5 metals:
 - cadmium, chromium total, copper, selenium and zinc
- 1 general chemistry parameter:
 - electrical conductivity (EC)

Fenced Area - Groundwater COPCs:

- 9 dissolved metals:
 - aluminum, arsenic, copper, iron, manganese, mercury, selenium, silver, and zinc
- 4 nutrients:
 - sulphate, nitrate, nitrite, and total ammonia

River Valley Alliance Trail - Soil COPCs:

- None





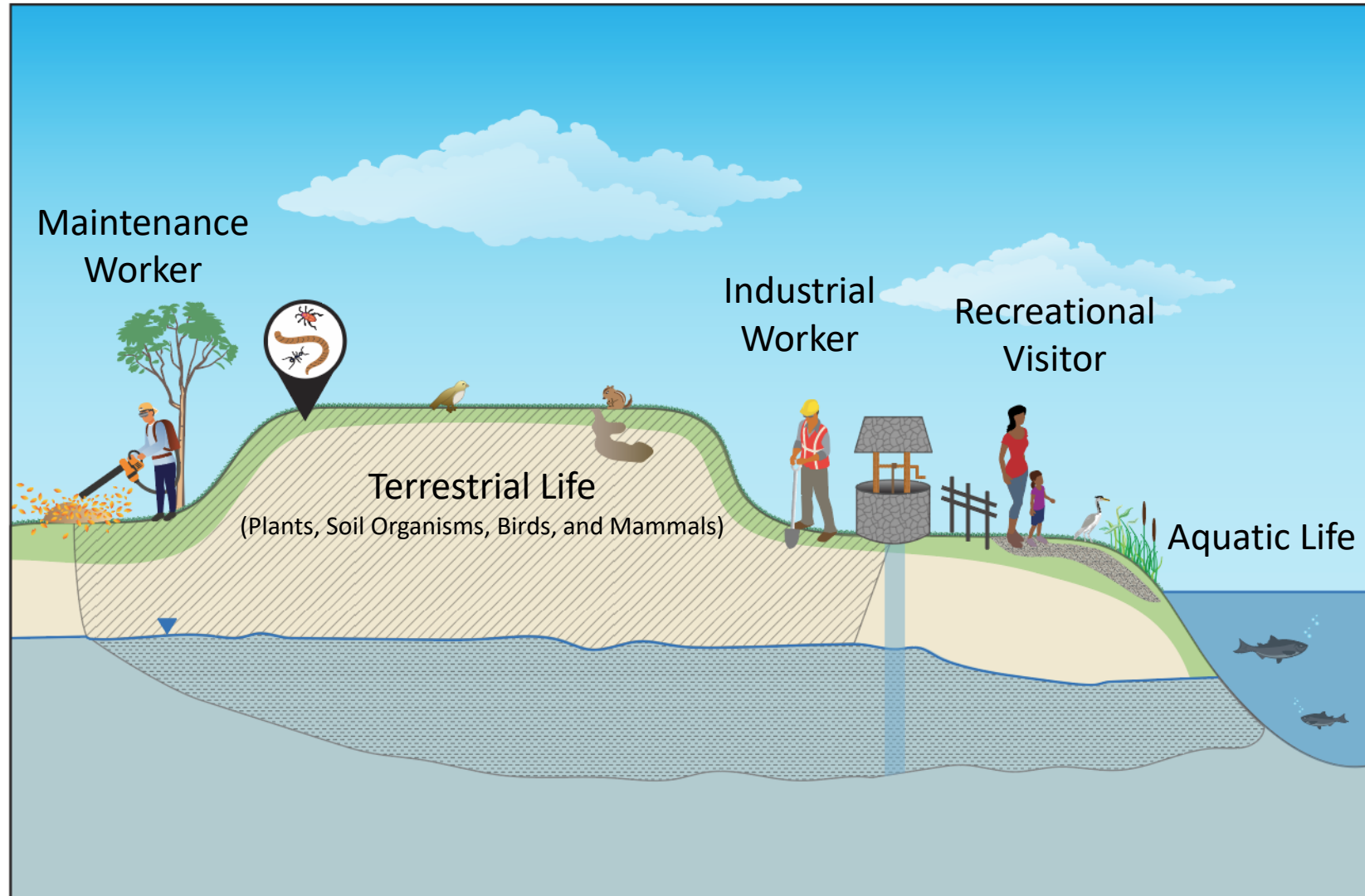
Conceptual Site Model



Conceptual Site Model



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Human Health Risk Assessment (HHRA)



HHRA Results



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Pathway	Potential for Risk?
Direct contact with surface soil	x
Off-site migration of surface soil	x
Vapour inhalation from soil and groundwater	inc
Protection of DUA from soil → groundwater	nv
Potable groundwater ingestion	✓

Ecological Risk Assessment (ERA)



ERA Results







Pathway	Potential for Risk?	
	Step 1. 2° Screening	Step 2. Detailed Analysis
Soil		
• Direct contact with surface soil → <i>Trophic level analysis</i>		
• Protection of freshwater aquatic life		
• Nutrient/energy cycling check		
• Off-site migration		

ERA Results



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Pathway	Potential for Risk?	
	Step 1. 2° Screening	Step 2. Detailed Analysis
Groundwater		
• Direct contact with groundwater		
• Aquatic life → <i>Assimilation analysis</i>		



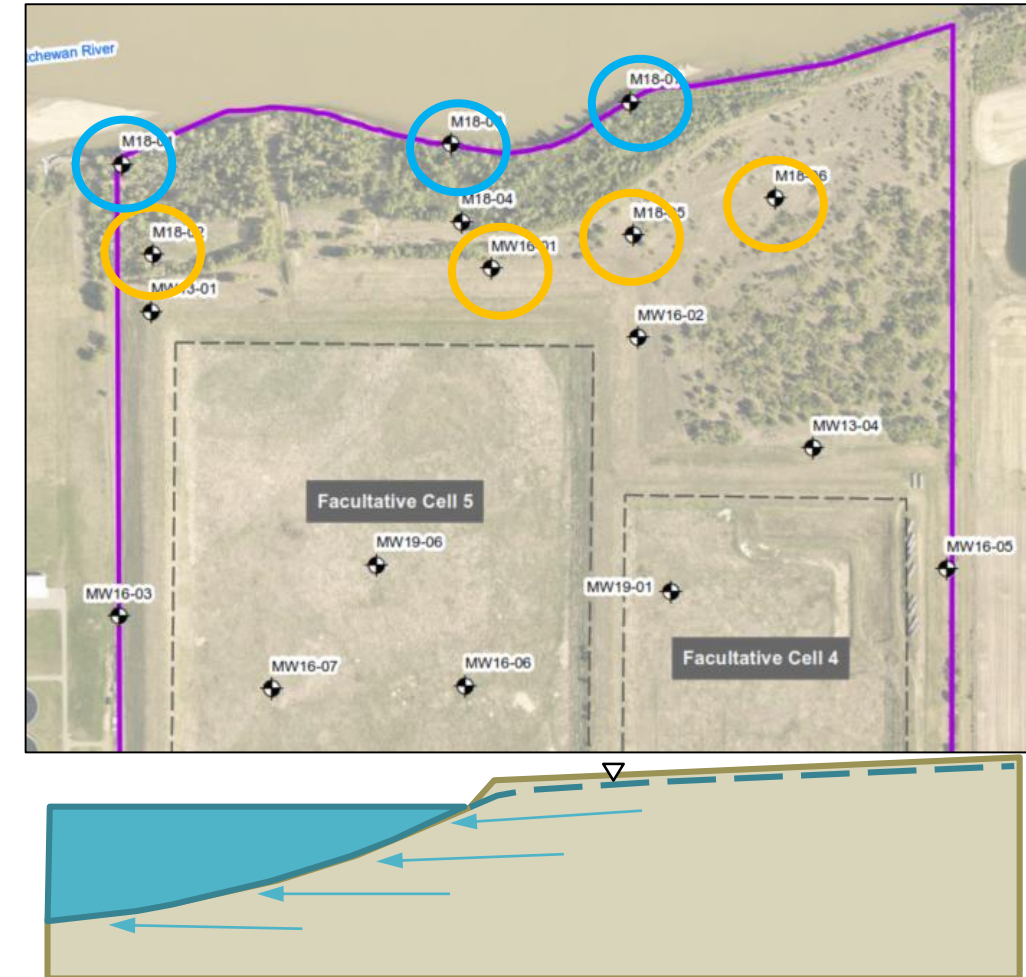
Assimilation Analysis



Assimilation Analysis



- Evaluation of potential effects on aquatic receptors in North Saskatchewan River
- Conservative assumptions:
 - Maximum site groundwater concentrations – no dilution/assimilation
 - Maximum discharge volume
 - Minimum flow in the NSR
 - Site groundwater mixing with only 5% of NSR flow
- Cumulative total concentrations (river + site) compared to EQGSW



Assimilation Analysis



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COPC	River Background (mg/L)	Calculated Change (mg/L)	EQGSW (mg/L)	Concern?
Ammonia	0.0335 to 0.2235	0.01 to 0.02	9	No
Nitrate + Nitrite	0.1280 to 0.3045	0.001	3	No
COPC	River Background (µg/L)	Calculated Change (µg/L)	EQGSW (µg/L)	Concern?
Aluminum (dissolved)	34 to 148	- 0.004 to 0.004	50	No
Arsenic	<0.2 to 2.40	0.11 to 0.23	5	No
Cadmium	<0.01 to 0.095	0.0012 to 0.0026	0.37	No
Chromium	1.1 to 6.4	0.0905 to 0.1927	8.9	No
Copper	3.0 to 9.3	0.0818 to 0.1742	7	No
Iron (dissolved)	5 to 80	106 to 226	300	No
Lead	0.3 to 5	0.072 to 0.153	7	No
Manganese	48 to 375	6 to 13	n/v	No
Mercury (total)	0.0185 to 0.05	0.00018 to 0.00039	0.005	No
Selenium	0.10 to 0.70	0.00049 to 0.00104	1.0	No
Zinc (total)	2 to 39	0.366 to 0.799	30	No

- In almost all cases, calculated changes in COPC concentrations are not measurable by commercial laboratories
- In no cases did COPC concentrations in groundwater cause EQGSW exceedances

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Results Summary



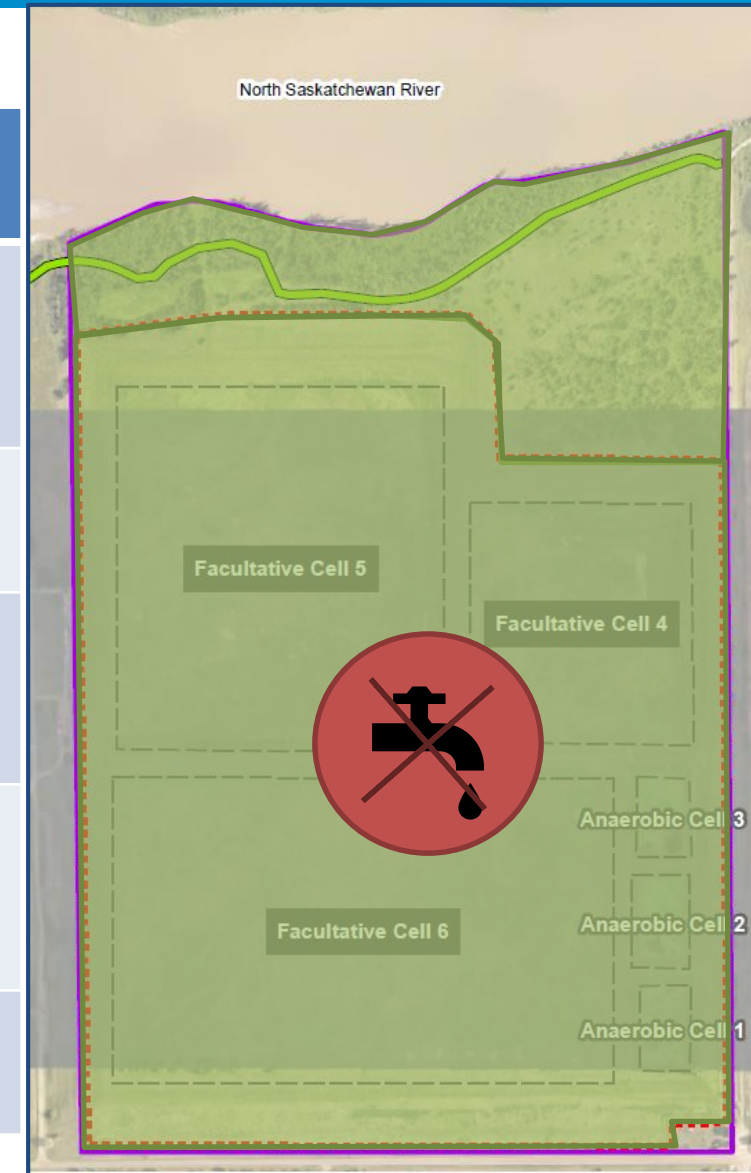
Results Summary



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HHRA Results Summary:

Location	Human Receptors	Pathway	Potential Risk?
Fenced Area	Industrial Worker	Ingestion of on-site groundwater as drinking water source	<u>Yes</u>
		Vapour inhalation from soil and groundwater	No
	Maintenance Worker	Direct contact and of-site migration of surface soil	No
	Trespasser	Protection of domestic use aquifer from surface soil	No
River Valley Alliance Trail	Recreational Visitor	Direct Soil Contact	No



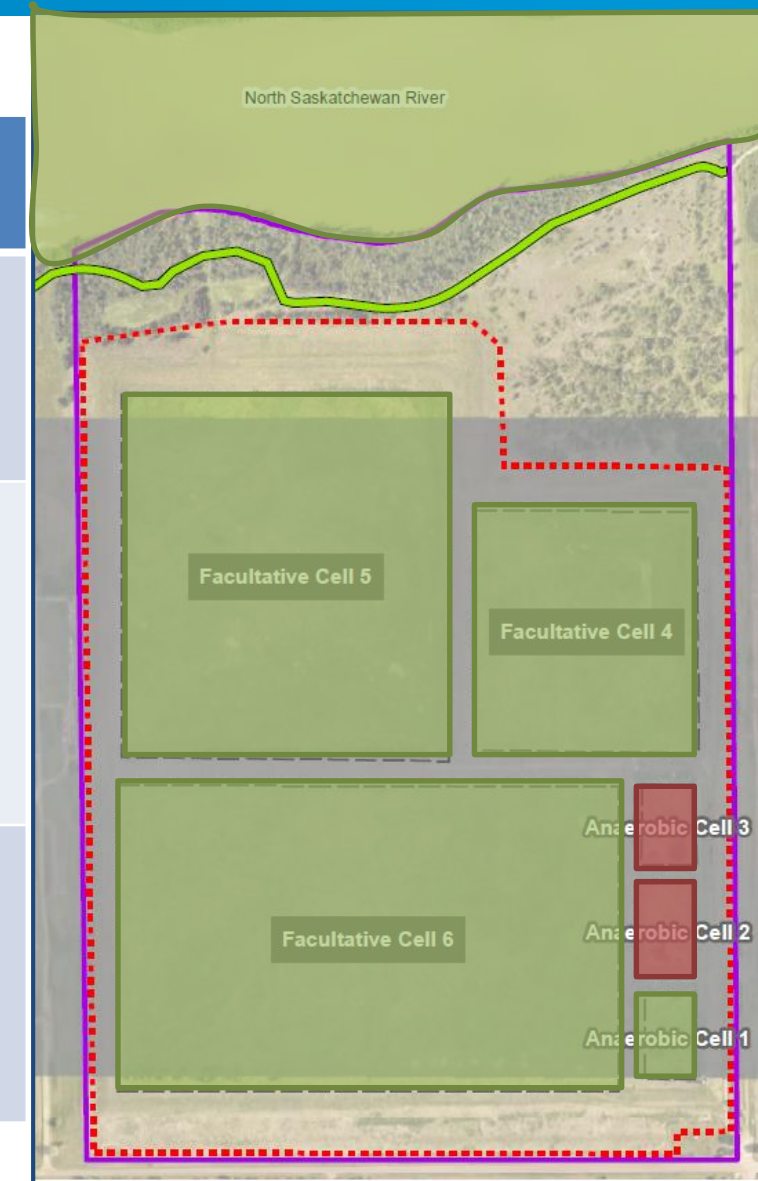
Results Summary



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ERA Results Summary:

Location	Ecological Receptors	Pathway	Potential Risk?
Cells 2 and 3 (Fenced Area)	Terrestrial Receptors	Soil exposure <ul style="list-style-type: none"> Plant uptake Direct contact and ingestion Ingestion of plants and invertebrates/mammals 	<u>Yes</u>
Cells 1, 4, 5, 6 (Fenced Area)			No
North Saskatchewan River	Aquatic Receptors	Groundwater migration to river <ul style="list-style-type: none"> Direct contact and ingestion 	No adverse effects

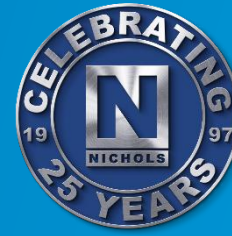




Proposed Risk Management and Remediation Strategy



Risk Management Measures



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- Risk Management Measures proposed:
 - Shallow soil cap to address limited impacts in on-site soil in Cells 2 and 3
 - Restriction on use of on-site groundwater as drinking water source
- Reclamation Plan proposed:
 - Phytoremediation
 - Groundwater monitoring



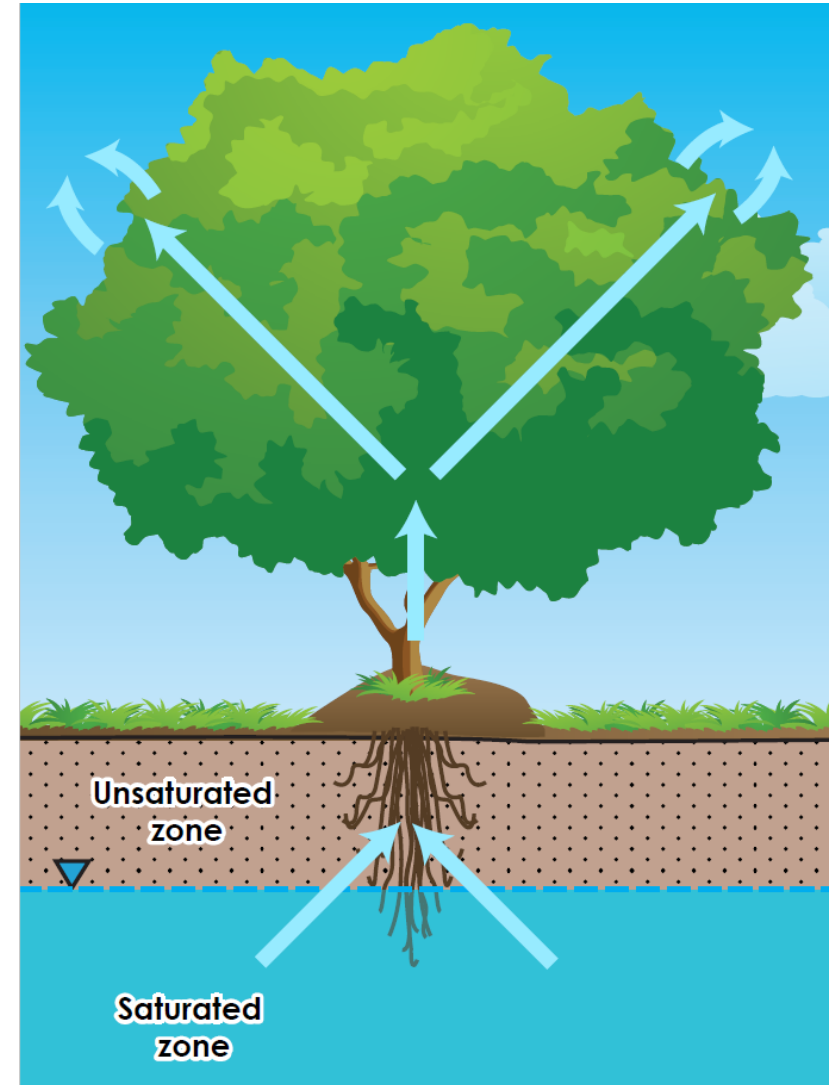
Proposed Reclamation Plan – Phytoremediation



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Key remedial objectives:





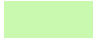

1. Remediation of groundwater and biosolids impacts
 - Removal of nitrogenous compounds
 - Removal of metals and selenium impacts
2. Hydraulic control of site groundwater
 - Plant root uptake of groundwater in aquifer and water in unsaturated surficial soils

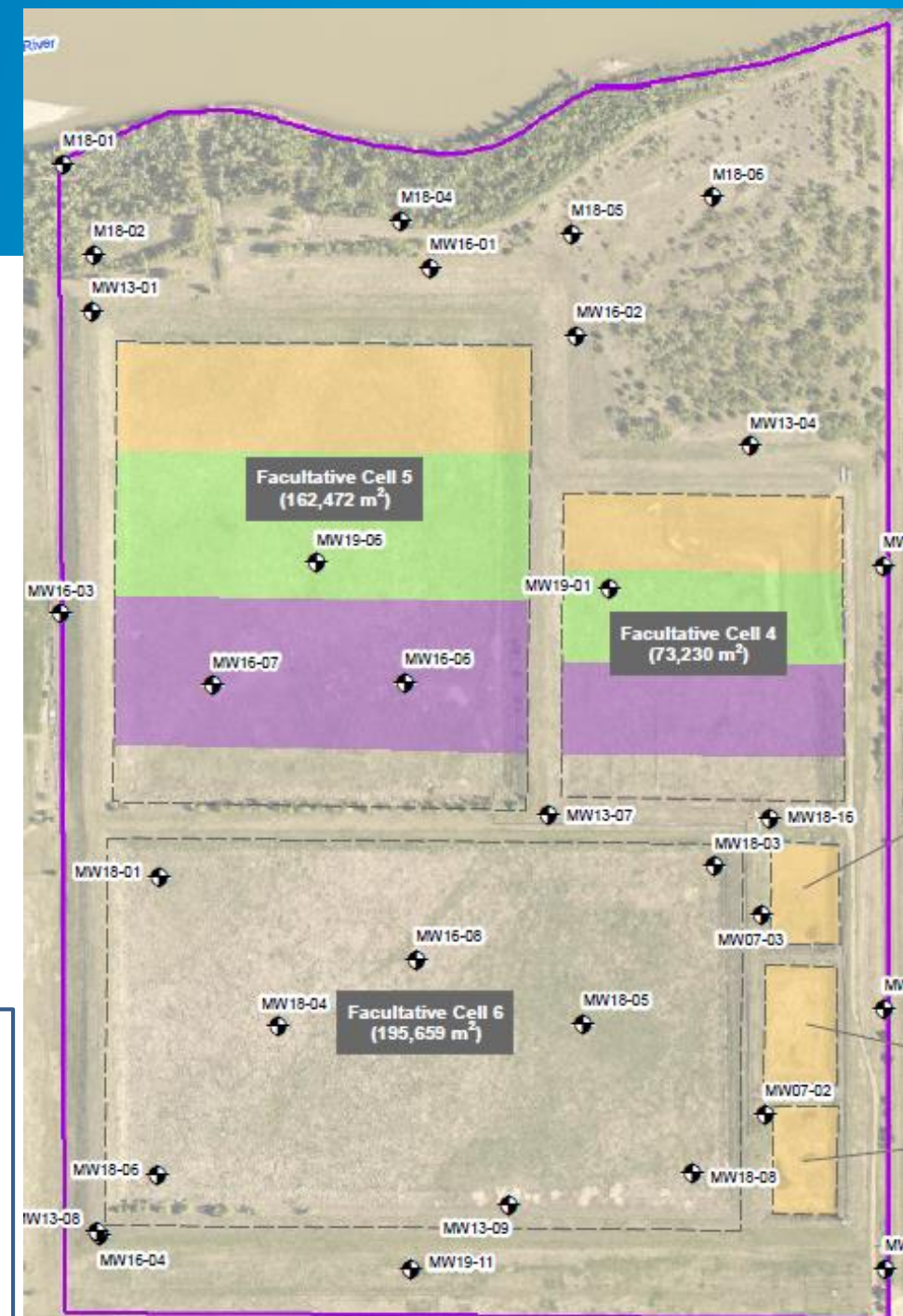


Proposed Reclamation Plan

- Phytoremediation on ~50% of lagoon cell surfaces
- Long-term monitoring, 20 years post-implementation
 - Tree health assessments
 - Groundwater monitoring
 - Reporting

Legend

-  Groundwater monitoring well
-  Lagoon Cell
-  Property Boundary
-  Proposed Phase 1 (Year 1) Phytoremediation
-  Proposed Phase 2 (Year 2) Phytoremediation
-  Proposed Phase 3 (Year 3) Phytoremediation



Thank you!



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