

# Process Guide for Approaching Salt Contamination – Supplementary Work on Regulatory Gaps

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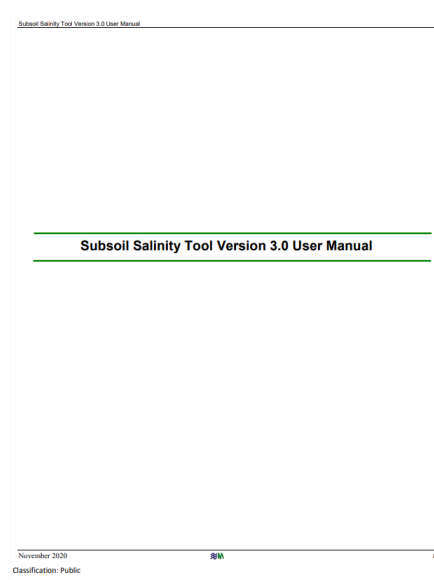
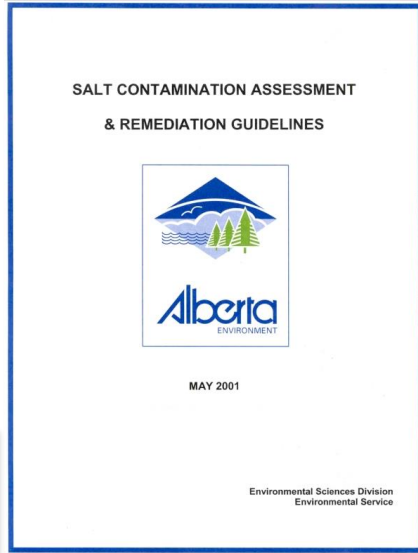
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# Stage 1 Summary - Key Regulatory Documents

Alberta tier 1  
soil and groundwater  
remediation guidelines

Alberta tier 2  
soil and groundwater  
remediation guidelines



Native Prairie Protocol  
for Reclamation  
Certification of  
Salt-Affected Wellsites

OCTOBER 2019



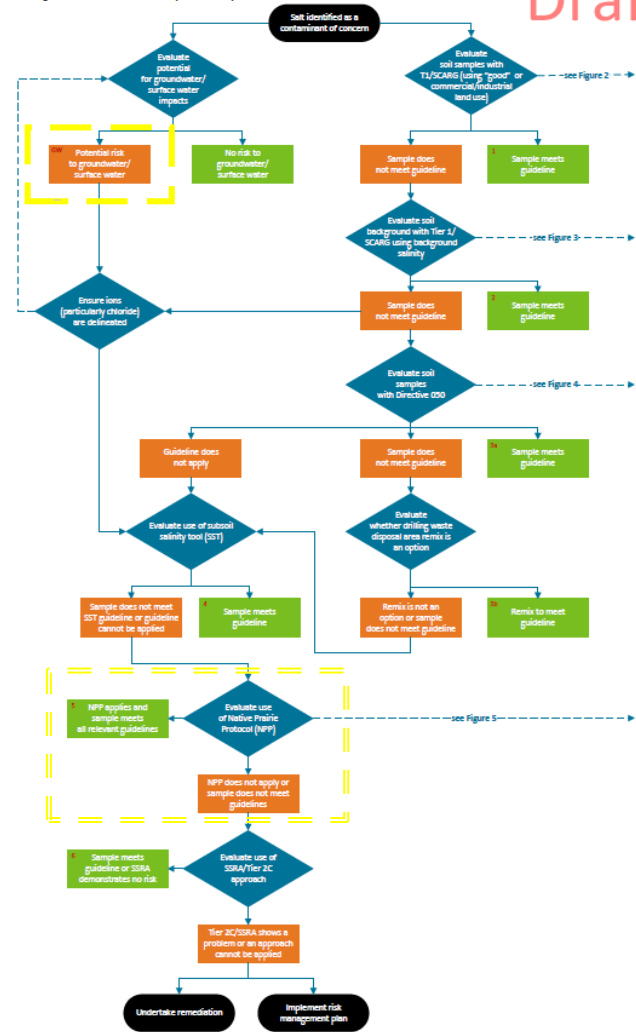
Assessing Drilling Waste  
Disposal Areas:  
Compliance Options for  
Reclamation Certification

March 2014

# Stage 1 - Process Flow

- DRAFT process flow developed
- Intent is to find the most efficient “end point”
- Users move through the flow process until guidelines are met
- Summary of existing guidance (no new guidance)

FIGURE 1. High-level Salt Process Flowchart (Flow Process)



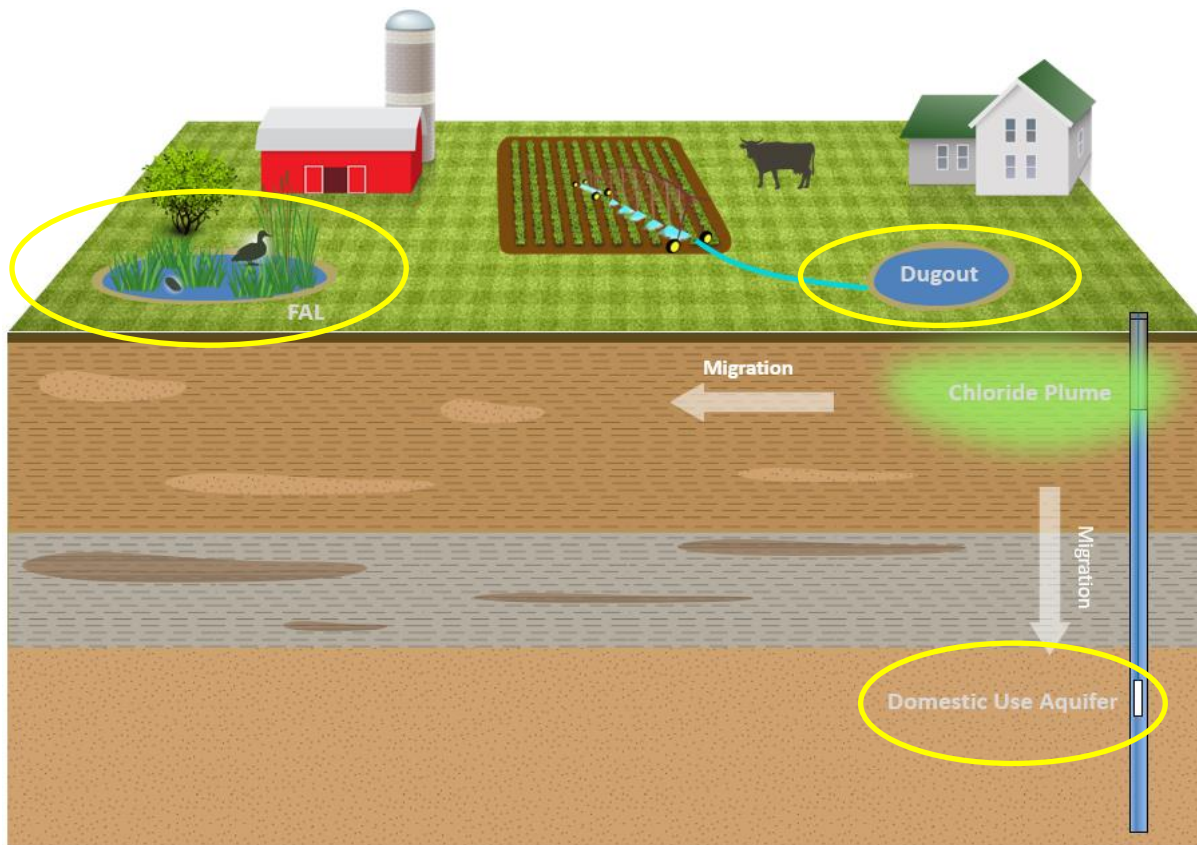
## Stage 2- Evaluation of Risk to Groundwater

Understanding the risk to groundwater posed by chloride in soil is a particularly pertinent issue:

- No consistent guidance on when there is no groundwater risk
- Delineation of elevated concentrations does not directly inform on the risk of adverse effect
- Tier 1 guideline values are applicable at the point of compliance



# Groundwater Exposure Paths Evaluation



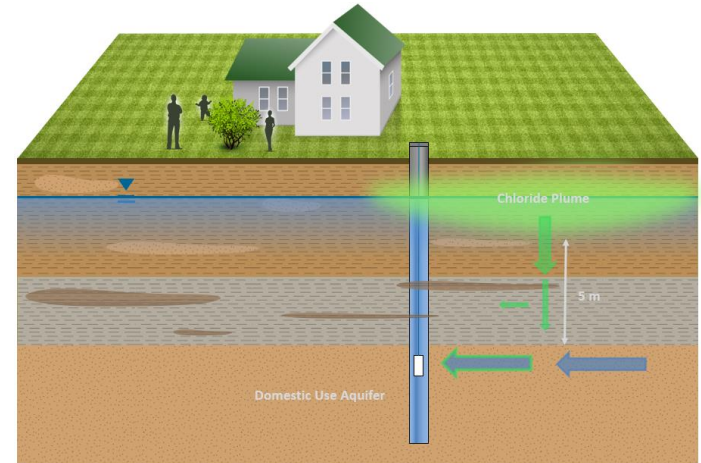
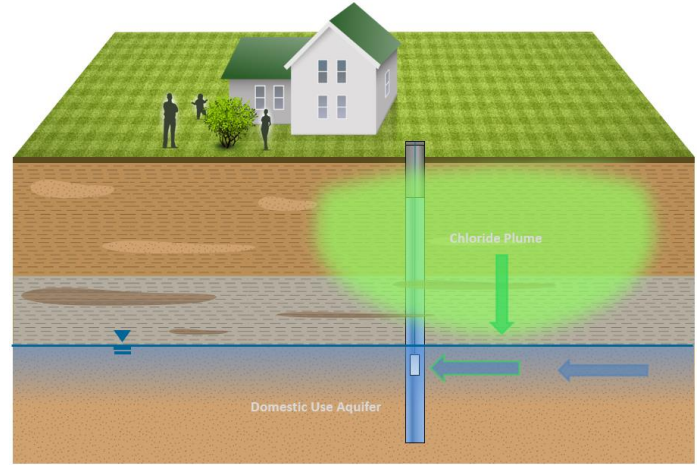
FAL = Freshwater aquatic life

# Domestic Use Aquifer (DUA)

CCME/Tier 1 chloride guideline 250 mg/L

Chloride Screening Values Developed Utilizing:

- Dilution Factor 3
  - Grain size, CMI (infiltration rate), Source Length
- Simplified Subsoil Salinity Tool
  - Grain Size, CMI (infiltration rate), Source Length, Source Thickness

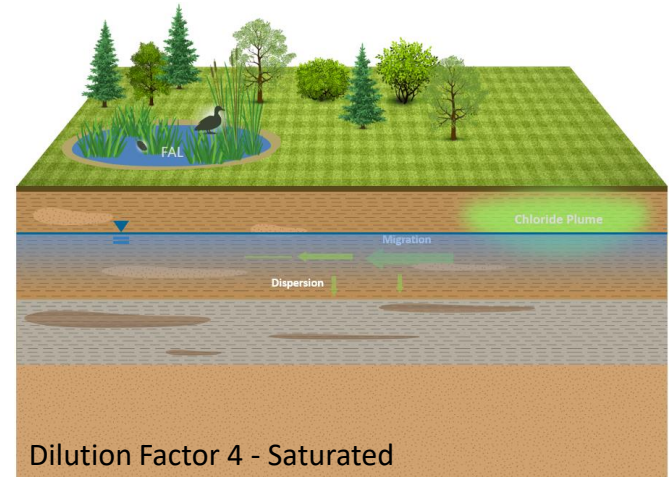
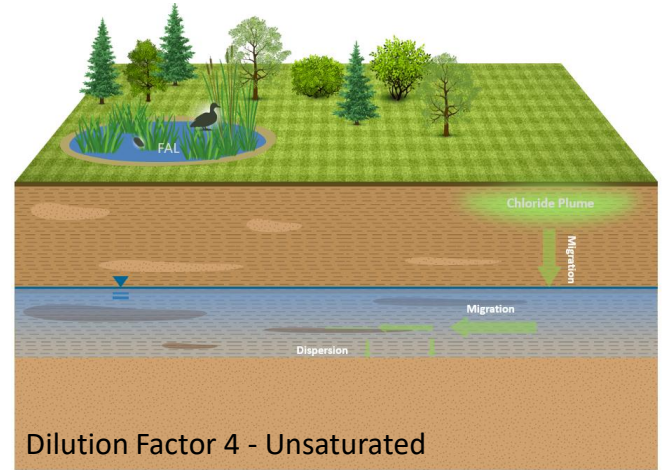


# Freshwater Aquatic Life (FAL)

CCME/Tier 1 chloride guideline 120 mg/L

## Chloride Screening Values Developed Utilizing:

- Dilution Factor 4
  - Grain size, Distance to FAL, Source Length
    - CMI (Infiltration) for Unsaturated Soils





# Dugout

## Livestock Watering

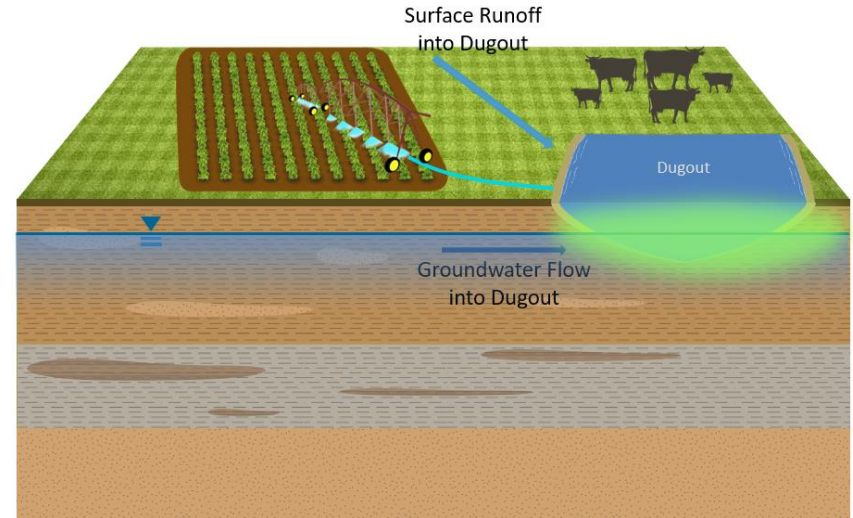
- Tier 1 TDS guideline 3,000 mg/L

## Irrigation Water

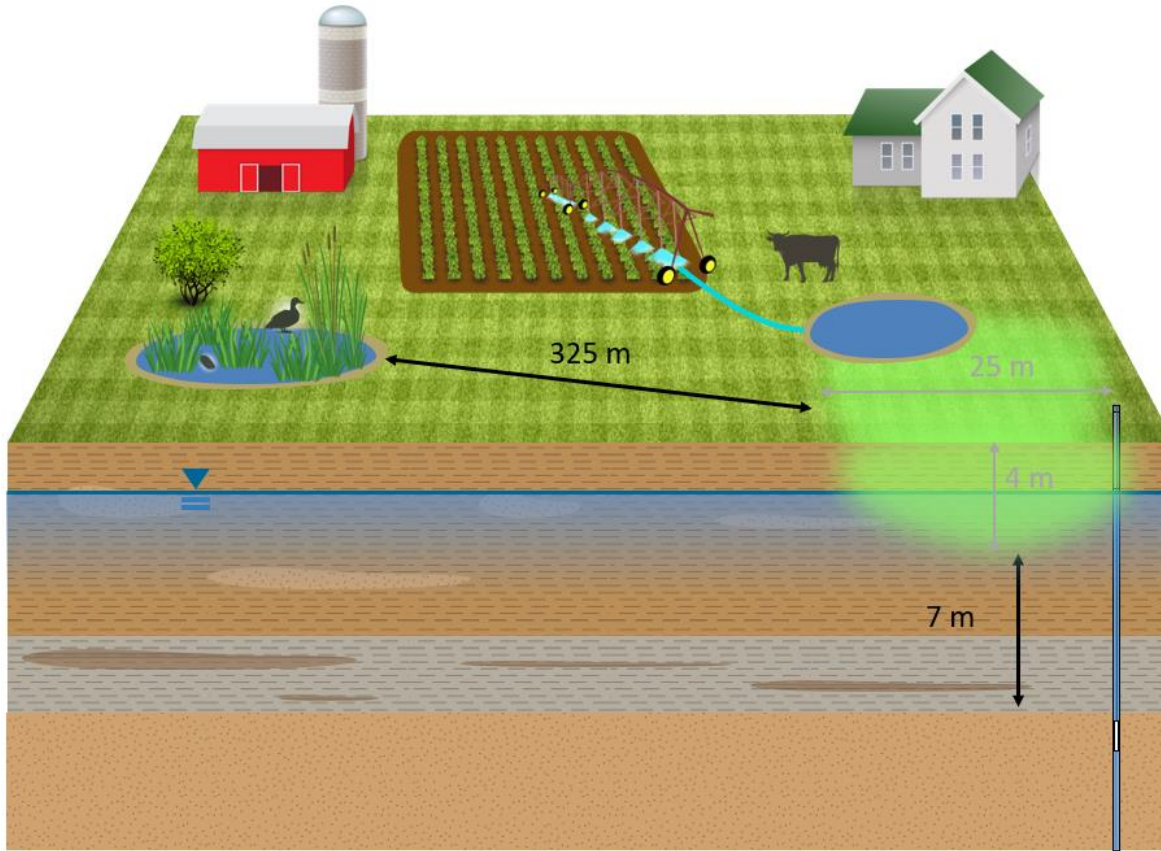
- SST chloride guideline 355 mg/L

## Chloride Screening Values Developed Utilizing:

- Subsoil Salinity Tool
  - Grain size, Depth To Groundwater, Background Sulphate



# Case Study



- Agricultural land use
- CMI (infiltration rate): Wet (12 mm)
- Fine grained
- 4 m thickness
- > 5 m separation
- 2 to 4 m water table depth (saturated)
- 25 m source length
- 325 m to FAL
- Background sulphate 500 mg/kg

# Domestic Use Aquifer (DUA)

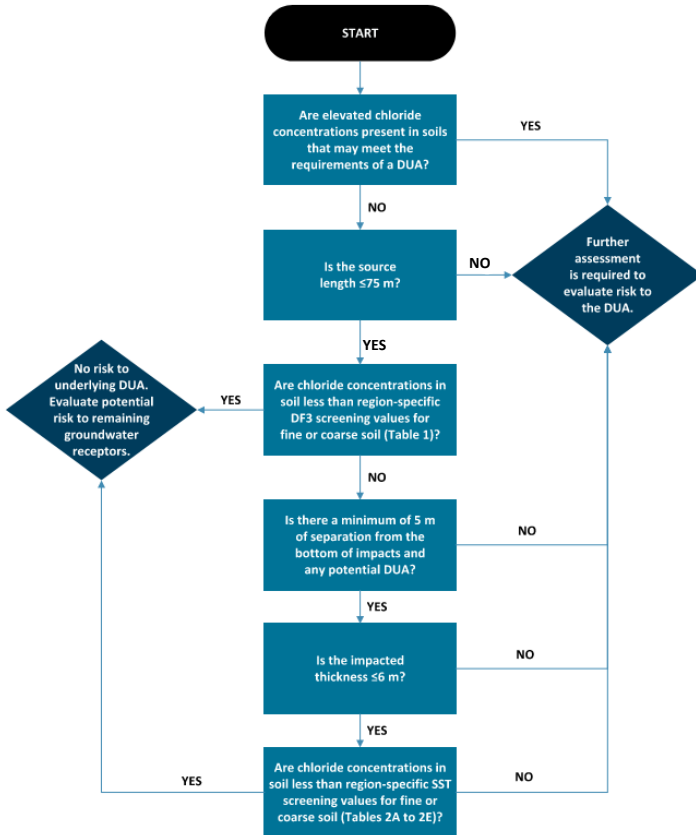


Table 1 - Soil Screening Values (mg/kg) for Protection of a DUA

Source Length	Wet		Moist		Slightly Dry		Moderately Dry		Dry	
	Fine (12 mm)	Coarse (60 mm)	Fine (9 mm)	Coarse (30 mm)	Fine (6 mm)	Coarse (15 mm)	Fine (3 mm)	Coarse (7 mm)	Fine (1 mm)	Coarse (2 mm)
5	820	110	1100	200	1600	390	3200	810	9500	2800
10	420	63	560	110	820	200	1600	410	4800	1400
15	290	48	380	79	560	140	1100	280	3200	940
20	230	40	290	63	420	110	820	210	2400	710
25	190	36	240	54	350	91	660	180	1900	570
30	160	33	210	48	290	79	560	150	1600	480
35	140	31	180	44	260	70	480	130	1400	410
40	130	29	160	40	230	63	420	120	1200	360
45	120	28	150	38	210	58	380	110	1100	320
50	110	27	140	36	190	54	350	96	980	290
60	96	25	120	33	160	48	290	83	820	250
70	86	24	110	31	140	44	260	74	710	210
80	79	23	96	29	130	40	230	67	620	190
90	74	23	88	28	120	38	210	61	560	170
100	69	22	83	27	110	36	190	57	500	160

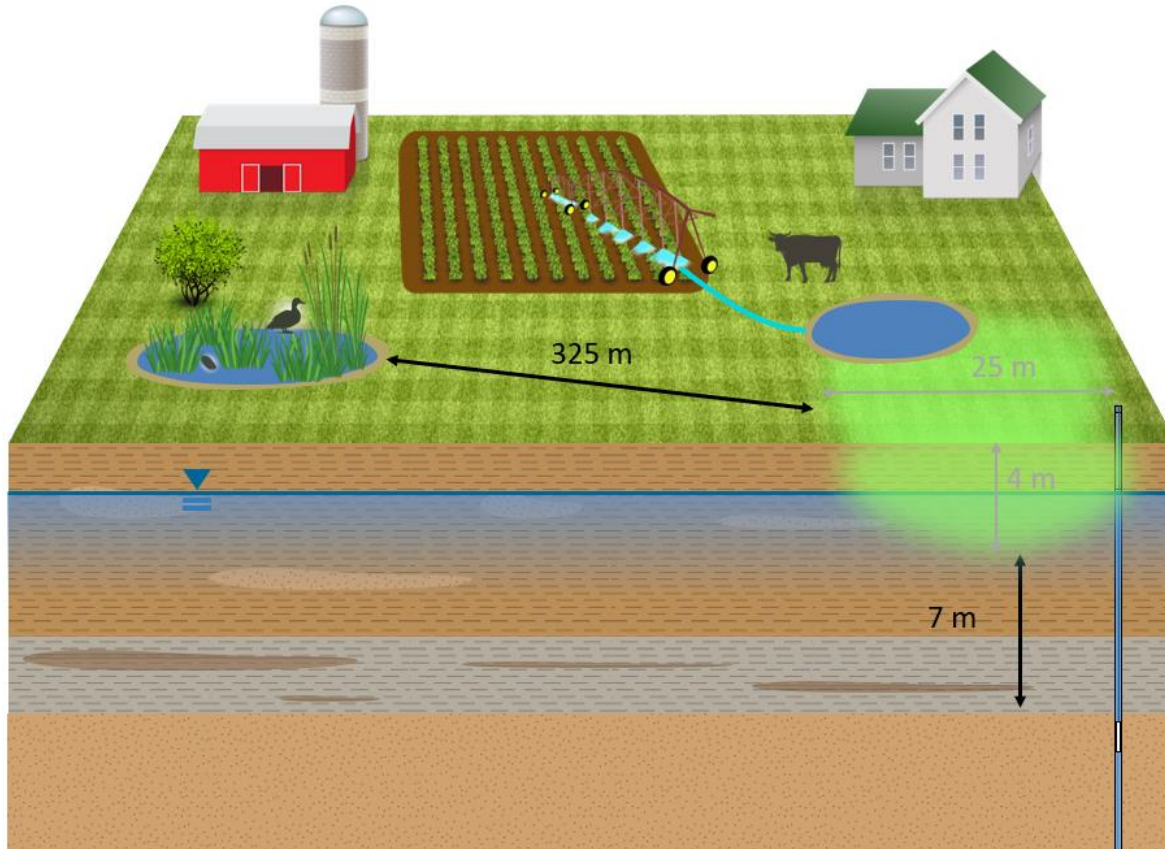
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Table 2A - SST Soil Screening Values (mg/kg) for Protection of a DUA - Wet (12 mm / 60 mm)

Source Length (m)	Source Thickness (m)									
	2		3		4		5		6	
	Fine (12 mm)	Coarse (60 mm)	Fine (12 mm)	Coarse (60 mm)	Fine (12 mm)	Coarse (60 mm)	Fine (12 mm)	Coarse (60 mm)	Fine (12 mm)	Coarse (60 mm)
15	3600	370	2600	250	2000	200	1700	190	1500	170
25	2300	280	1600	190	1300	150	1100	140	980	130
50	1300	210	950	140	750	110	640	100	560	95
75	1000	180	720	120	570	100	480	91	430	84
100	860	170	610	110	480	94	410	86	360	79

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# Case Study



- Agricultural land use
- CMI (infiltration rate): Wet (12 mm)
- Fine grained
- 4 m thickness
- > 5 m separation
- 2 to 4 m water table depth (saturated)
- 25 m source length
- 325 m to FAL
- Background sulphate 500 mg/kg

<b>DRAFT</b>	DUA	1,300 mg/kg
	FAL	170 mg/kg
	Irrigation	1,700 mg/kg
	Livestock Watering	8,000 mg/kg
	<b>Limiting Chloride Threshold</b>	<b>170 mg/kg</b>



# Addressing Root Zone Impacts via a Detailed Site Assessment

# Stage 1 - Process Flow

Focus on root zone gap

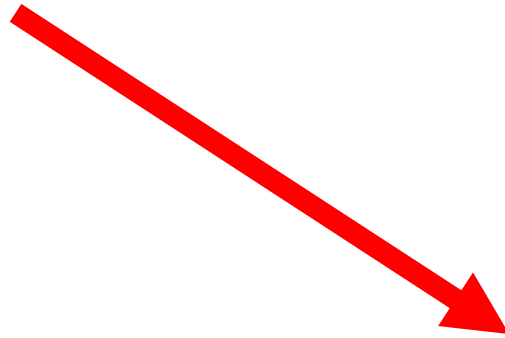
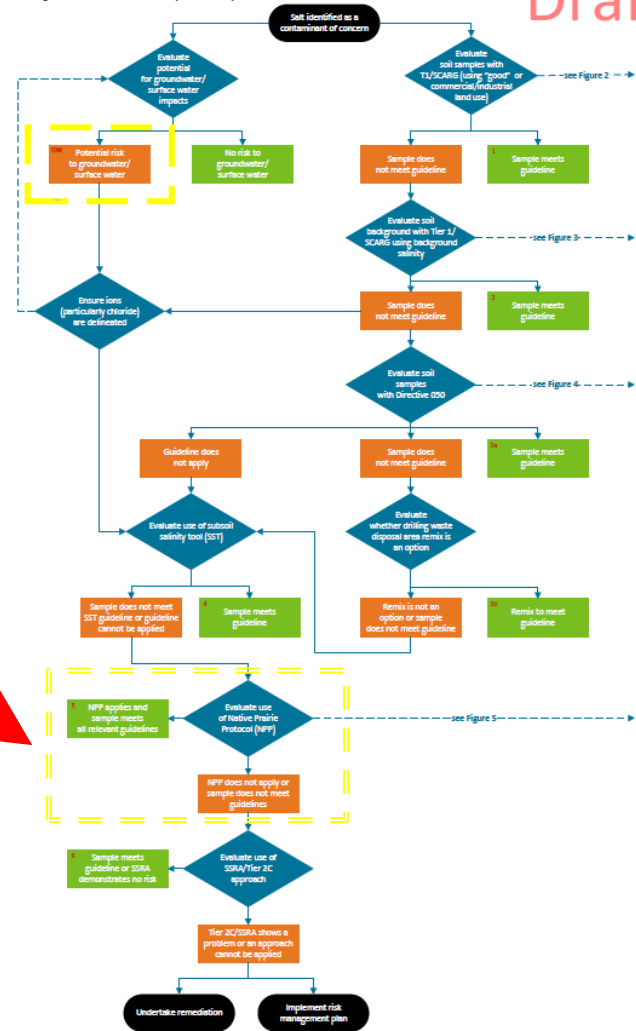


FIGURE 1. High-level Salt Process Flowchart (Flow Process)

Draft



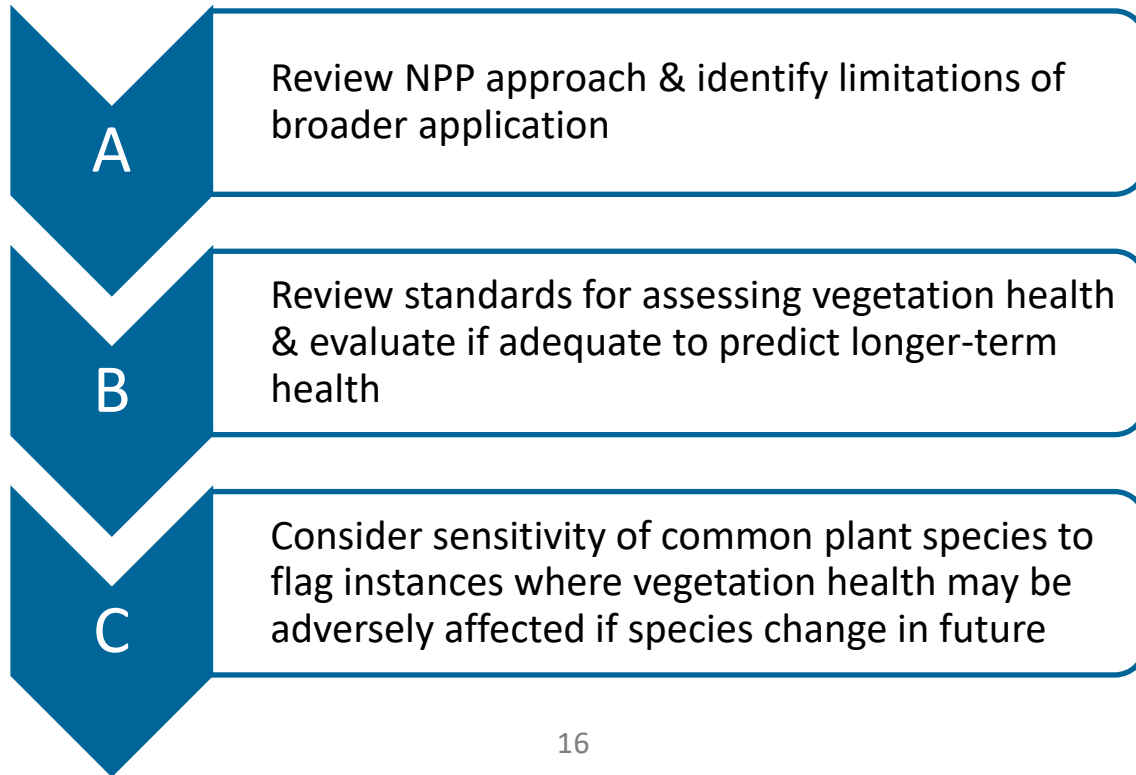
# Rational for Evaluation of Risk to Root Zone

- Gap -- no routine Tier 2 for root zone EC and SAR risk for most land uses
- SST -- risk of migration of salts upward into the root zone only
- For minor anthropogenic deviation from natural EC and SAR ranges
- *The Native Prairie Protocol (NPP)* already available
- Project proposes a parallel approach for most other land uses



# Objective of the Root Zone Project

Prepare draft guidance for when an evaluation of vegetation health is adequate to address soil EC and SAR exceeding guidelines within the root zone.





# Considered Alberta Specific Documents on Vegetation Salinity Tolerances

*Acceptable Salinity,  
Sodicity and pH Values for  
Boreal Forest Reclamation*  
(Howat, 2000)

*Manual of Plant Species  
Suitability for Reclamation  
in Alberta – 2<sup>nd</sup> edition*  
(Hardy BBT Limited, 1989)

*Salt Tolerance of Plants*  
(Wentz, 2001)

*Agronomic Receptor  
Evaluation for Direct Soil  
Contact, Stage 2*  
(Millennium EMS Solutions  
Ltd. (MEMS), 2022)

# Ranges of Vegetation Tolerances to Salinity

Vegetation Types	Range of Salinity Tolerances
Agricultural settings, common field crops, forages and more specialized vegetable and fruit crops	2 dS/m to >12 dS/m
Urban settings, non-native trees and shrubs, turf grasses	<3 dS/m to >12 dS/m
Natural settings, native trees, shrubs and native grasses	Wide range of tolerances



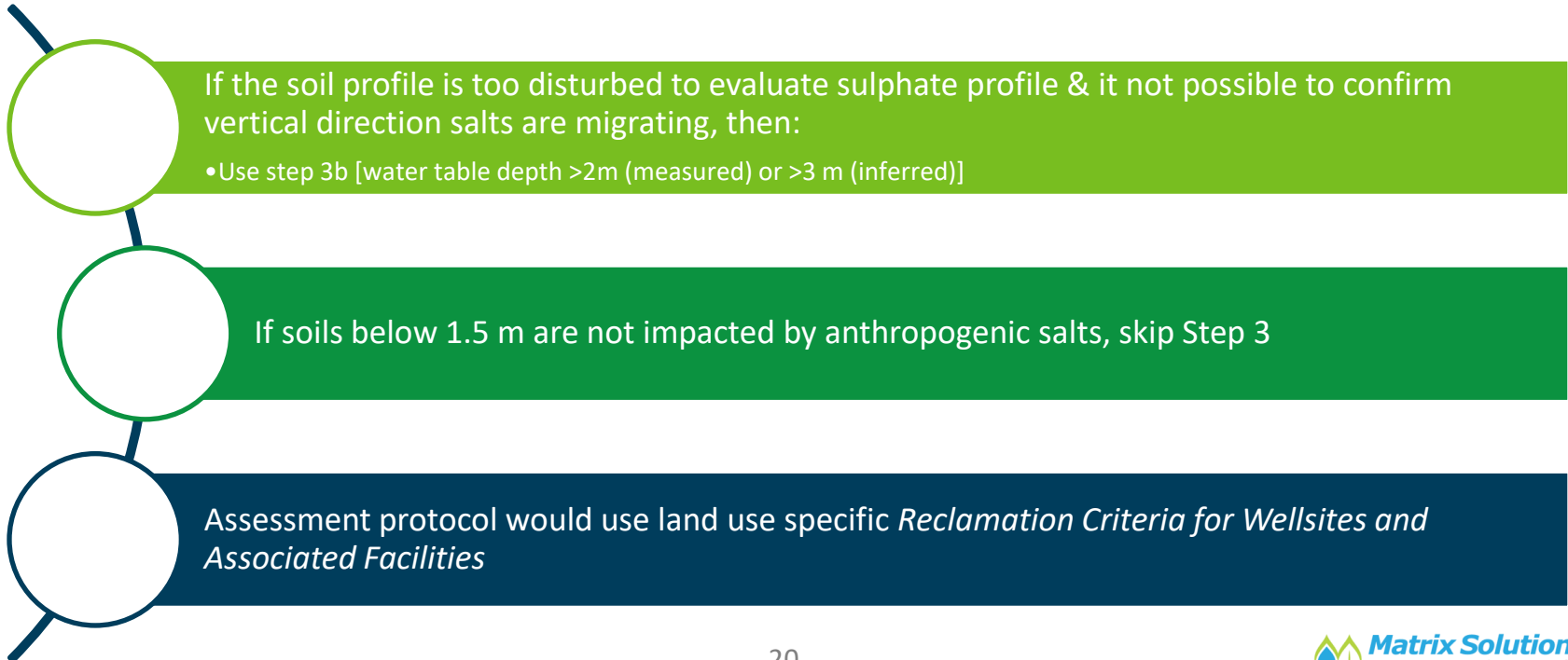
# Adapting the Native Prairie Protocol

The main steps in the NPP are as follows:

1. *Demonstrate the site is applicable to be considered under NPP*
2. *Demonstrate site conditions are having no current adverse effect(s) on the grassland plant community*
3. *Demonstrate site conditions are not likely to have an adverse effect on the grassland plant community in the future*
  - 3a. *Evaluate natural sulphate profile*
  - 3b. *Evaluate water table depth*
4. *Demonstrate site conditions are not likely to have an adverse effect on any other receptors via relevant exposure pathways*

# Adapting the Native Prairie Protocol (continued)

Steps 1 to 4 in the NPP potential to be applied to other land uses with the following adaptations:



If the soil profile is too disturbed to evaluate sulphate profile & it not possible to confirm vertical direction salts are migrating, then:

- Use step 3b [water table depth >2m (measured) or >3 m (inferred)]

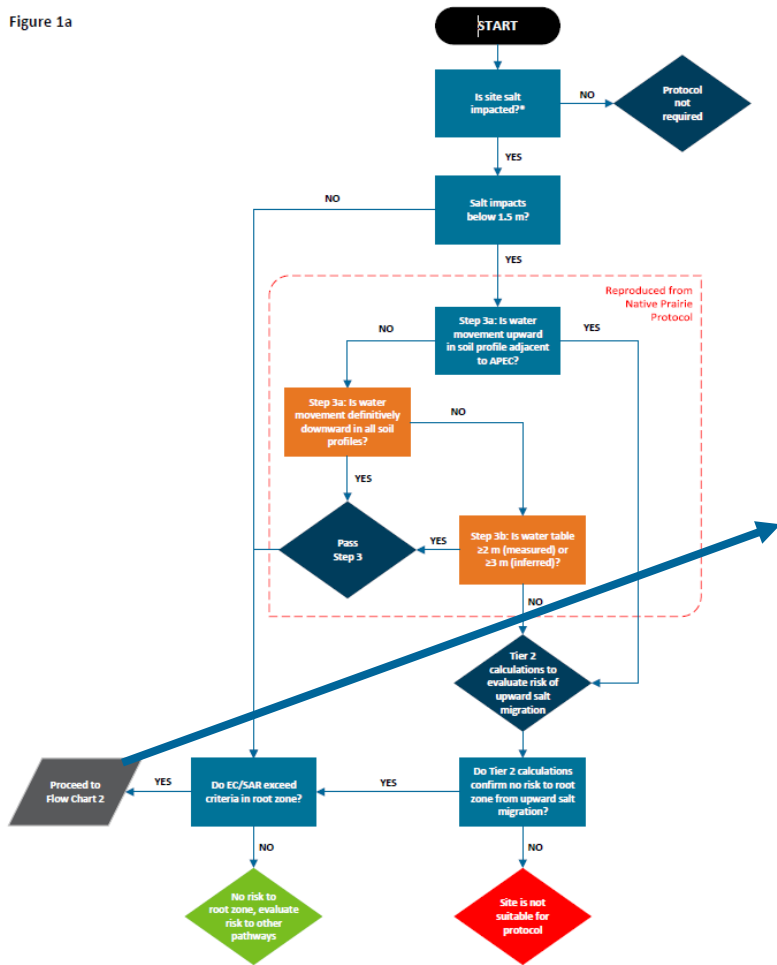
If soils below 1.5 m are not impacted by anthropogenic salts, skip Step 3

Assessment protocol would use land use specific *Reclamation Criteria for Wellsites and Associated Facilities*

# Proposed Protocol

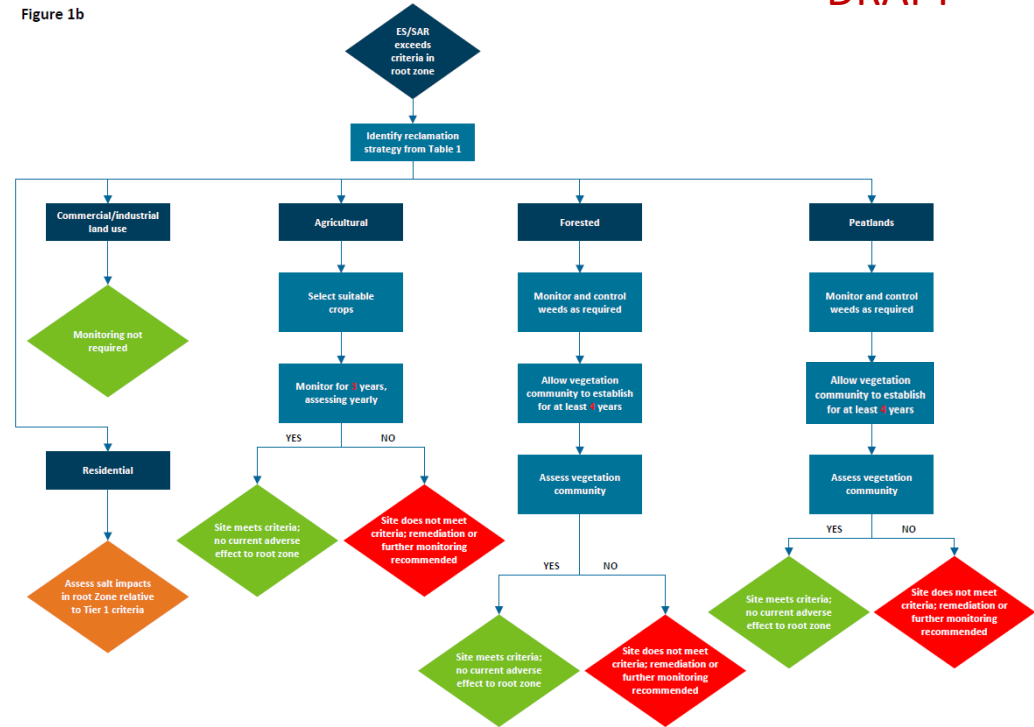
Land Use	Assessment Criteria	Vegetation Monitoring
Agricultural Lands	Reclamation Criteria for Cultivated Lands	Minimum of 3 years. List of crops prepared; most salt sensitive crop evaluated during monitoring program
Forested Lands	<b>Adapted</b> Criteria for Forested Sites	At least 4 years (post revegetation) Health rating assessment added
Industrial or Commercial Lands	Not applicable	Focus on protection of other receptors
Peatlands	Reclamation Criteria for Peatlands	At least 4 years (post revegetation)
Residential Lands	No routine Tier 2 for root zone proposed	

Figure 1a



\*Defined as sites with soils that exceed Tier 1 guidelines for EC or SAR or Tier 2 site-specific guidelines for sodium/SAR and chloride.

Figure 1b



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# Summary

- Evaluation of chloride risk to groundwater
- Approach for addressing rootzone salinity and sodicity impacts

# Disclaimer

- Project is in DRAFT and has NOT yet received Regulatory endorsement.
- Proposed methods applied within the project are intended to be conservative screening level evaluation to support practitioners in evaluating potential risk and do not preclude the use of alternative Tier 2 approaches.
- The concentration thresholds within this document are not intended for remediation, or any other purposes but rather as a tool to assess the potential risk to groundwater receptors based on soil chloride concentrations.

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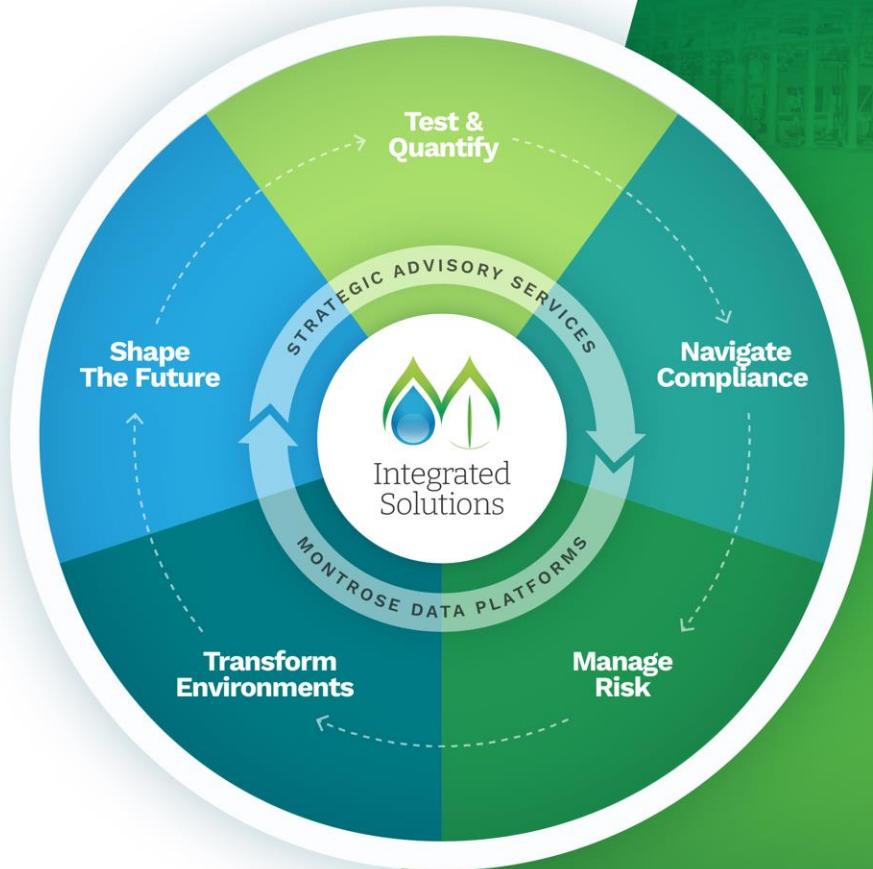
# Acknowledgements

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- Sheila Luther, Lindsay Oiffer, Daniel Pollard, Ashley Morgan – Matrix Solutions Inc. a Montrose Environmental Company



## Montrose At A Glance

Montrose provides strategic, integrated solutions that guide organizations through environmental challenges, ultimately delivering business value and positively impacting our planet and society.

We implement environmental solutions that scale.

- ~3,200 employees
- ~100 locations worldwide
- ~5,600 clients from the private and public sectors
- 6 patents issued in 2022, for a total of 18 patents



# Questions?

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