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Low Probability Receptor Framework for Site Closure

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Overview of Presentation

- Introduction and objectives
- Site closure – current options and limitations
- What is Low Probability Receptor (LPR) approach?
- Regulatory framework
- Benefits of LPR approach
- Future opportunities

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Alberta Contaminated Sites Policy Outcomes

- Pollution prevention: Avoid impairment of, or damage to, the environment, human health or safety, or property
- Health protection: Take action on contaminated sites that is commensurate with risk to human health and the environment
- Productive use: Encourage remediation and return of contaminated sites to productive use

[Alberta Contaminated Sites Policy Framework, 2014]

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Objectives

- Optimize effectiveness of industry's remediation and reclamation activities by:
  - Reducing overall environmental liability
  - Minimizing adverse human and environmental effects (e.g. greenhouse gas emissions, adverse health effects)
  - Simultaneously increasing environmental protection
- Uphold policy outcomes of Alberta's contaminated sites management framework

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Current Closure Options in Alberta

- Tier 1: Generic risk-based numerical guidelines. Eligible for regulatory closure
- Tier 2: Limited site-specific adjustment of Tier 1 guidelines
  - Pathway elimination or guideline recalculation. Eligible for regulatory closure
  - Site-specific risk assessment (SSRA). May be eligible for regulatory closure
- Exposure Control (i.e. risk management). Ineligible for regulatory closure
- Target level of human health and ecological protection is the same under all three Tiers

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Basis for Current Tier 1/Tier 2 Guidelines

- Protective of receptors associated, by definition, with generic land use category reflecting “typical activities” on such lands
- Intended to protect sensitive receptors, and to apply at majority of sites
- Recognize that specific sites may differ from the generic land use definitions, necessitating a Tier 2 or alternative approach

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Limitations of Current Closure Options

- Remediation is often driven by receptors such as dugouts, residences, water wells etc.
- Approaches are unnecessarily conservative where such receptors are absent and have a low probability of occurrence in the future
  - Hence "**low probability receptors**" (LPR)
- Considerable resources required to protect LPRs, with no benefit
- Increased environmental and human health impacts
- Current closure options do not allow site-specific receptor modification

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Options for Site-specific Receptor Modification

- Tier 2 SSRA – may not allow for regulatory closure if receptor profile modified
- Emerging options under Tier 2, e.g:
  - Native prairie protocol
  - Ecological soil contact guidelines based on site-specific species
  - Other “outcome-based” approaches aimed at equivalent land capability
- Low probability receptor (LPR) approach

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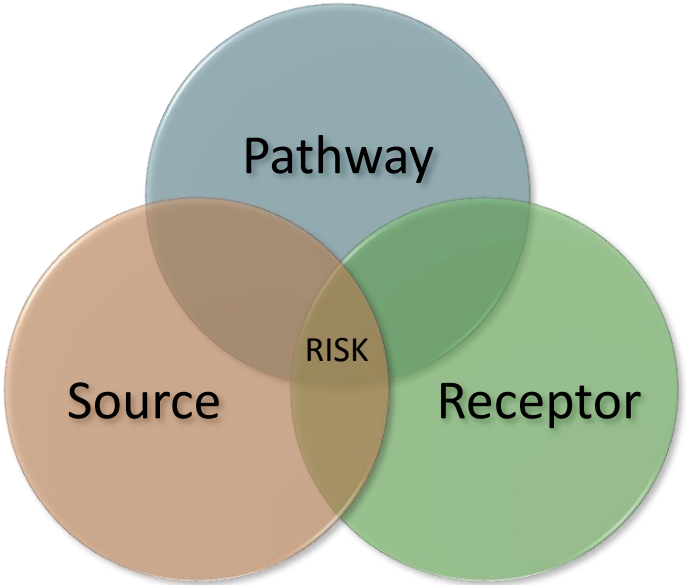
What is LPR Assessment?

- Focus on the receptors present and likely to be present
- There is no risk associated with receptors that are not present, and not likely to occur in the future



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Current LPR Initiative

- Development of LPR identification and mapping tools
- Pilot projects in Alberta funded by PTAC and industry partners to validate approach and potential benefits
- Pilot study funded by BC OGRIS to investigate application of approach to BC
- Development of regulatory/implementation framework

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LPR Mapping

- Determination of future probability of receptor based on rate of change in number of receptors with time
  - Spatial and temporal mapping of receptors
  - Determination of trends – no historical presence, linear, non-linear (increasing or decreasing rate)
- Sources of information
  - ABMI human footprint dataset (dugouts)
  - Alberta water well information database (water wells)

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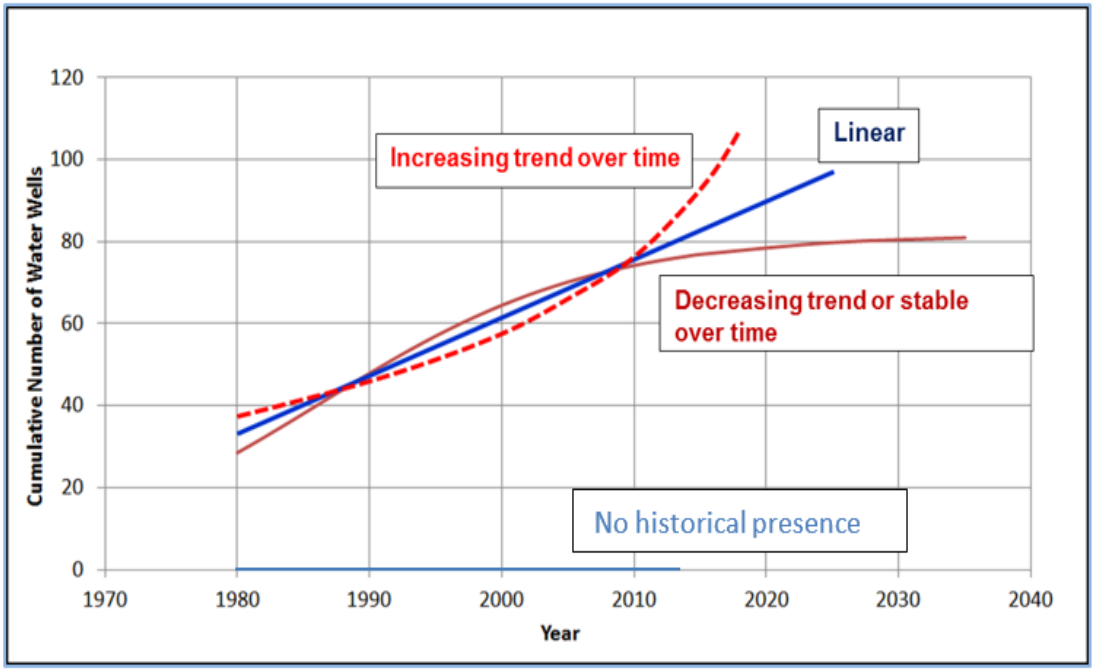
LPR Mapping (cont'd)

- Temporal trends



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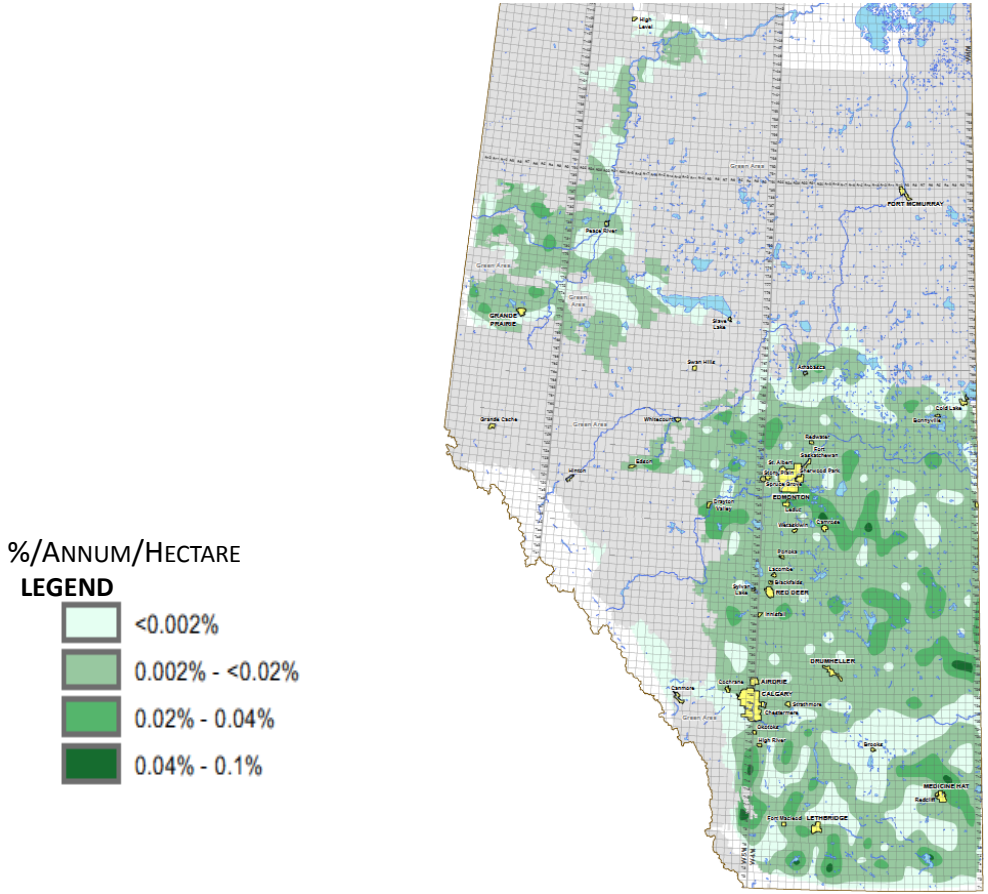
LPR Mapping (cont'd)

- Provincial zone mapping for "dugout" receptor
- Linear increasing trend



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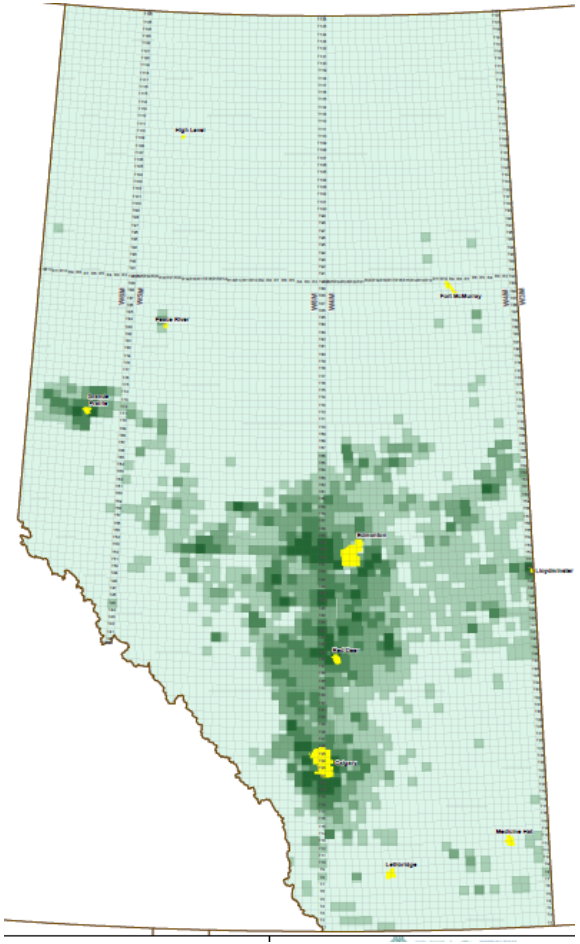
LPR Mapping (cont'd)

- Province-wide mapping for water well receptor (well depths 0-30 m)
- Linear increasing trend

%/ANNUM/HECTARE

LEGEND

Green Area
Populated Place
%/annum/hectare
<0.002%
0.002% - <0.02%
0.02% - <0.04%
0.04% - 0.1%



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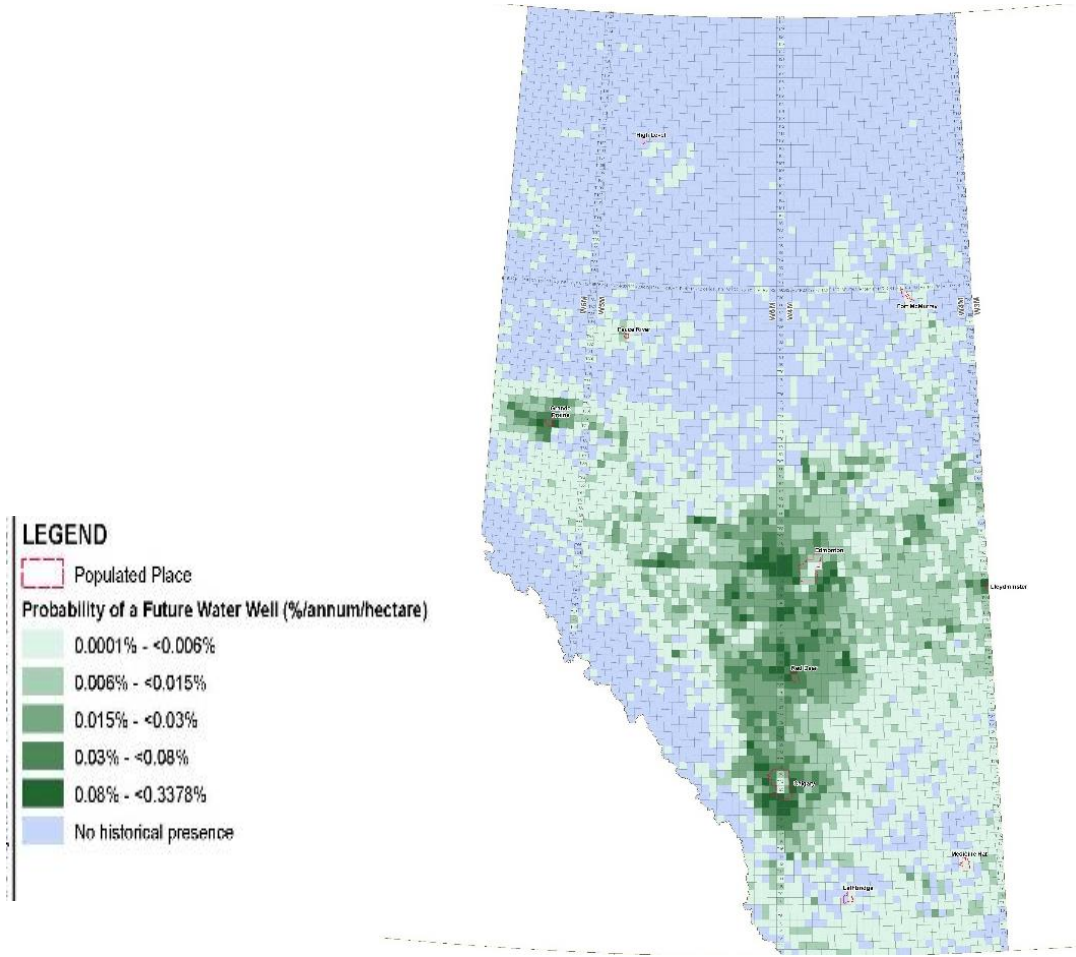
LPR Mapping (cont'd)

- Areas of province with no historical presence of water wells



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Case Studies

- Probability of future wells and dugouts

Case Study	Water Well	Dugout	Lifetime Probability	Economic Impact
	0 - >30 m			
	% Probability / Annum / Hectare			
Site 1	0.025%	0.017%	0.6%	$2,578,000
Site 2	0.039%	0.004%	0.02%	$33,200
Site 3	0.050%	<0.0001%	0.04%	$34,560
Site 4	0.050%	<0.0001%	0.1%	$29,000
Site 5	0.0124%	<0.0001%	0.04%	$725,000

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Case Studies (cont'd)

- Liability reduction opportunity

Case Study	Remediation Volume (m^3)		Remediation Cost ($)		
	Conventional	*LPR*	*Conventional*	*LPR*	*Savings*
Remediation Budget			$5,000,000	$5,000,000	
1	19,400	1,500	$2,794,000	$216,000	92%
2	555	325	$80,000	$46,800	42%
3	640	400	$92,160	$57,600	38%
4	3,800	3,600	$547,000	$518,000	5%
5	6,175	1,140	$889,000	$164,000	82%
Remediation Opportunity (sites remediated)			**6 sites**	**24 sites**	

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Case Studies (cont'd)

- Case Study #1 emission reductions due to reduction in soil volumes excavated, hauled and backfilled:
  - CO_2 – 240,500 kg
  - NO_x – 1,690 kg
  - PM – 56 kg
  - THC – 127 kg

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Regulatory Framework

- LPR is consistent with policy outcomes of Alberta contaminated sites management framework
  - Pollution prevention, health protection, productive use
- LPR is consistent with, and an extension of, existing Tier 2 approaches
  - Basis for LPR is similar to assumptions involved in current land use definitions, and in other permitted Tier 2 modifications
- Potential regulatory challenges related to site closure based on LPR
  - Need for financial assurance
  - Need for mechanisms to track LPR-based closure and potential future changes to land use and receptors

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Benefits of LPR Approach

- Benefits not only limited to reduced remediation cost (i.e. economic)
- Other benefits include environmental and social (reduction in impacts of remediation to human health and environment)
- Net benefit analysis (NBA) used to quantify benefits and costs and allow comparison of remedial approaches on a common platform
- Preliminary results demonstrate that the net benefits associated with LPR may be 4 to 5 fold greater than use of conventional approach

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Future Opportunities / Direction

- Application in non-oil & gas settings, e.g. urban and/or brownfield sites
- Identification of low probability receptors / low probability pathways based on development trends, zoning etc.
- Examples include:
  - No DUA use in large urban areas
  - Absence of direct contact and ecological pathways beneath streets
  - Low likelihood of grade changes in stable developed areas
  - High density vs. low density residential zoning

Acknowledgements

- Millennium EMS Solutions Ltd.
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- CAPP
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- BC OGRIS

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Questions?