

# Thresholds in the Land Use Framework: The Science-Policy Linkage

Bill Donahue

V.P. & Chief Monitoring Officer

Land Use 2016 - 5 May 2016



**aemera.org**

## Land-use Framework (2008)

“The Government of Alberta will develop a process to identify appropriate thresholds, measurable management objectives, indicators and targets for the environment (air, land, water and biodiversity), at the regional levels and, where appropriate, at local levels. Land-use planning and decision-making will be based on balancing these environmental factors with economic and social considerations.”

# Land-use Framework (2008)

“Regional plans will... define the cumulative effects management approach for the region and identify targets and thresholds...”

## Land-use Framework (2008)

“The Government of Alberta will create Regional Advisory Councils for each region to provide advice and receive direction ... on the development of the regional plan. Regional Advisory Councils will... provide advice on addressing trade-off decisions regarding land uses and on setting thresholds to address cumulative effects...”

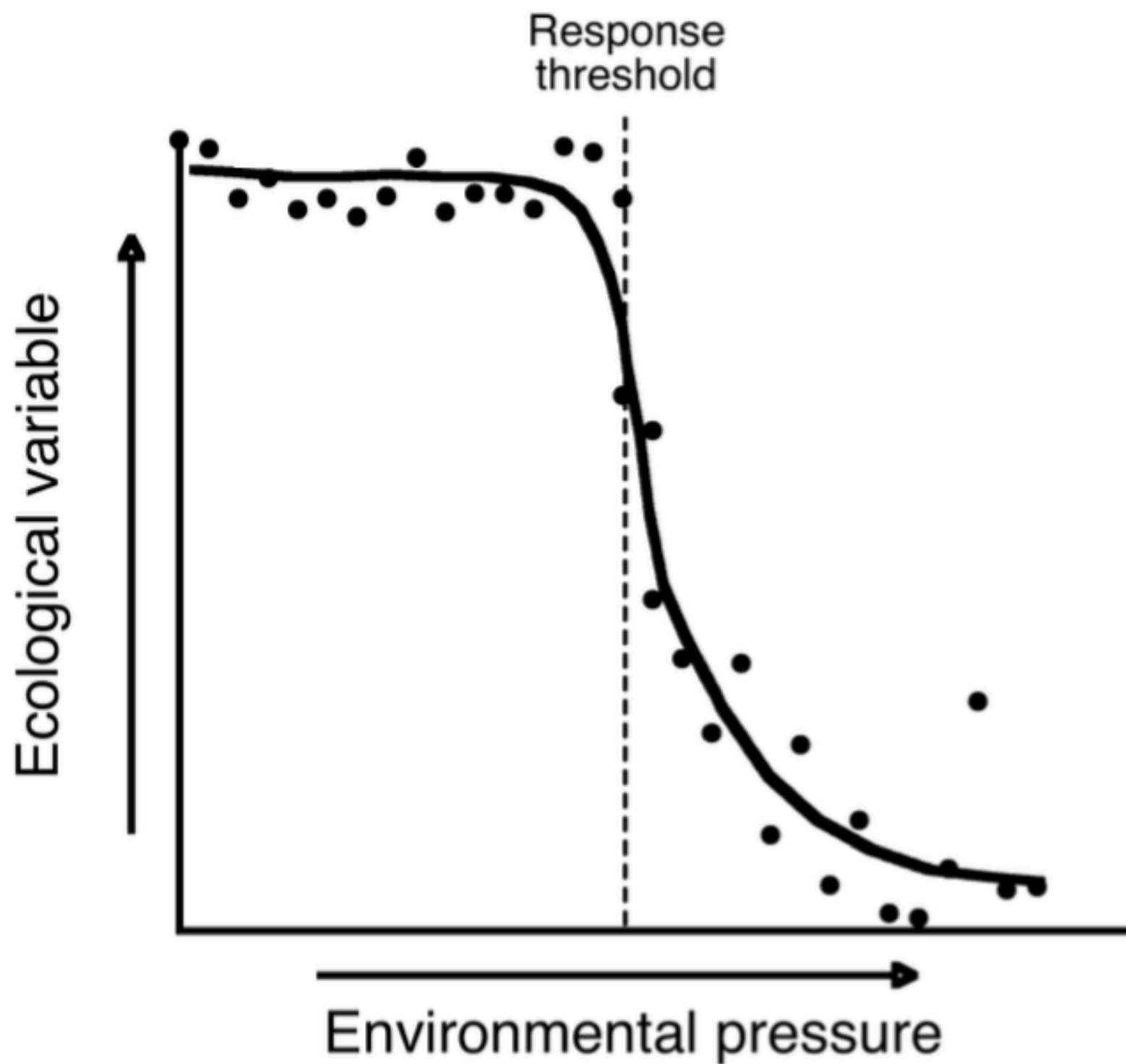
# Thresholds in Alberta's Land-use Frameworks

- Regulatory or compliance thresholds in the form of concentrations (air/water quality), flow rates (water quantity)
- Synonymous with “triggers”: when threshold reached, a management response may occur
- Distinct from ecological thresholds
- Generally, “thresholds” are statistical values derived from long-term monitoring data

# Ecological Thresholds

*"An ecological threshold is the point at which there is an abrupt change in an ecosystem quality, property or phenomenon, or where small changes in an environmental driver produce large responses in the ecosystem."*

Groffman *et al.* 2006. *Ecosystems* (9): 1-13.



Important:

**“management response”** and **“management action”** have distinct meanings in Alberta’s land use management frameworks, and are place-based (*i.e.*, vary according to location in Alberta)



# Management response

- a set of steps that to be undertaken (all or in part) if the annual data indicate an exceedance of a trigger or limit
- this includes determining the need for any management actions to deal with any identified exceedances

# Management response

- confirm results identified in routine data
- pursue further investigation (modeling, additional monitoring, identification of potential sources/causes, etc)
- model efficacy of response options
- make recommendations
- direct mitigative action
- follow-up monitoring
- assess outcomes/efficacy of action
- continue as needed

# Lower Athabasca Region Air Quality Management Framework

For Nitrogen Dioxide (NO<sub>2</sub>) and  
Sulphur Dioxide (SO<sub>2</sub>)



# South Saskatchewan Region Air Quality Management Framework

For Nitrogen Dioxide (NO<sub>2</sub>), Ozone (O<sub>3</sub>) and  
Fine Particulate Matter (PM<sub>2.5</sub>)



## Air Quality Management Frameworks

- Federal thresholds mainly for urban air quality metrics ( $\text{PM}_{2.5}$ ,  $\text{NO}_2$ , and  $\text{O}_3$  in South Saskatchewan Region;  $\text{NO}_2$  and  $\text{SO}_2$  in Lower Athabasca Region)
- thresholds described are average air concentration levels that trigger additional monitoring actions or planning
- generally inspire mitigative action only as air quality exceedances of actual limits become likely or occur

# Levels as Thresholds in Air Quality Frameworks

Action Levels, Triggers and Limits for Ozone and Fine Particulate Matter

Description	O <sub>3</sub> (*)	PM <sub>2.5</sub> 24-hour(**)	PM <sub>2.5</sub> annual(***)
Level 4 <sup>(iv)</sup>			
Limit <sup>(i)</sup>	63 ppb	28 µg/m <sup>3</sup>	10.0 µg/m <sup>3</sup>
Level 3 <sup>(v)</sup>			
Trigger for Level 3 <sup>(ii)</sup>	56 ppb	19 µg/m <sup>3</sup>	6.4 µg/m <sup>3</sup>
Level 2 <sup>(vi)</sup>			
Trigger for Level 2 <sup>(iii)</sup>	50 ppb	10 µg/m <sup>3</sup>	4.0 µg/m <sup>3</sup>
Level 1 <sup>(vii)</sup>			



**Description and Management Intent for Average of Annual Hourly Data for  
NO<sub>2</sub> and the PM<sub>2.5</sub> and O<sub>3</sub> Ambient Air Quality Levels**

<b>Level</b>	<b>Description</b>	<b>Management Intent</b>
4	Ambient air quality exceeding the air quality limit	Improve ambient air quality to below the limit
Limit		
3	Ambient air quality below but approaching the air quality limits	Proactively maintain air quality below the limit
Trigger into Level 3		
2	Ambient air quality below air quality limits	Improve knowledge and understanding, and plan
Trigger into Level 2		
1	Ambient air quality well below air quality limits	Maintain air quality through standard regulatory and non-regulatory approaches

## Air Quality Management Frameworks

- Management "levels" trigger policy or management actions when indicator values exceed long-term averages and do not reflect day-to-day air or water quality:
  - $O_3$ : 4<sup>th</sup>-highest 8-hour average in a year, averaged over 3 years
  - $PM_{2.5,24-hr}$ : 98<sup>th</sup>-percentile of daily average, averaged over 3 years
  - $PM_{2.5,annual}$ : 3-year running average
- Not be used for assessing current conditions or acute health/environmental risks

# Lower Athabasca Region

## Surface Water Quality Management Framework for the Lower Athabasca River



# South Saskatchewan Region

## Surface Water Quality Management Framework

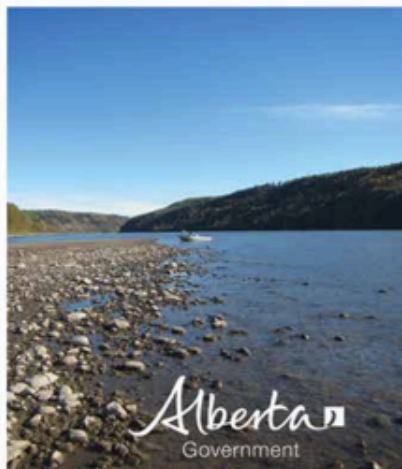
For the Mainstem Bow, Milk, Oldman and  
South Saskatchewan Rivers (Alberta)





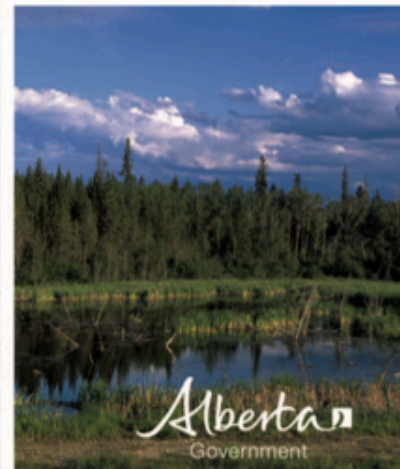
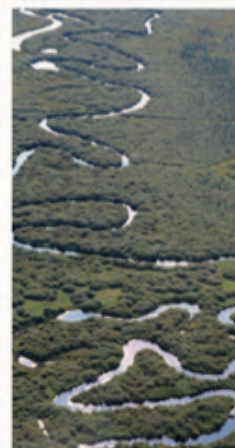
# Lower Athabasca Region

## Surface Water Quantity Management Framework for the Lower Athabasca River



# Lower Athabasca Region

## Groundwater Management Framework



# Indicators – Water Quality

- suspended sediments, macro-nutrients, major ions, some contaminants + some other water chemistry measures
- chosen on the basis of:
  - significant historical datasets
  - have ecological and anthropogenic relevance
  - exhibit a downstream increase
  - considered responsive to management actions

# Triggers & Limits – Water Quality

Based on historical monthly data from 1 site on Lower Athabasca + 9 sites in SSRB:

- 4 on Bow River, 3 on Oldman River, 1 on South Sask River, 1 on Milk River
- triggers = values that have been observed in recent years
- *“therefore not all trigger exceedances signal real or meaningful change”*
- meant to be an “early warning” of change in water quality
- triggers for open-water season (Apr-Oct) and winter (Nov-Mar):
  - median values + 90<sup>th</sup> percentile value for data from a site
  - each trigger is therefore different for each of 9 sites

Limits = Alberta and CCME water quality guidelines (9 compounds)

# Ambient Water Quality Management Thresholds

Level	Description	Management Intent
3	Indicator seasonal median values exceed water quality limits.	Management actions required to improve ambient water quality to below limits.
Limit		
2	Indicator seasonal median and/or peak values statistically higher than trigger values.	<p>Management response and determination of risk and urgency for management action to maintain water quality below limits.</p> <p>Investigation of cause and effects; evaluation and implementation of management actions.</p>
Trigger		
1	Median and peak water quality conditions at or better than historical water quality conditions.	Apply standard regulatory and non-regulatory approaches to manage water quality.

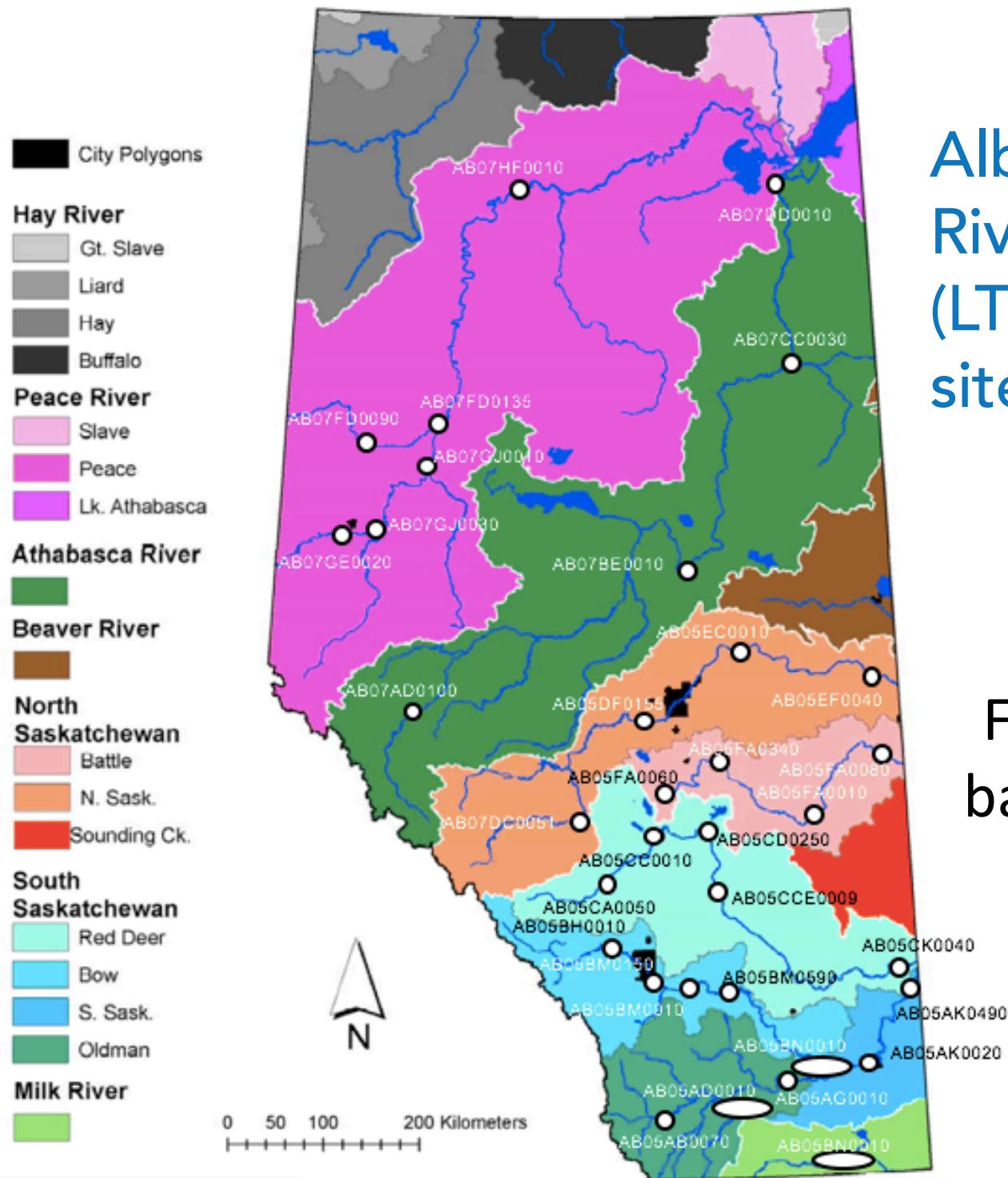


# Monitoring Program Design Issues

- monitoring programs dictated by Frameworks are limited in number and location of sites, and type and frequency of sampling
- indicators (and therefore triggers and limits) generally limited to urban air quality and basic water quality

# Monitoring Program Design Issues

- Assumes identified air and water quality triggers and limits will or can inform land-use planning decisions
- BUT... land-use decisions will require much more robust environmental information and understanding that connects air and water quality changes to regional and local land-use change



## Alberta's Long-term River Network (LTRN) monitoring sites

Framework limits are based on exceedances at these sites.

# Monitoring Must Inform Decisions

Intent of Frameworks was establish a starting point and take an adaptive approach, evolving with improved understanding of environmental risks associated with natural processes/events and land-use decisions and disturbance.

Ambient monitoring programs in air and water throughout Alberta are being redesigned to identify cause-effect relationships between human activities and environmental change. This will lead to more robust Frameworks and a stronger link between science, policy and management.