Water Management in Northeast Alberta

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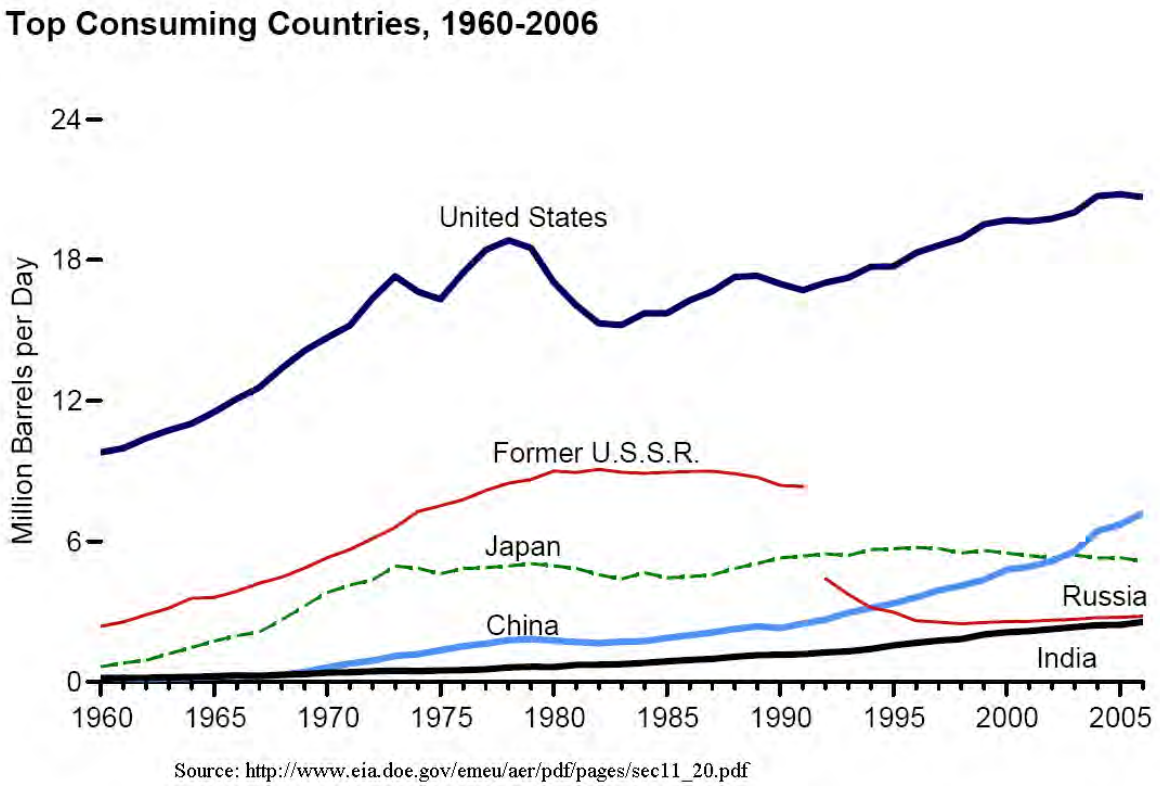
The most public of issues

- The Athabasca River Flow (Quantity)
  - AENV/DFO Instream Flow Needs Framework (2007)
  - Flows and water use
- Water Quality
  - Upstream - Downstream
  - Air, groundwater,
  - Drainage
- Tailings
  - Seepage
  - Water release
- A bit about me

The Driver

Oil Addiction



- World oil demand increasing by 2%/yr
- About 70% of oil used is for transportation
- No alternate technology now
- Oil a must for foreseeable future

The Alternatives during the transition

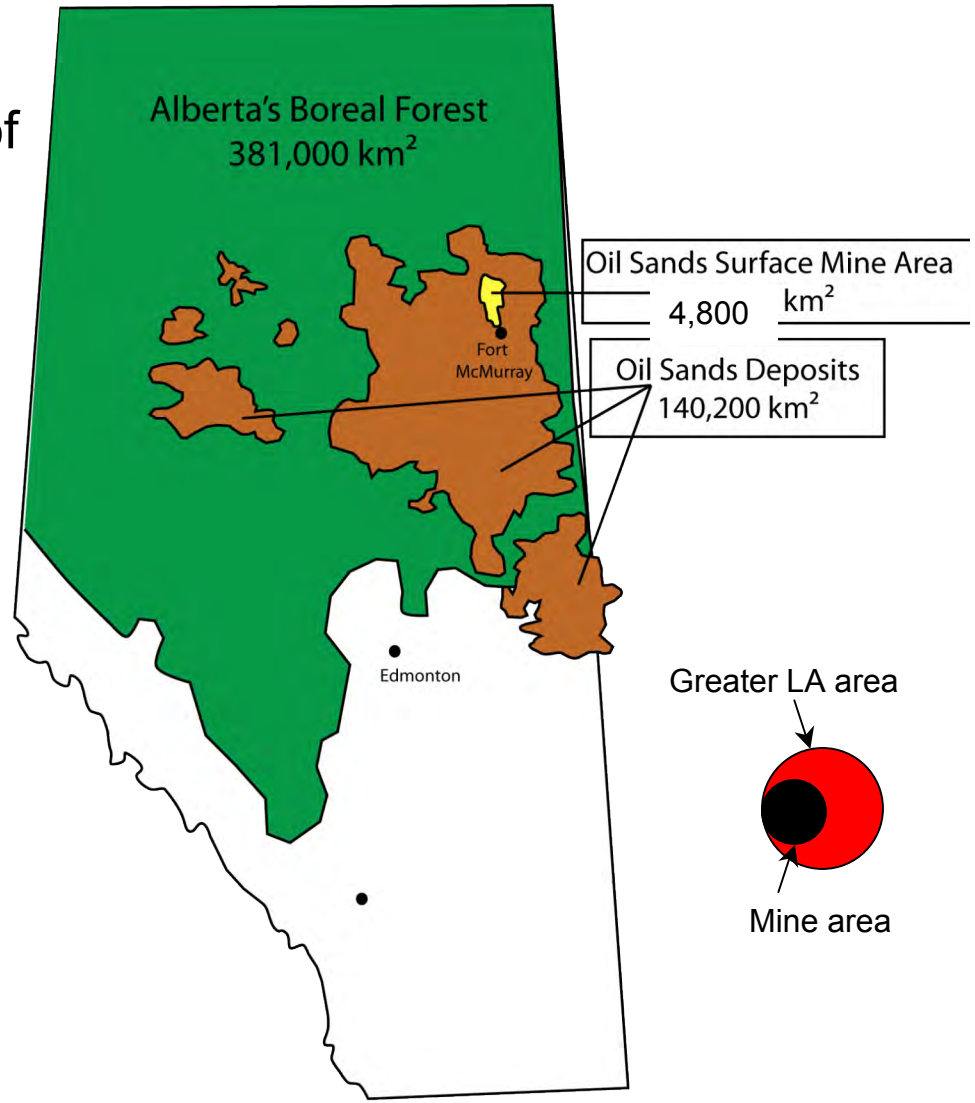
- **Nigeria: U.N. Investigator Discovers Horrible Atrocities in Police Cells:**
  - The United Nations' top torture investigator Manfred Nowak has discovered the worst violations of human rights he has ever seen in Nigerian police cells.
  - Shell reports 236 oil spills in one year (NPR Aug 22, 2005)

Source: National Geographic

Source: Vanity Fair

The resource relative to the area

- The Perception: An area the size of Florida will be dug up.
- The statistics: Oil sands deposits cover an area of 141,000 km^2, similar to Florida.
- 4,800 km^2 has the potential to be mined
- Significant impacts to certain sub-watersheds
- These sub-watersheds contribute about 3% of the flow (8% for region)
  - 530 km^2 disturbed to date
  - 64 km^2 undergoing active reclamation/reclaimed
  - First reclamation certificate issue March 2008



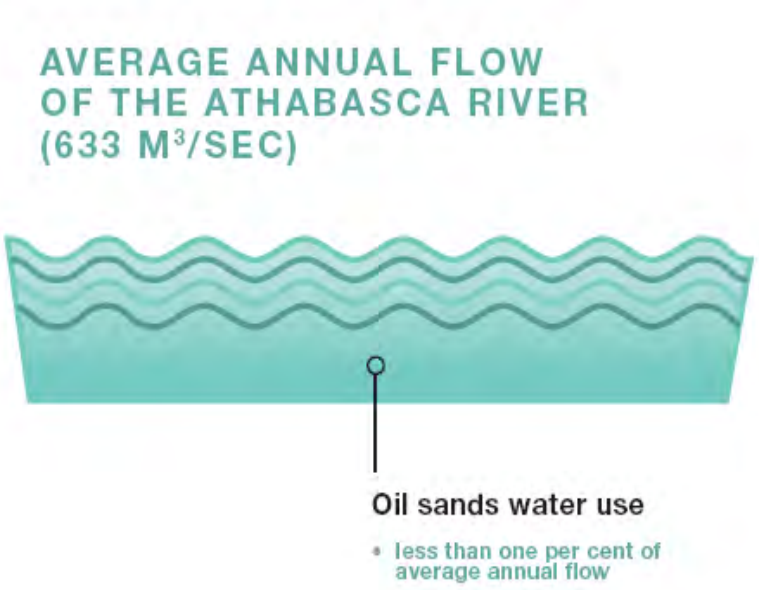

N
N
Image © 2010 DigitalGlobe
Image © 2010 TerraMetrics
©2009 Google
29 km
Imagery Dates: May 7, 2005 - Jun 30, 2008
57°08'25.25" N 111°27'50.19" W elev 0 m
Eye alt 100.97 km

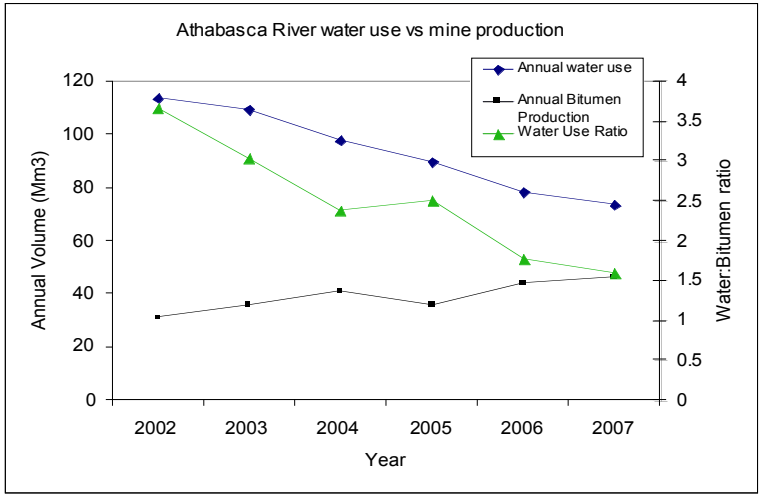
Water use in the oil sands

Perception is use exceeds supply

Water Use: The reality

Use is not excessive:





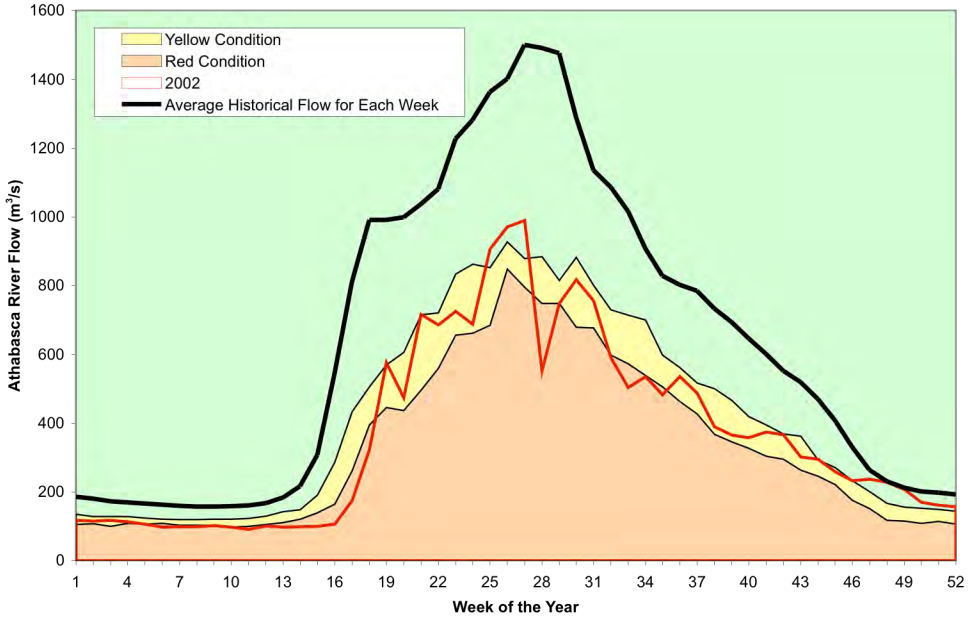
Nor is it out of control:

- Athabasca River Water Management Framework (regulatory protection of the Athabasca River)
- Interim Water Management Framework for the Muskeg River
- Water efficiency at mines improving
- Update to Oil Field Injection Policy to facilitate consideration of all potential water sources
  - Will provide detailed guidance on application for water use at in situ facilities including tradeoff assessment for Net Environmental Impact

Athabasca River Water Management Framework – Phase 1

- Strict limits are placed on water use
- Framework puts a weekly cap on how much water oil sands companies can remove
- Strong *Water Act* with tools to implement pursuant to terms and conditions in licences; amendments of licences; issuance of water management orders; and suspension of licences.

Figure 1: Phase 1 Framework Boundary Conditions



Green Condition

Allows water withdrawals up to 15% of river flow.

Yellow Condition

River is experiencing natural low flows (occurs about
14 per cent of the time). Water withdrawals limited to 10%.

Red Condition

The river is experiencing natural drought (occurs about four per cent of the time).

- 8-12 m3/s in winter weeks, less than 10% of the lowest weekly flow on record.

Industry Water Sharing Agreement

- New agreement each year from companies
- Very important to social license

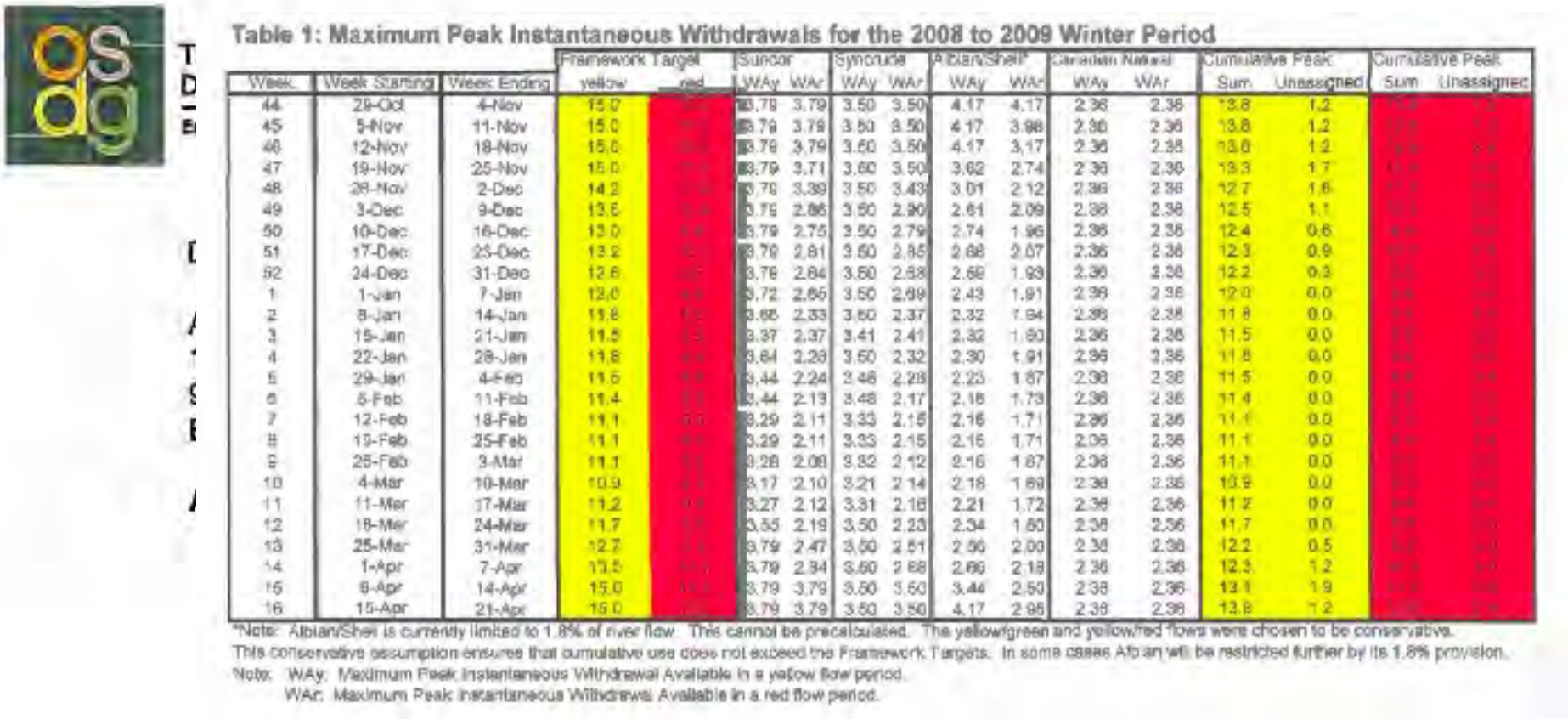


Table 1: Maximum Peak Instantaneous Withdrawals for the 2008 to 2009 Winter Period

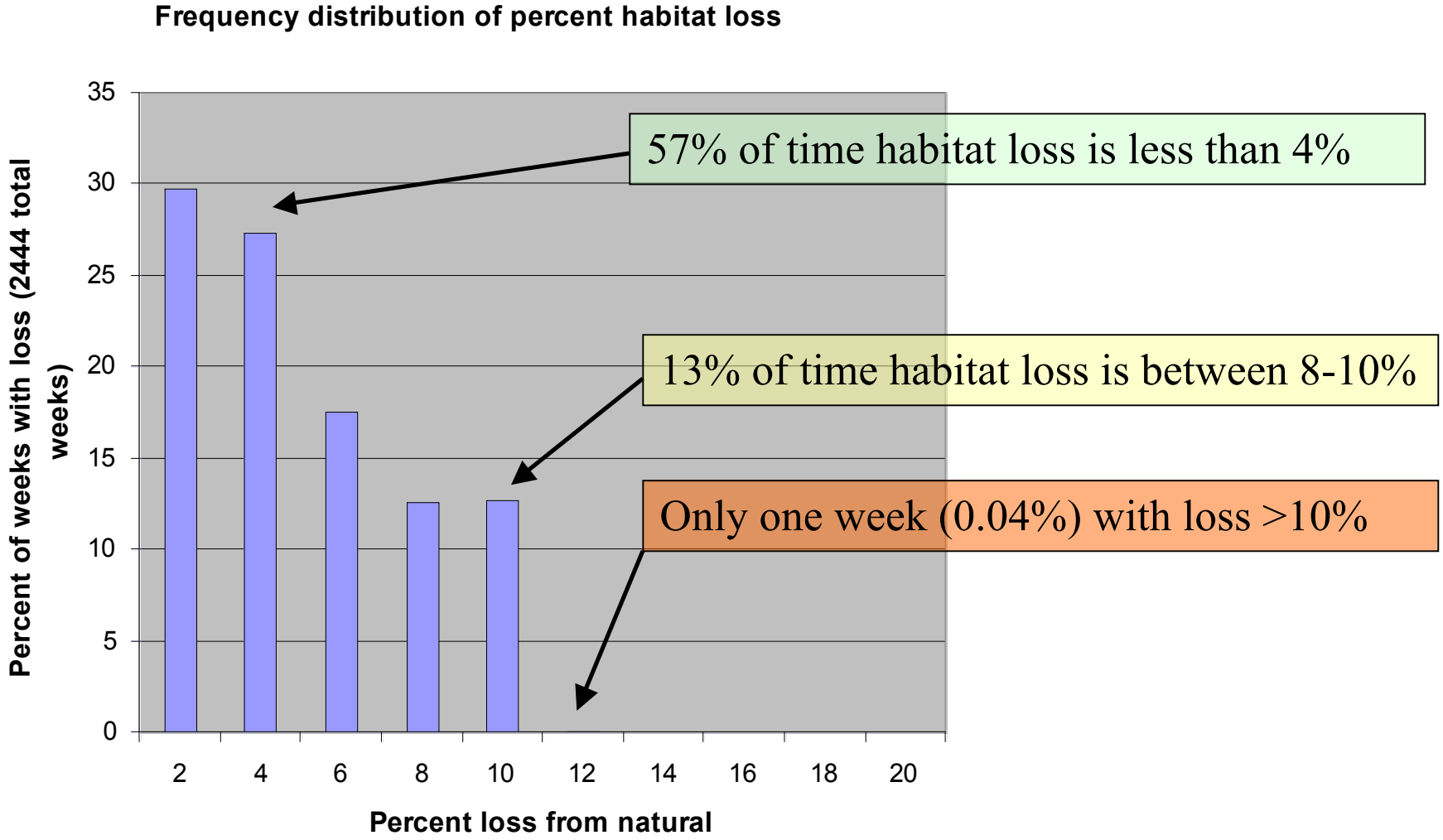
Week	Week Starting	Week Ending	Framework Target yellow	red	Suncor WAy	WAr	Syncrude WAy	WAr	Albian/Shell* WAy	WAr	Canadian Natural WAy	WAr	Cumulative Peak Sum	Unassigned	Cumulative Peak Sum	Unassigned
44	29-Oct	4-Nov	15.0		3.79	3.79	3.50	3.50	4.17	4.17	2.36	2.36	13.8	1.2		
45	5-Nov	11-Nov	15.0		3.79	3.79	3.50	3.50	4.17	3.98	2.36	2.36	13.8	1.2		
46	12-Nov	18-Nov	15.0		3.79	3.79	3.50	3.50	4.17	3.17	2.36	2.36	13.8	1.2		
47	19-Nov	25-Nov	15.0		3.79	3.71	3.50	3.50	3.62	2.74	2.36	2.36	13.3	1.7		
48	26-Nov	2-Dec	14.2		3.79	3.39	3.50	3.43	3.01	2.12	2.36	2.36	12.7	1.6		
49	3-Dec	9-Dec	13.6		3.75	2.86	3.50	2.90	2.61	2.09	2.36	2.36	12.5	1.1		
50	10-Dec	16-Dec	13.0		3.79	2.75	3.50	2.79	2.74	1.96	2.36	2.36	12.4	0.6		
51	17-Dec	23-Dec	13.2		3.79	2.81	3.50	2.85	2.68	2.07	2.36	2.36	12.3	0.9		
52	24-Dec	31-Dec	12.6		3.79	2.84	3.50	2.58	2.69	1.93	2.36	2.36	12.2	0.3		
1	1-Jan	7-Jan	12.0		3.72	2.65	3.50	2.69	2.43	1.91	2.36	2.36	12.0	0.0		
2	8-Jan	14-Jan	11.8		3.65	2.33	3.50	2.37	2.32	1.84	2.36	2.36	11.8	0.0		
3	15-Jan	21-Jan	11.5		3.37	2.37	3.41	2.41	2.32	1.80	2.36	2.36	11.5	0.0		
4	22-Jan	28-Jan	11.8		3.64	2.28	3.50	2.32	2.30	1.91	2.36	2.36	11.8	0.0		
5	29-Jan	4-Feb	11.5		3.44	2.24	3.48	2.28	2.23	1.87	2.36	2.36	11.5	0.0		
6	5-Feb	11-Feb	11.4		3.44	2.13	3.48	2.17	2.18	1.73	2.36	2.36	11.4	0.0		
7	12-Feb	18-Feb	11.1		3.29	2.11	3.33	2.15	2.16	1.71	2.36	2.36	11.1	0.0		
8	19-Feb	25-Feb	11.1		3.29	2.11	3.33	2.15	2.16	1.71	2.36	2.36	11.1	0.0		
9	26-Feb	3-Mar	11.1		3.28	2.09	3.32	2.12	2.16	1.67	2.36	2.36	11.1	0.0		
10	4-Mar	10-Mar	10.9		3.17	2.10	3.21	2.14	2.18	1.69	2.36	2.36	10.9	0.0		
11	11-Mar	17-Mar	11.2		3.27	2.12	3.31	2.16	2.21	1.72	2.36	2.36	11.2	0.0		
12	18-Mar	24-Mar	11.7		3.55	2.19	3.50	2.23	2.34	1.80	2.36	2.36	11.7	0.0		
13	25-Mar	31-Mar	12.7		3.79	2.47	3.50	2.51	2.56	2.00	2.36	2.36	12.2	0.5		
14	1-Apr	7-Apr	13.5		3.79	2.84	3.50	2.88	2.66	2.18	2.36	2.36	12.3	1.2		
15	8-Apr	14-Apr	15.0		3.79	3.79	3.50	3.50	3.44	2.50	2.36	2.36	13.1	1.9		
16	15-Apr	21-Apr	15.0		3.79	3.79	3.50	3.50	4.17	2.95	2.36	2.36	13.8	1.2		

*Note: Albian/Shell is currently limited to 1.8% of river flow. This cannot be precalculated. The yellow/green and yellow/red flows were chosen to be conservative. This conservative assumption ensures that cumulative use does not exceed the Framework Targets. In some cases Albian will be restricted further by its 1.8% provision.

Note: WAy: Maximum Peak Instantaneous Withdrawal Available in a yellow flow period.
WAr: Maximum Peak Instantaneous Withdrawal Available in a red flow period.

Myth: Habitat loss is large

Phase 1: Habitat loss LNSC for Reach 4



The IFNTTG/CEMA Process

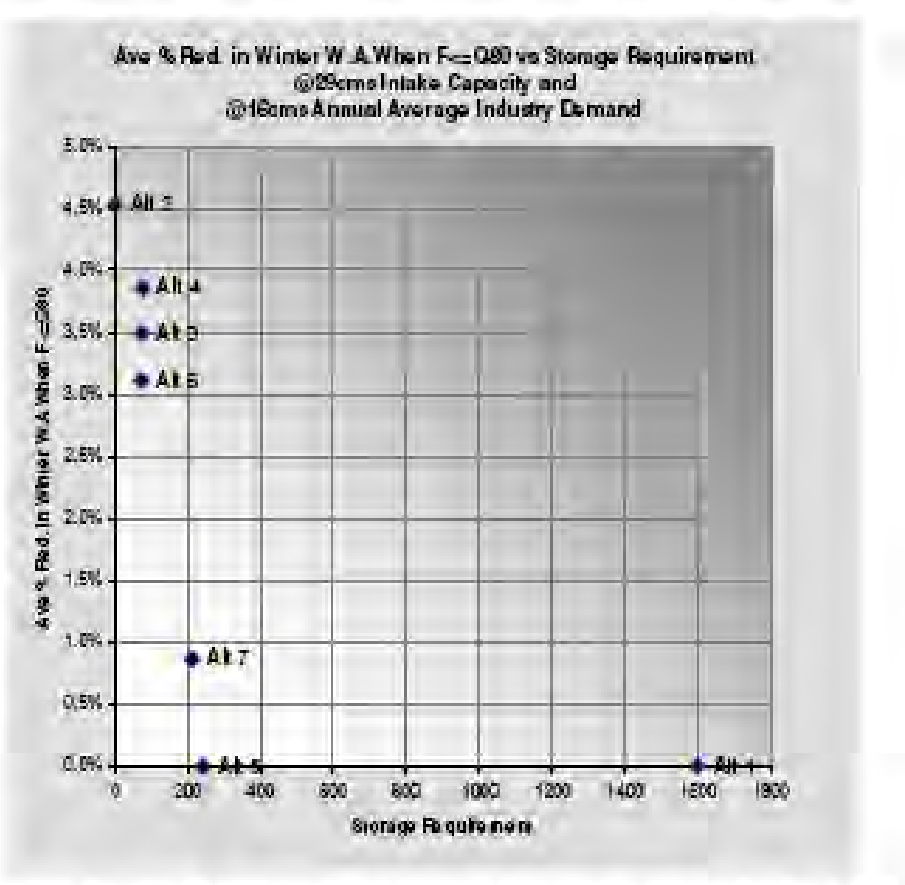


Figure 24: Loss of Average Winter Wetted Area versus Storage for Alts 1 to 7

- The obvious choice is option 5, 6 or 7
- This requires 73 or 210 million m3 of storage or 1.5 to 2.5 billion dollars
- The reality is that there is no difference on the y-axis as uncertainty is +/- 25%

Reported as much better performance (reality 3% and 4% are not different)

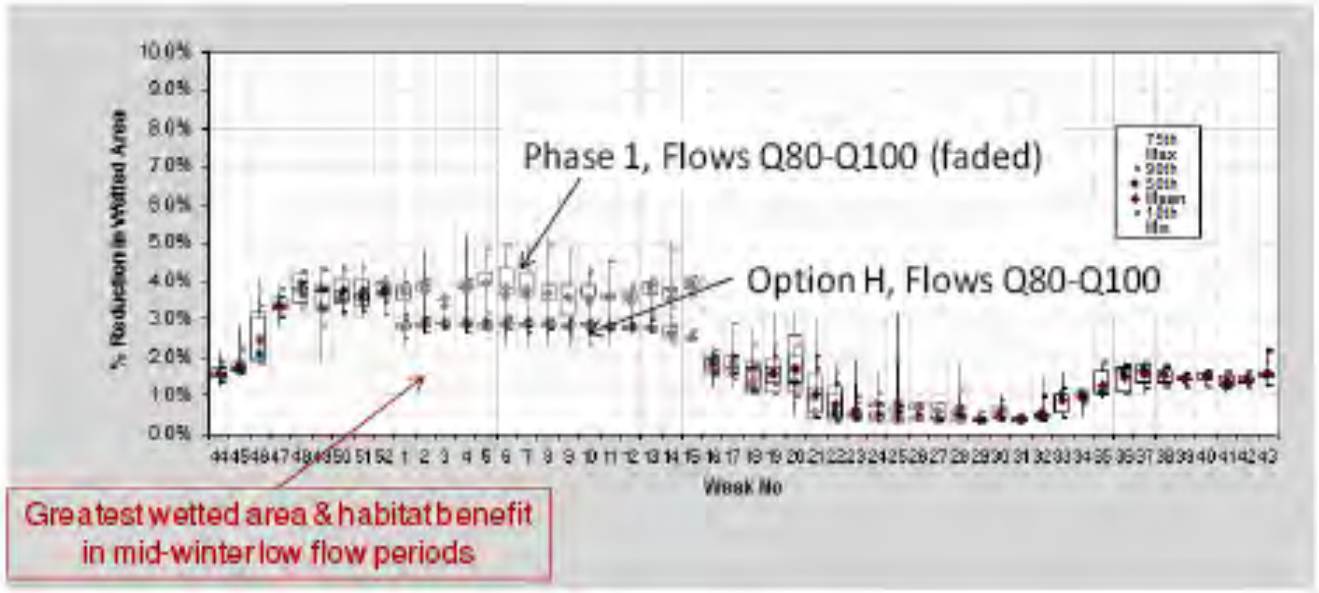
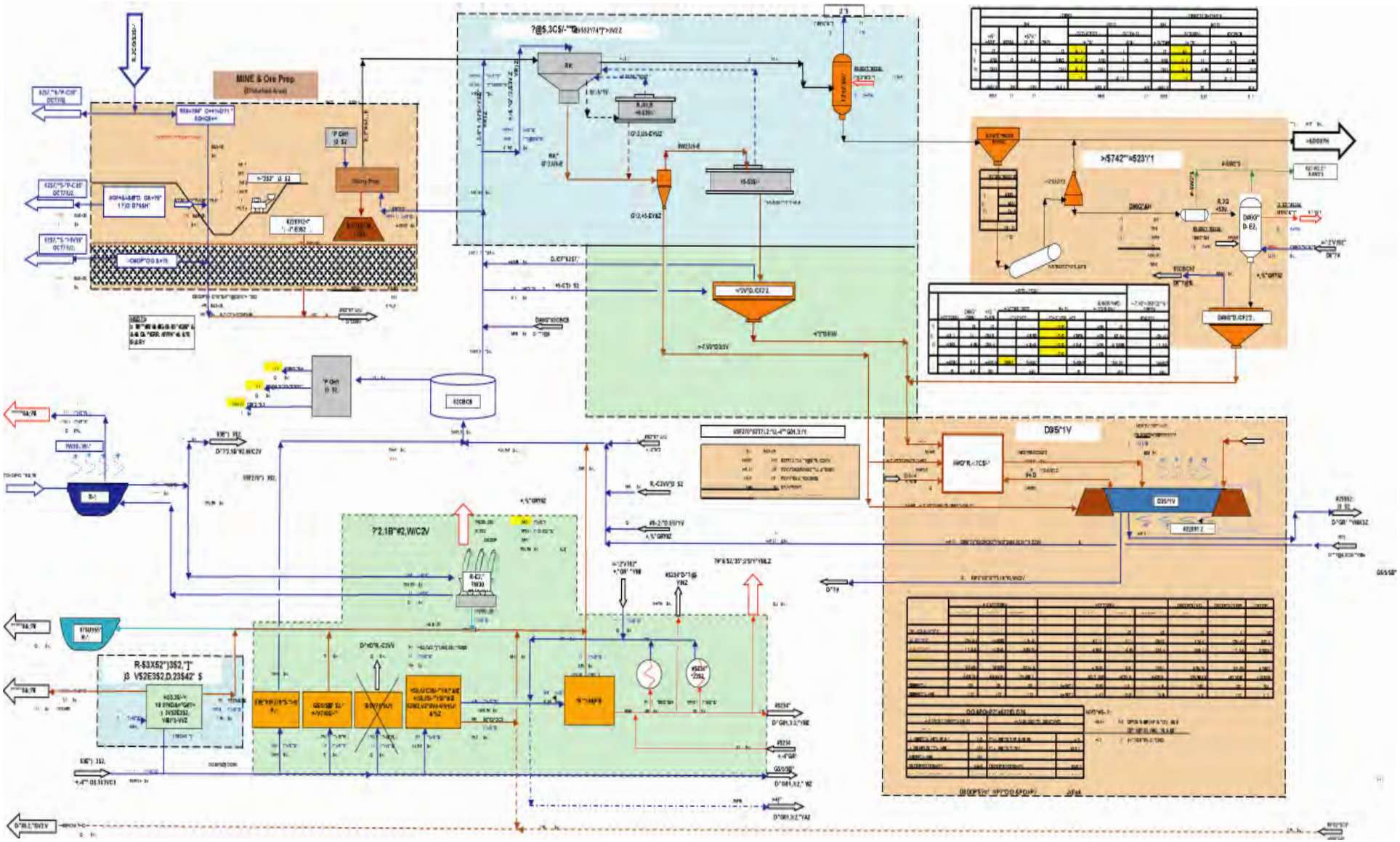
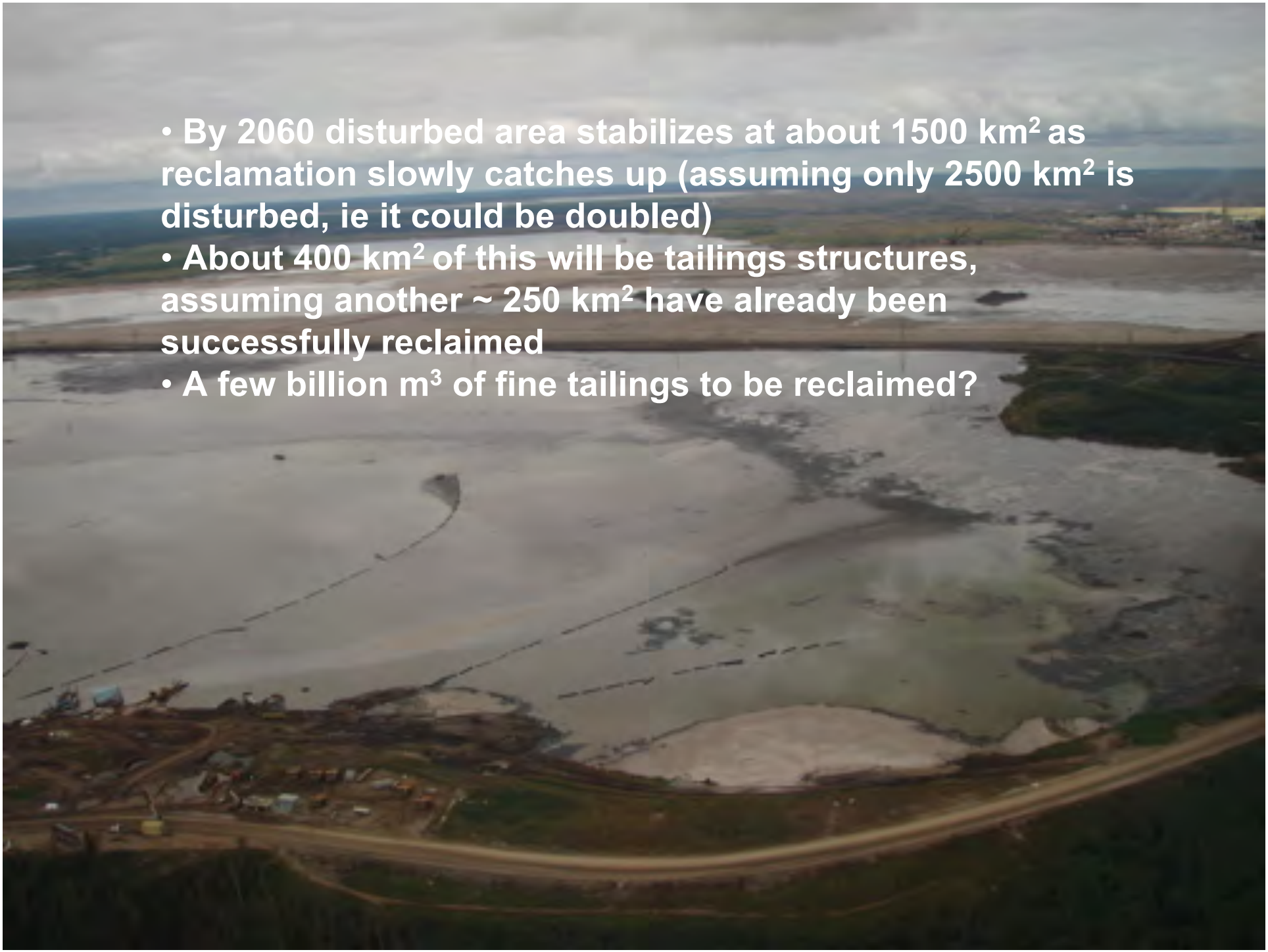


Figure 36: Wetted area performance in low flow years (Q80-Q100)

Water use models for each facility



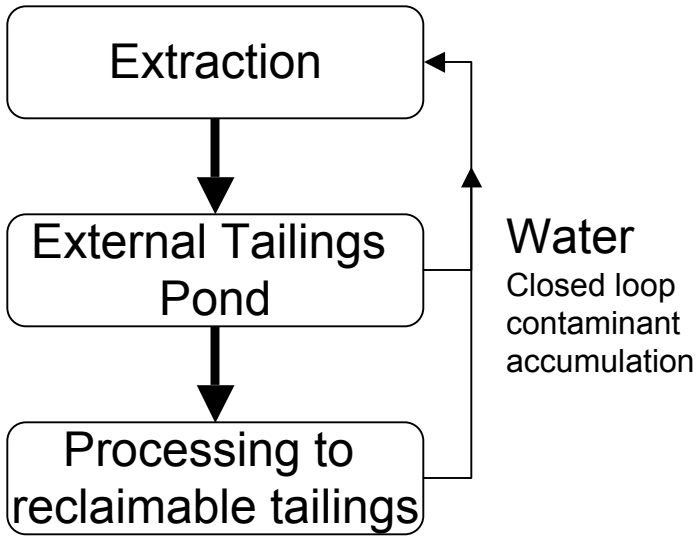

• By 2060 disturbed area stabilizes at about 1500 km² as reclamation slowly catches up (assuming only 2500 km² is disturbed, ie it could be doubled)
• About 400 km² of this will be tailings structures, assuming another ~ 250 km² have already been successfully reclaimed
• A few billion m³ of fine tailings to be reclaimed?

Tailings Strategy/ Framework a must do

- Will help industry in approving new water management solutions
- Will provide options for tailings management and integrated water and reclamation solutions
- Social License
- Likely to impact (positively) reclamation liability
- Systems for measurement - performance assessment required

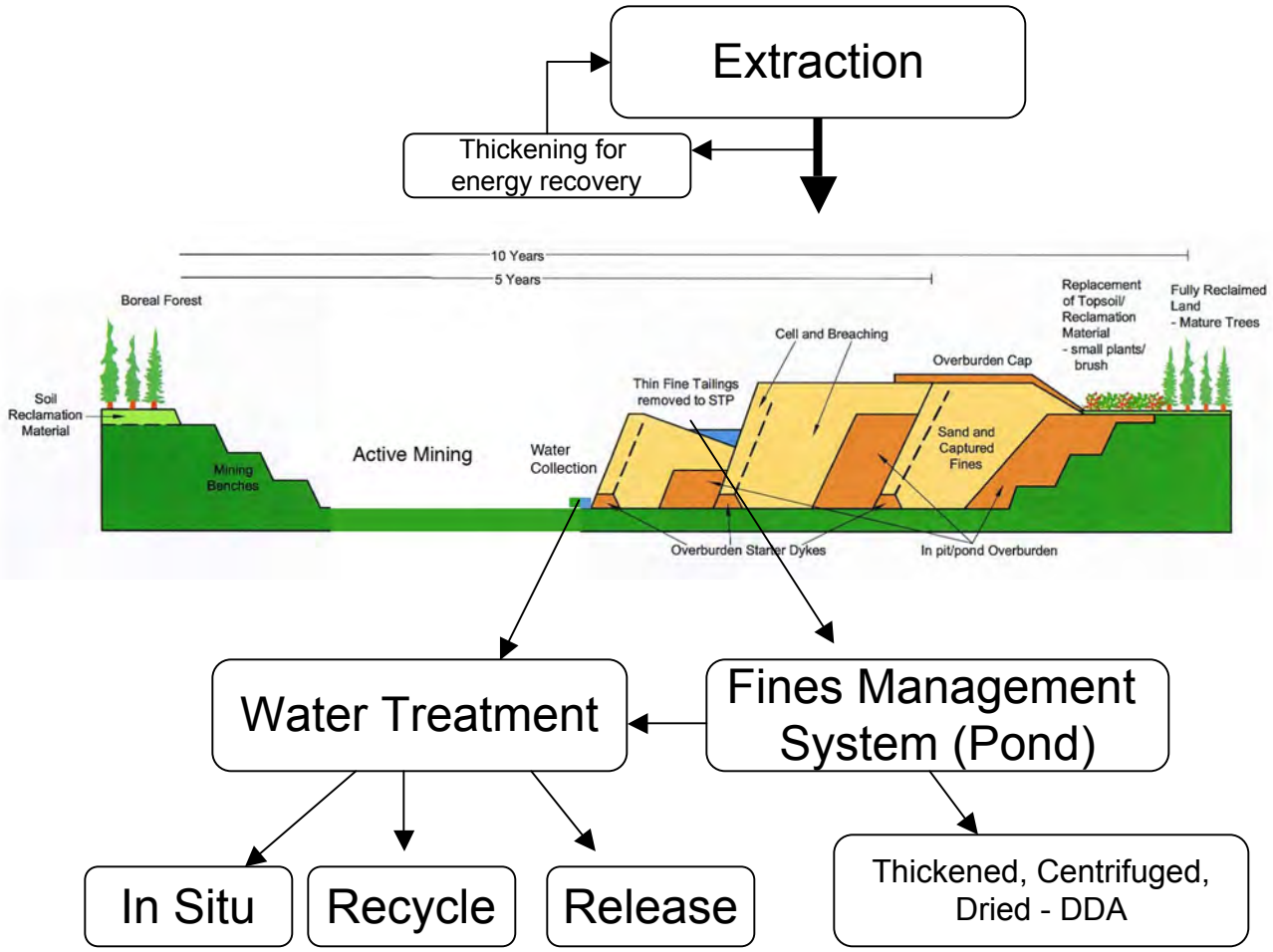
A Crazy Idea?

- Processing tailings, a smaller pond does not make?
  - Pond grows in size as fines-sand accumulates out of pit
  - Water quality impact
- Shift the process around
- Re-brand the wet compartments

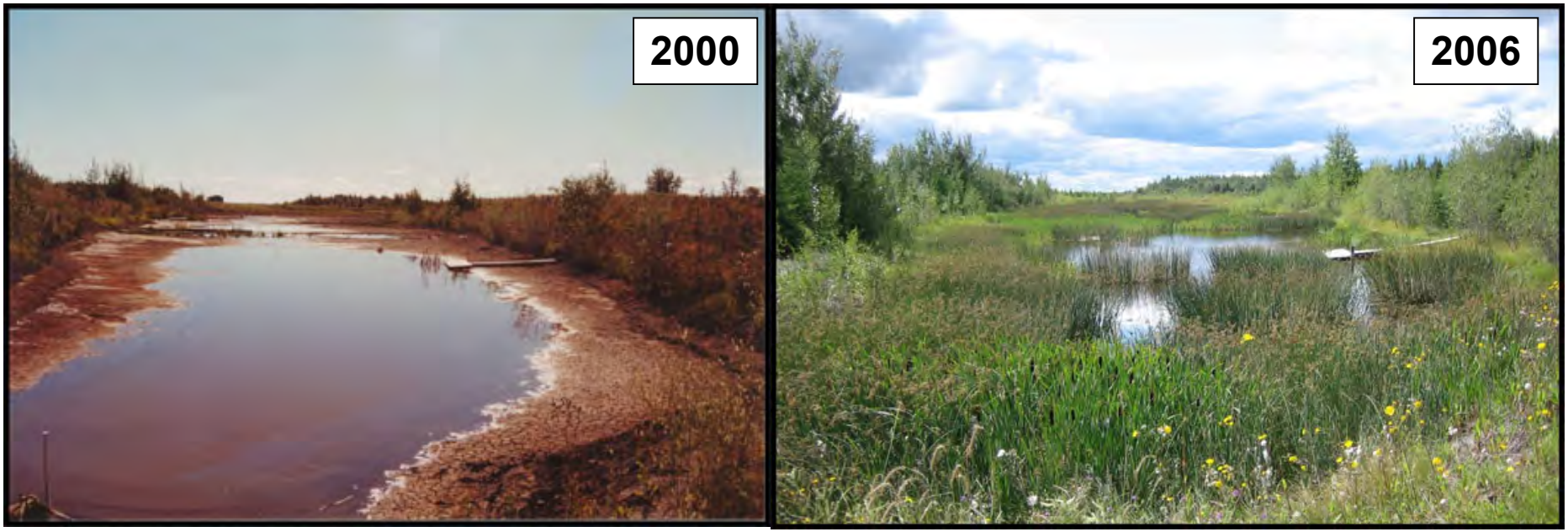


Can we reduce footprint?

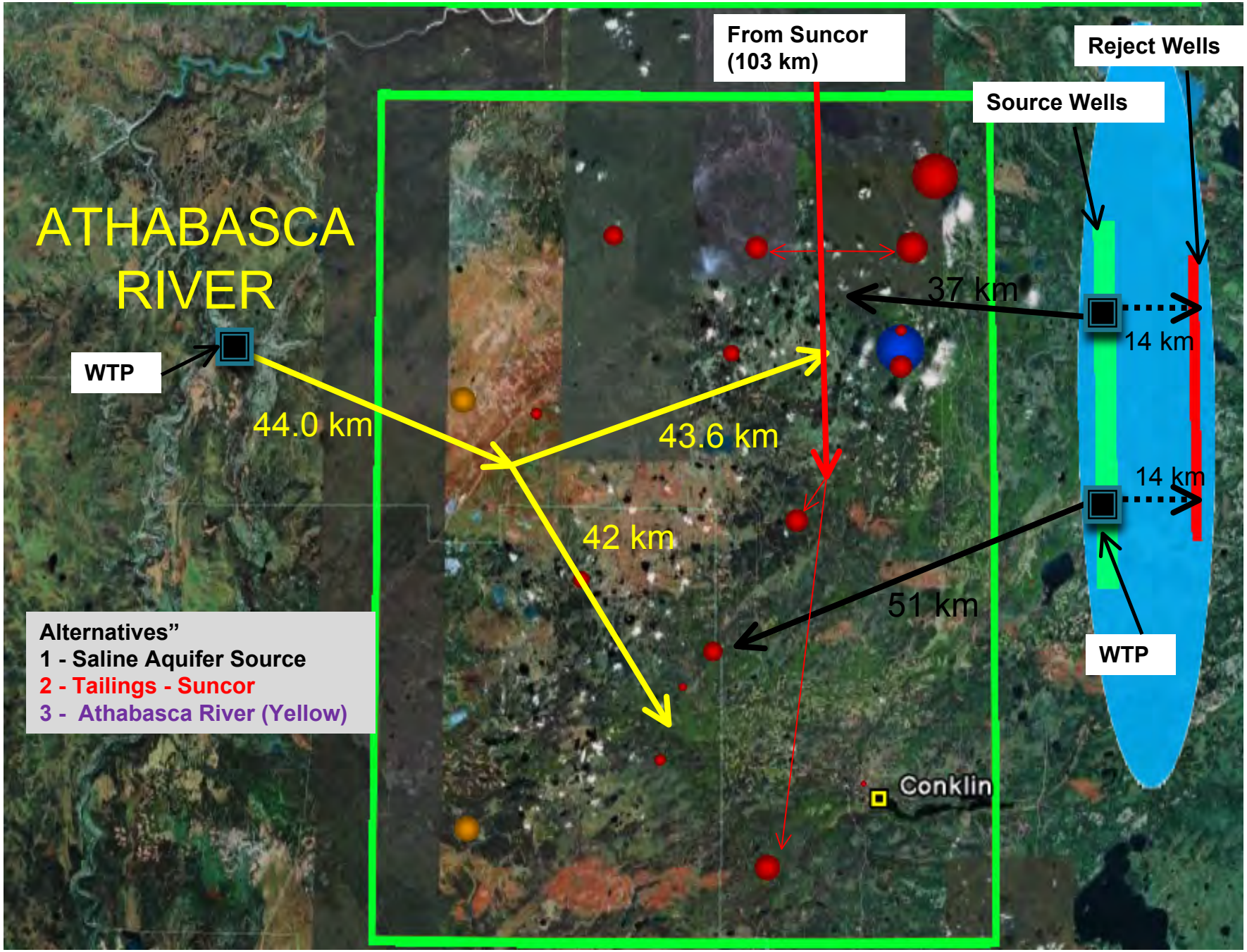
- Change from tailings pond to FMS
- Smaller, below grade?



Tailings Reclamation

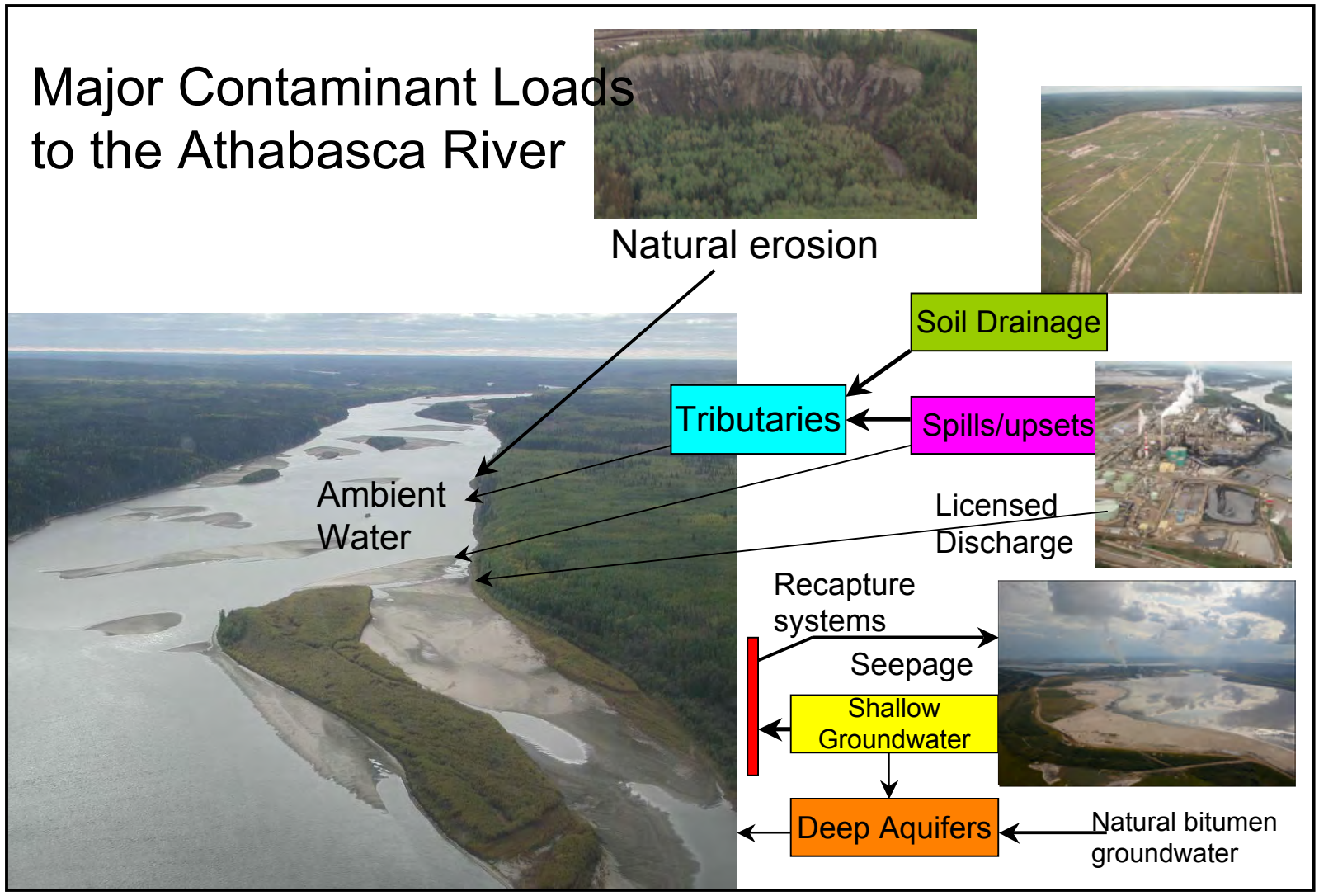


Suncor's research demonstrates the reclamation potential of wetlands containing consolidated tailings and recycled water.


From Suncor
(103 km)
Reject Wells
Source Wells
ATHABASCA
RIVER
WTP
44.0 km
43.6 km
42 km
37 km
14 km
14 km
51 km
WTP
Conklin
Alternatives"
1 - Saline Aquifer Source
2 - Tailings - Suncor
3 - Athabasca River (Yellow)

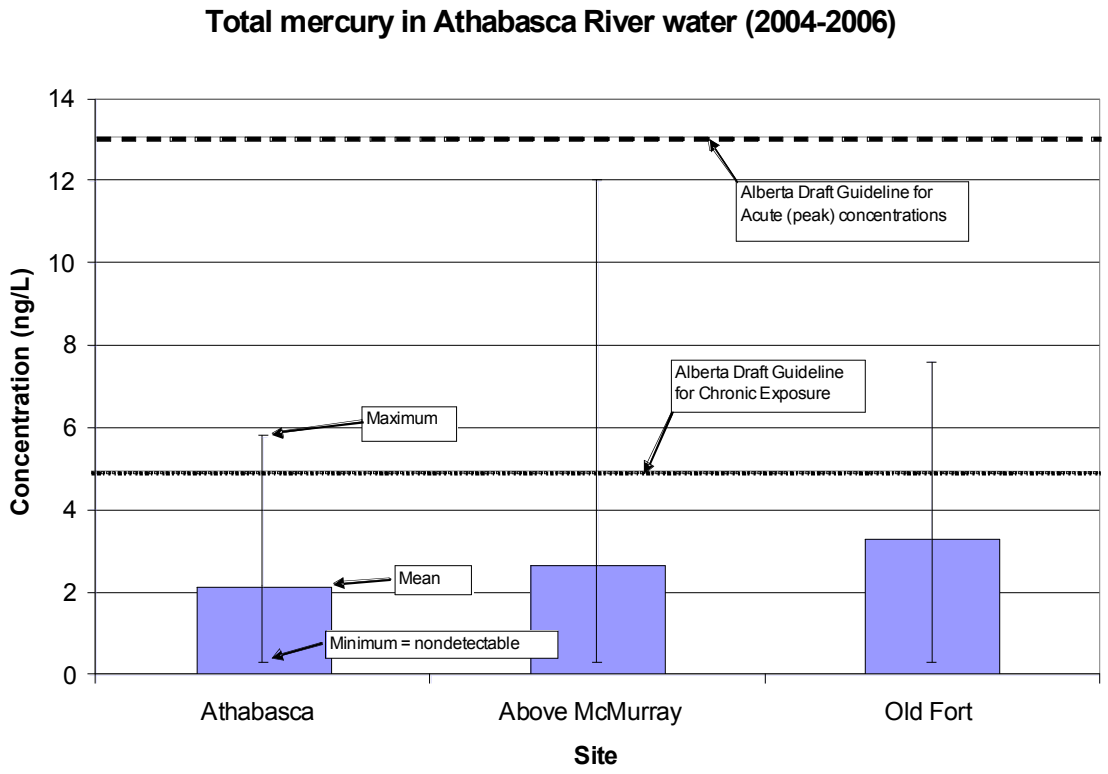
Discharges - ZLD not a sustainable option

Water Quality



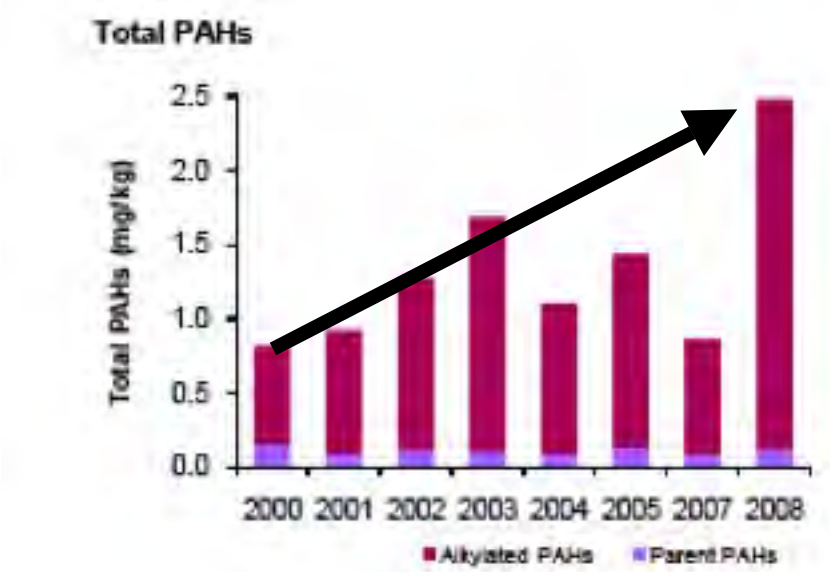
Water Quality - The Reality

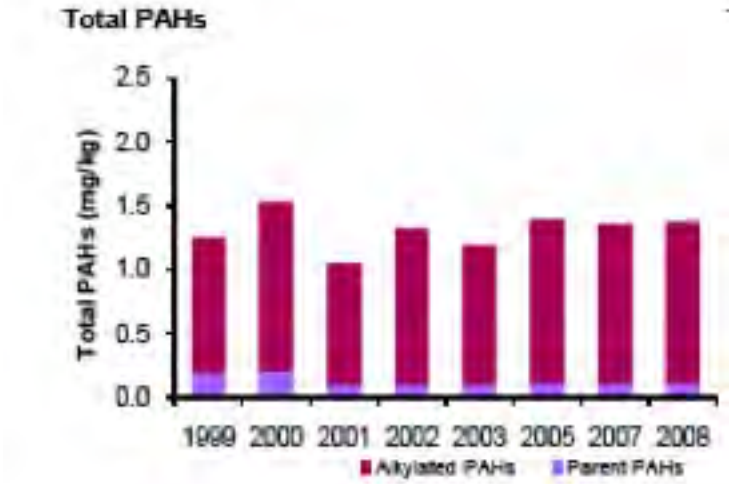
- **100 per cent ambient guideline compliance** for water quality in the Athabasca River downsteam of oil sands for metals mercury and arsenic. Very few detections of organic contaminants.



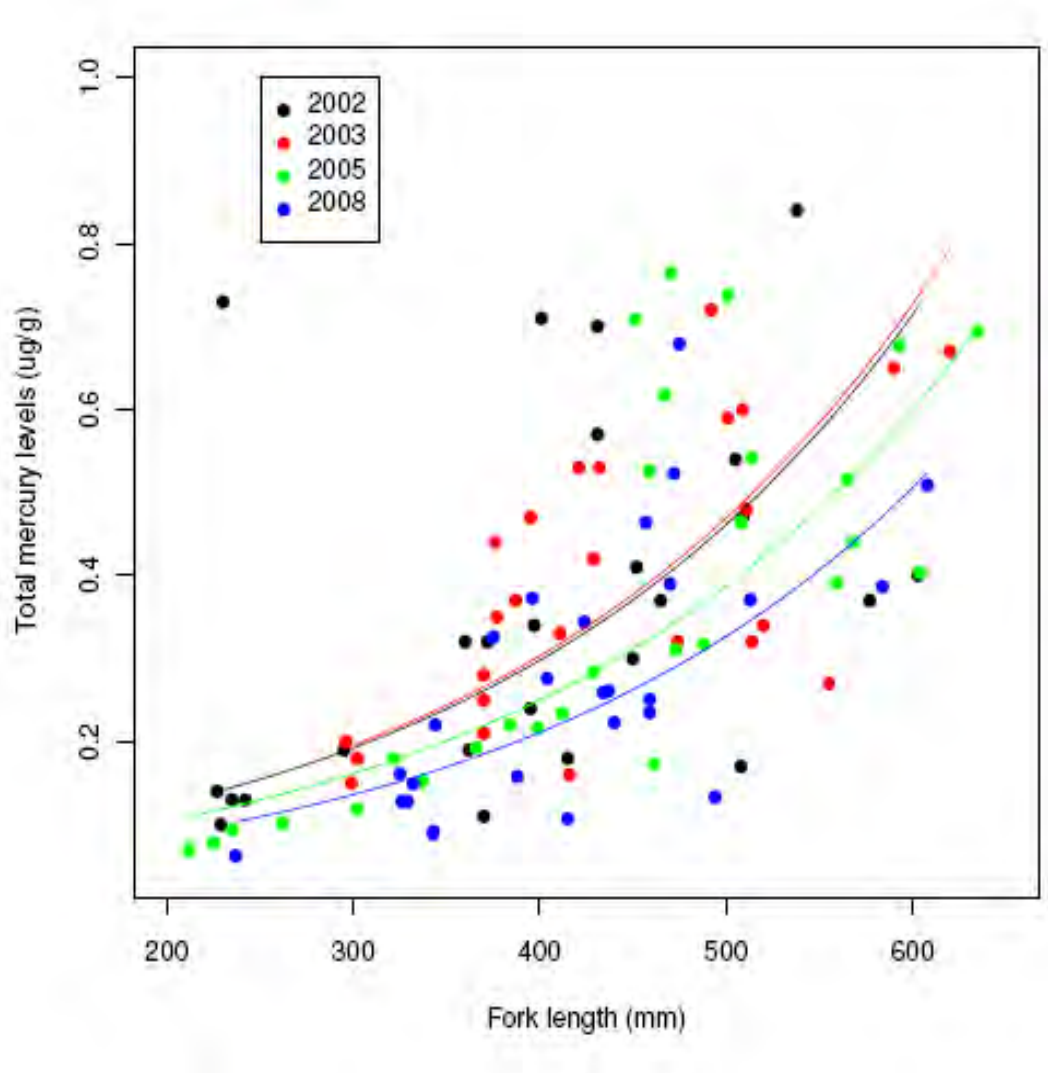
Data Availability, Interpretation, Science

- Lower Athabasca is a data rich region
- Credible reporting
- Misuse of data continues
- No credible science review available
- Science reviews likely to be negative
  - size and complexity
  - limited data availability





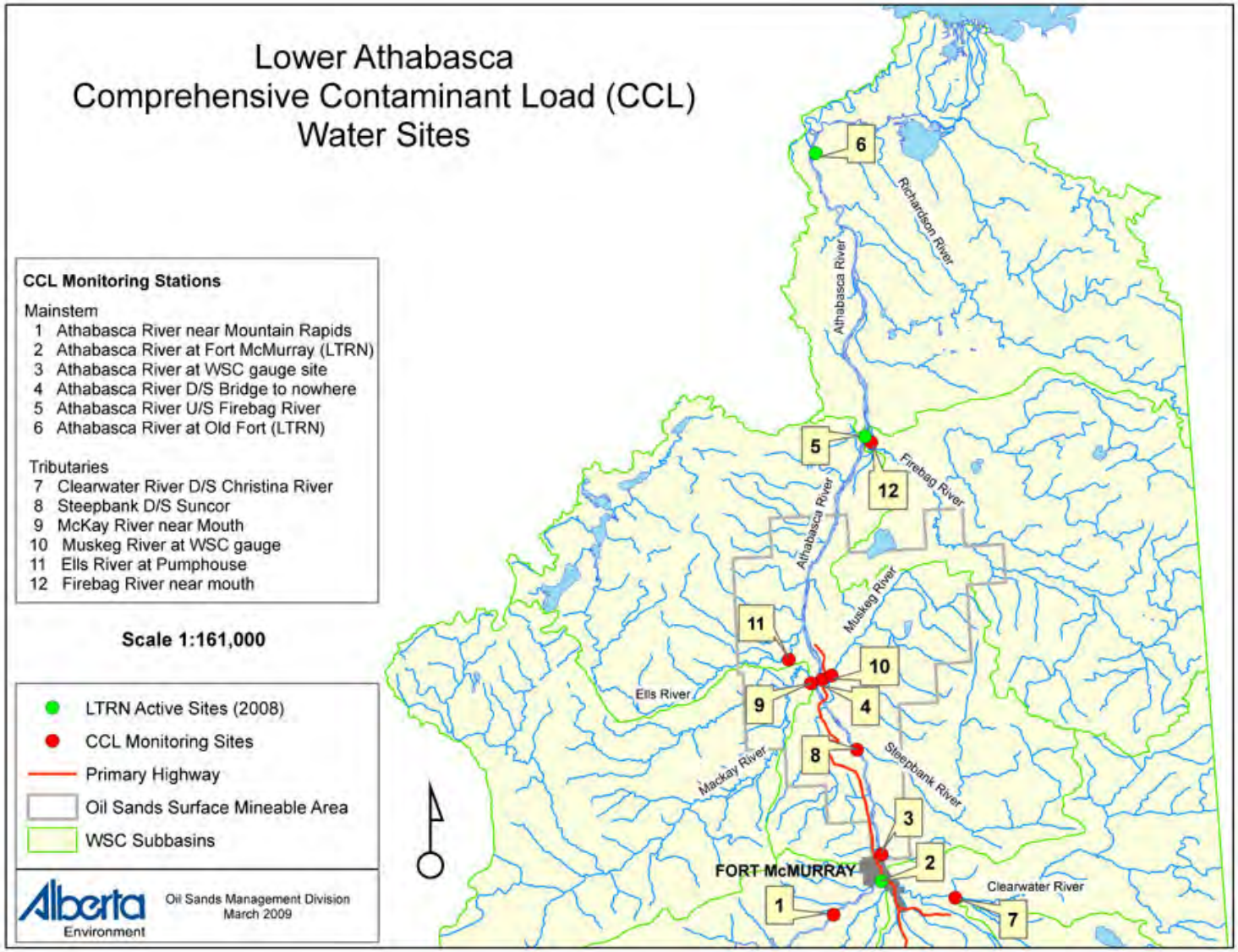
Mercury not increasing in fish



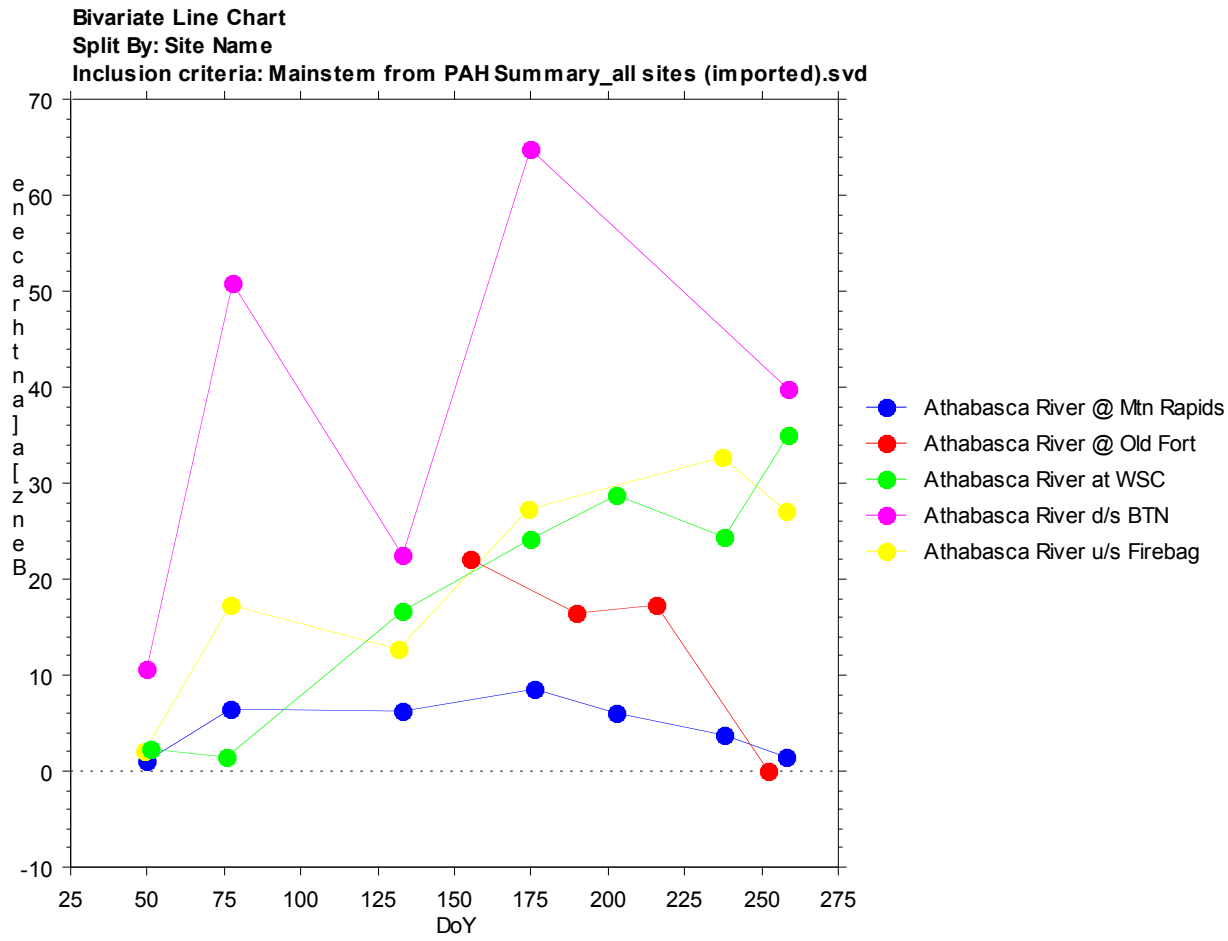
- Some reports have indicated mercury concentrations in fish have increased.
- This impression can be derived from available data when not correctly accounting for fish size.
- More detailed data are available
- These data show there has been no increase
- The same lack of increase is seen when using data back to the 70s

Athabasca River AENV sampling sites

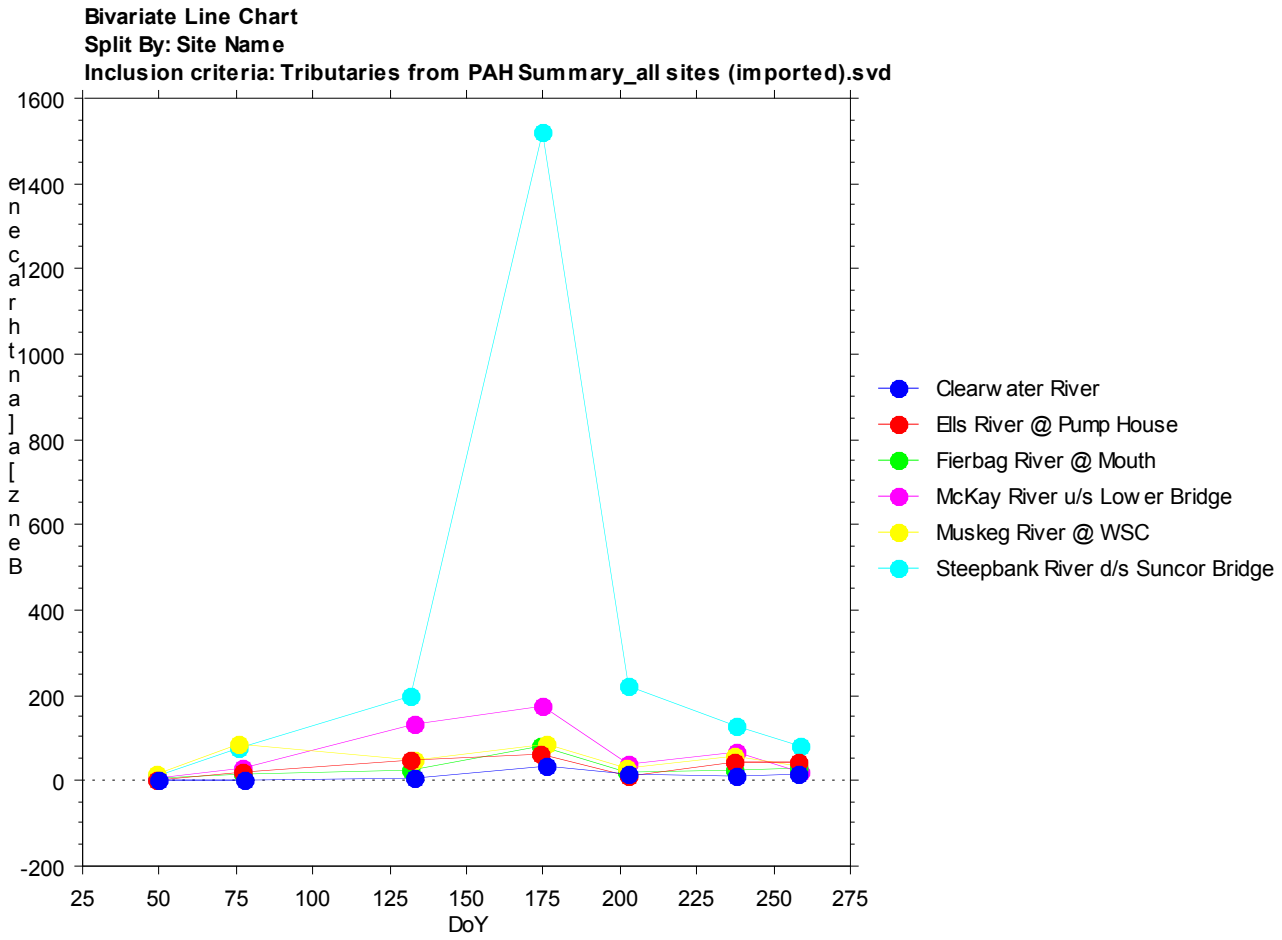
Green sites bulk water sampled monthly with extensive parameters analyzed
Red sites have continuous passive samplers installed (metals, Nas, PAHs)



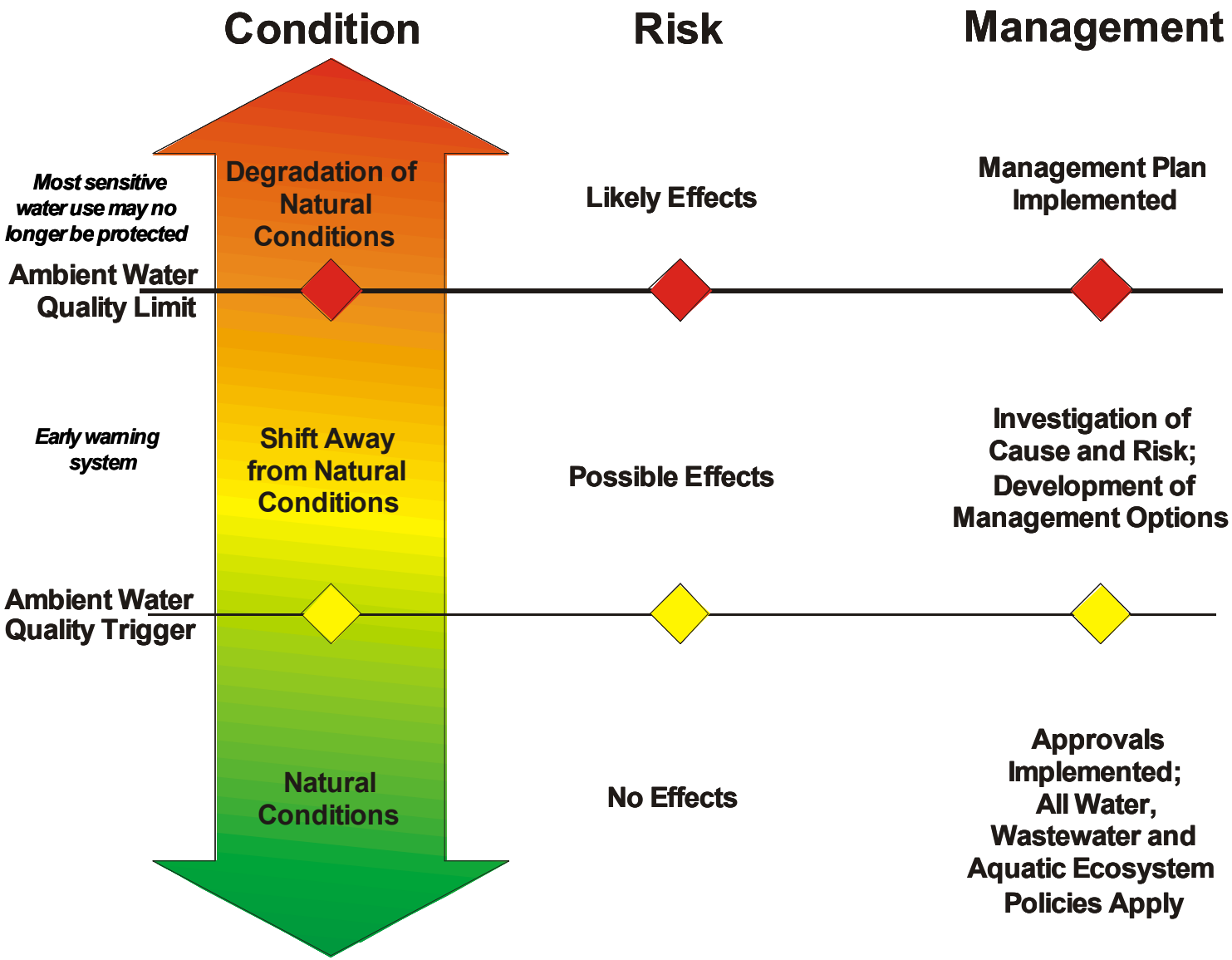
An example from our SPMD work on PAHs



Tributary sources



Management Framework for Water Quality



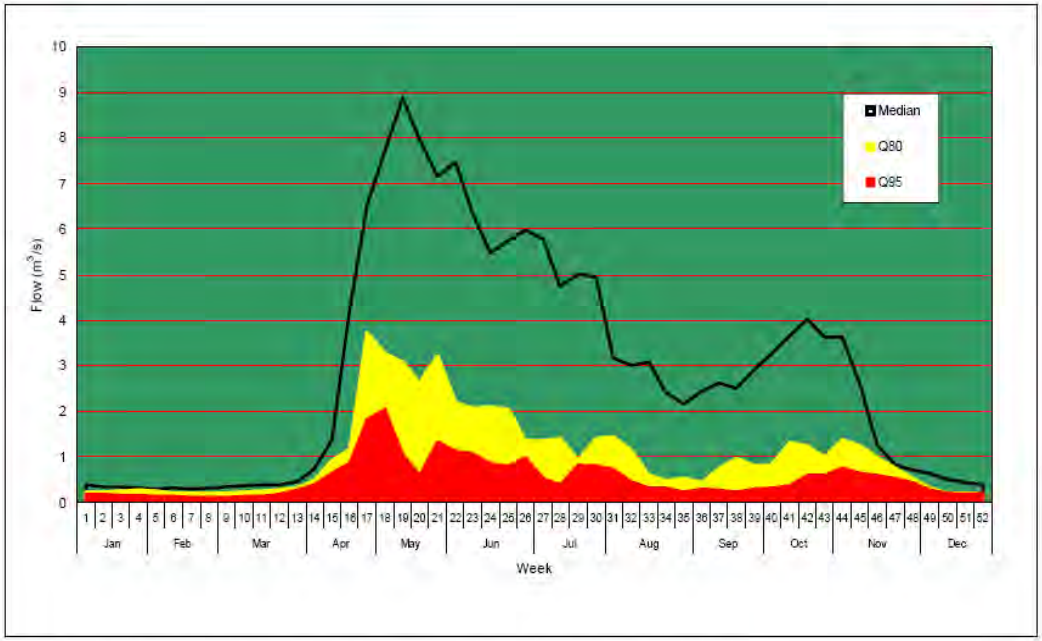
Purpose of the 2009 Update

- Overall objectives:
  - Develop new Water Quality Thresholds
  - Enhance the performance management system to monitor, evaluate & report on ambient river conditions.
- Will be combined with Phase 2 water quantity recommendation.
- Provides a framework for the collective management of human activities on the water quantity & quality of the Lower Athabasca River (LAR)
- All existing water, wastewater and aquatic ecosystem policies apply (in addition to the LAR WMF).

Water Quality Thresholds

- Wide net cast on parameters
  - If statistically significant increase from McMurray to Old Fort
  - If found in potential release waters at concentrations > 2 times background
- Selected 49 key water quality parameters (monitor already)
  - 11 general (e.g., pH, TP, sodium)
  - 29 metals (e.g., Al, Fe, Zn)
  - Naphthenic acids
  - 8 PAHs (polycyclic aromatic hydrocarbons)

Important components



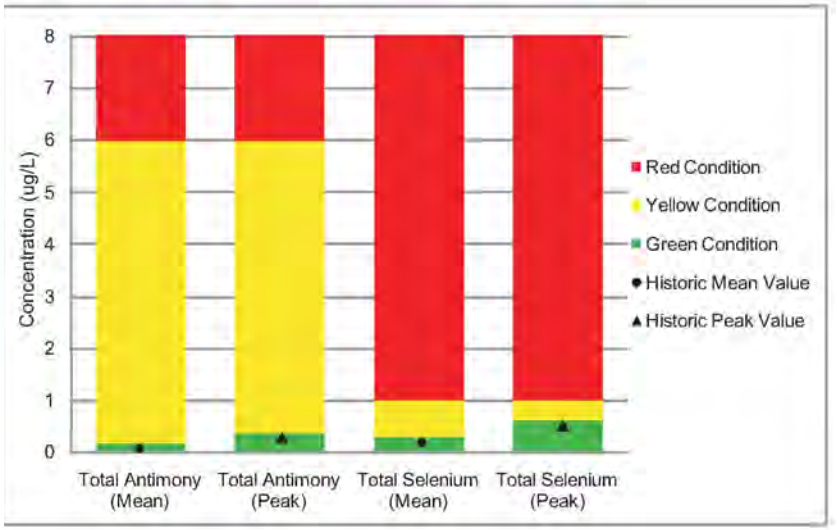


Figure 5.1 Natural Flows and Environmental Management Conditions of the Muskeg River

- Noted these were living and would be updated as data became available

Goal

- Flexible policy recognizing a hierarchy of impacts
- Minimization of Net Environmental Impact
- A robust and integrated monitoring and performance assessment system
- An ability to communicate current state, improvements and to address issues with examples immediately.

Water and tailings management framework Implications summarized

- The surface water framework:
  - Does not limit bitumen production
  - Provides a structure for decision making using existing policies (e.g. Industrial release limits policy, WQB Effluents Procedures Manual)
  - Provides incentive to reduce contaminant load in water either stored or drained (reclamation) to the environment
  - Moving forward – will balance water quality and quantity so that exceptional protection of one (e.g. quantity) does not create a quality problem
  - Protects the environment
- Monitoring and performance evaluation
  - Industry approvals monitoring integrated (similar cost to industry)
  - Potential for enhanced AENV personnel presence in auditing or implementation role in monitoring (small cost, funding options available, e.g. internal reduced consulting needed, external fund)
  - Increased AENV dissemination of results (report compilation, electronic database compilation)

Optimize water management

- Increasing water use efficiency
  - Fresh water intake < water lost to projected final densities. How much and timing?
- View water as the carrier not the commodity
  - Develop water and contaminant (in water) management plans for water recycle, alternative use or release
  - Find best means to dispose of contaminants
  - Develop water quality criteria for receiving systems
- Provide direction for end-pit lakes
  - Define a safe ratio of tailings to cap water, and EPL size
  - Define criteria for solids content in bottom of lake

Thank you