



# **Aquatic Effects Monitoring Program**

**Ekati's Environmental Monitoring and Management Programs**

**Workshop – December 3, 2008**



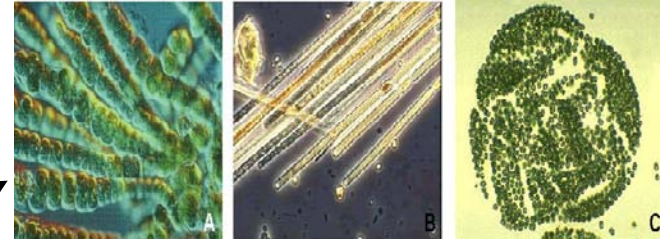
**Independent Environmental  
Monitoring Agency**

# Presentation Outline

- What is the AEMP ?
- Findings of the AEMP 2007 field season
- IEMA comments on the findings and monitoring program

# What is the AEMP?

- Annual program
- 2007 is 10<sup>th</sup> year of monitoring since mining started



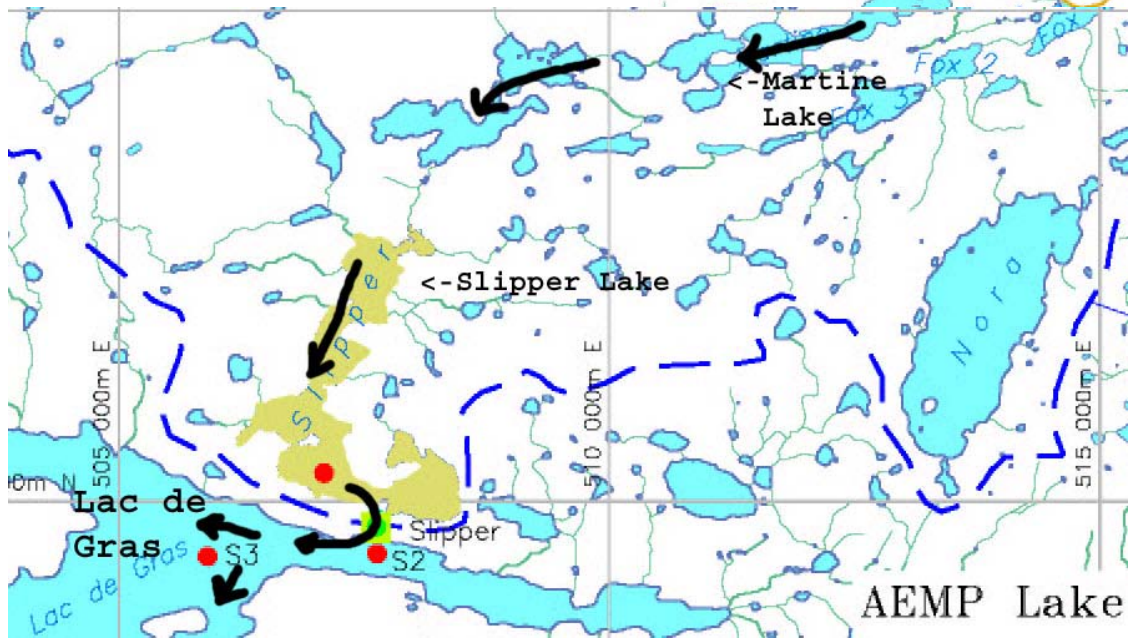
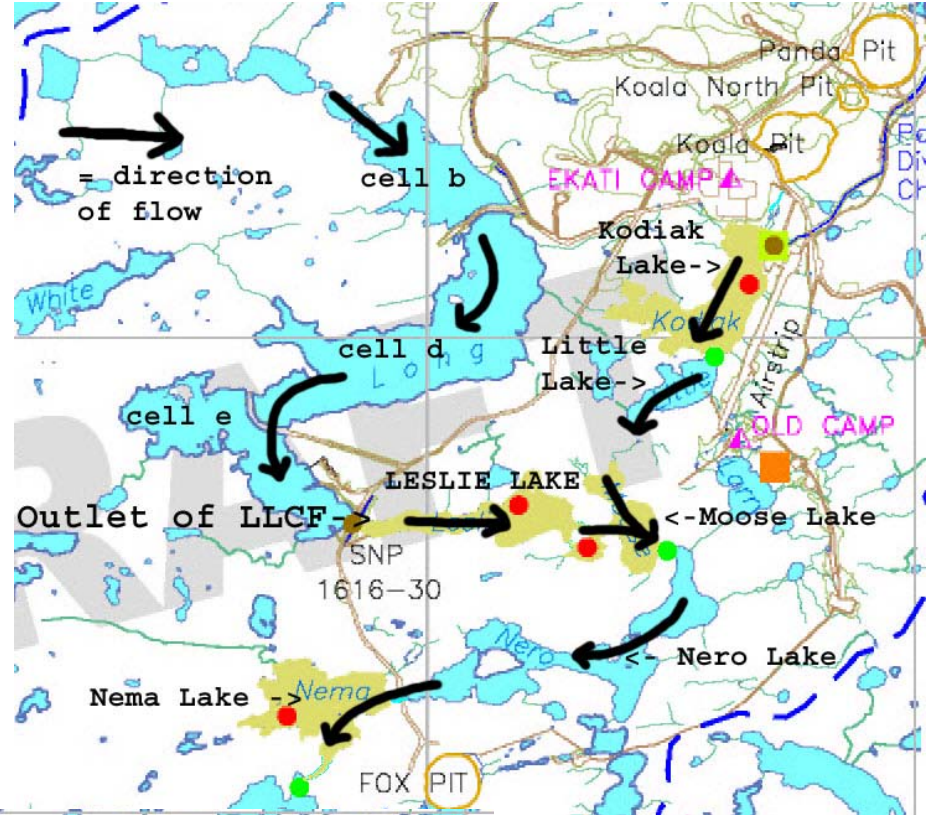
- Monitors water, fish, small plants and bugs to see if they are being affected by the mine



- Information used to track changes, with the aim of minimizing harmful effects
- Focused on downstream effects, not on discharge limits

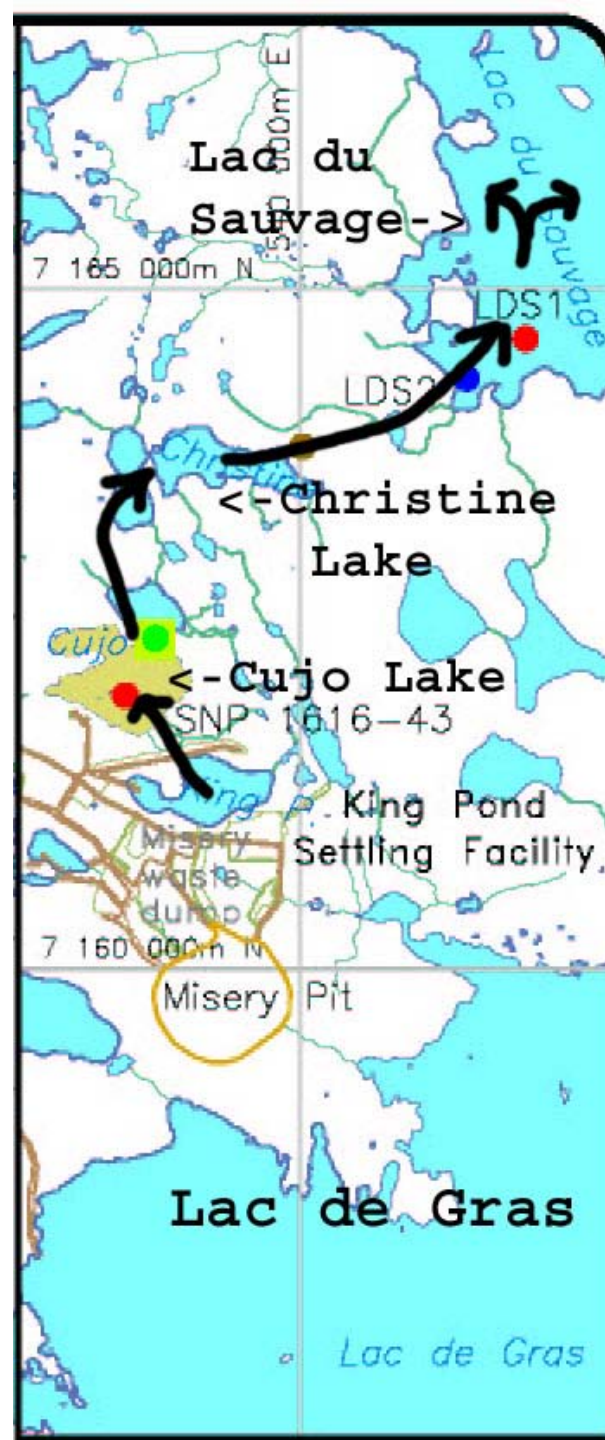
# What lakes are immediately downstream of Ekati in the Koala Watershed?

Leslie, Moose, Kodiak, Little, Nero, Nema, Martine, Slipper, Lac de Gras



# What lakes are immediately downstream of Misery Pit in the King Cujo Watershed?

King, Cujo, Christine,  
Lac du Sauvage, Lac  
de Gras





# **Has Lac de Gras been affected by Ekati up to 2006?**

- Small changes in water quality have been measured in NW arm of Lac de Gras :
  - pH
  - Sulphate
  - Potassium
  - Total Dissolved Solids
  - Chloride
  - Molybdenum



# Results of 2007 AEMP

## Elements nearing or exceeding CCME

- **Nitrate** risen above CCME guidelines
  - BHPB responding by holding back water in tailings pond.
- **Molybdenum**: at or near CCME, continued rise in Moose but slight decline in Leslie
  - BHPB wants to change WQ Objective
- **Selenium** : risen above CCME guidelines in Leslie, Moose and Nema

# Results of 2007 AEMP (cont)

- **Total Dissolved Solids and Chlorides**
  - continue at greater rate of increase
- **Winter Oxygen** measurements taken, but not reported due to equipment malfunctions





# Fish Studies Downstream of LLCF, First Since 2002

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For trout & whitefish:

- CPUE lower in most lakes in Koala watershed, in Cujo Lake and in reference lakes.
  - due to sampling mortality in the previous fish study (2002).
- Fish size and age increased since 2002
  - fewer fish means more food for the fish population
  - low recruitment of younger fish caused by fewer adult spawners.

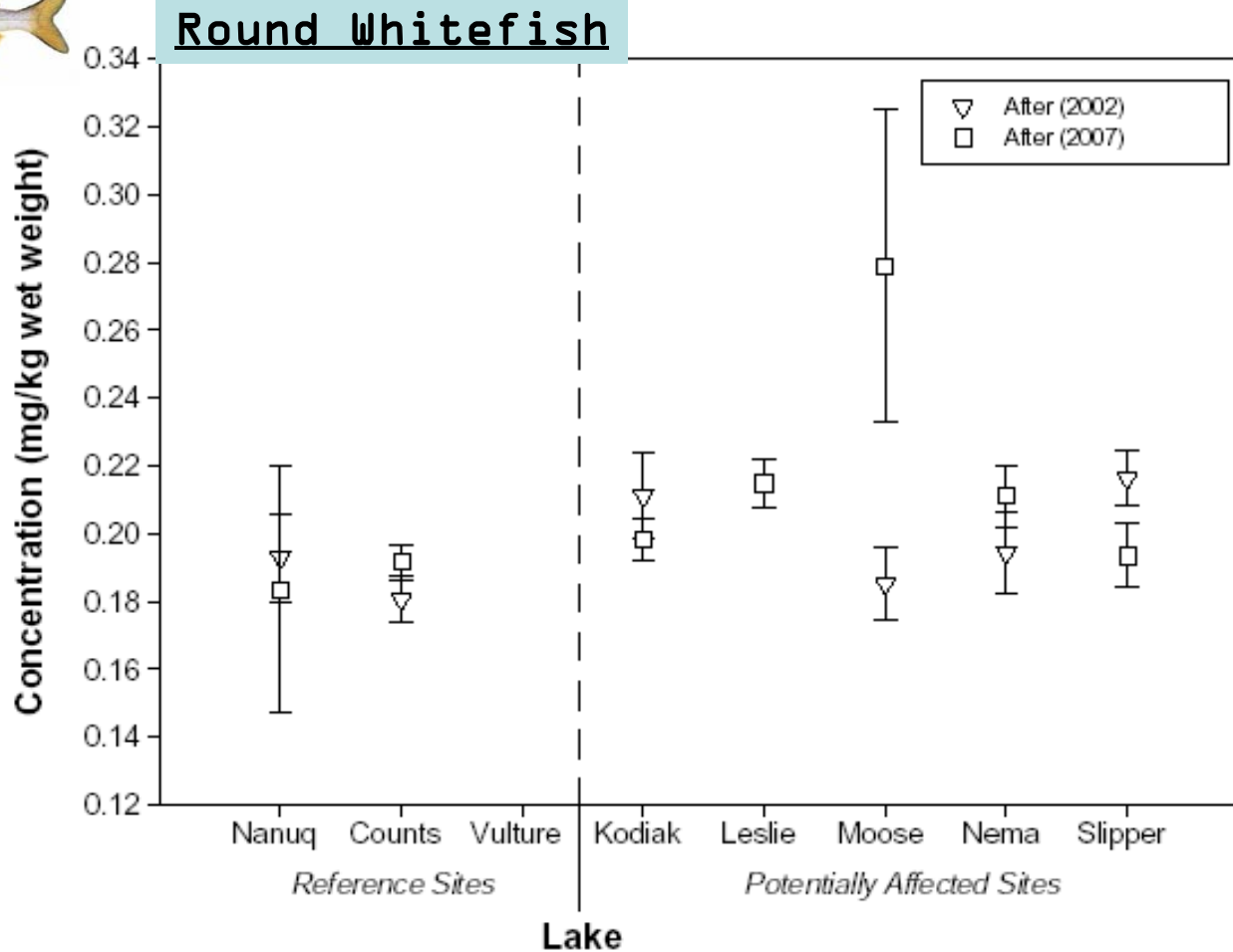


# Fish Studies Downstream of LLCF First Since 2002

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- Condition
- Contaminants (metals, hydrocarbons)
- Parasites
- TK use: DELT (checking for anatomical abnormalities)


# Molybdenum in Fish



Notes: Error bars represent standard error of the mean.

- Also, molybdenum higher in sculpin in all affected lakes compared to reference





# **Mercury in Trout Livers**

## **above Health Canada guidelines**

**(0.500 mg/kg)**

<b>Kodiak Lake</b>	<b>Nema Lake</b>	<b>Slipper Lake</b>
<b>0.874</b>	<b>0.531</b>	<b>0.474</b>
N=6 fish	7 fish	16 fish

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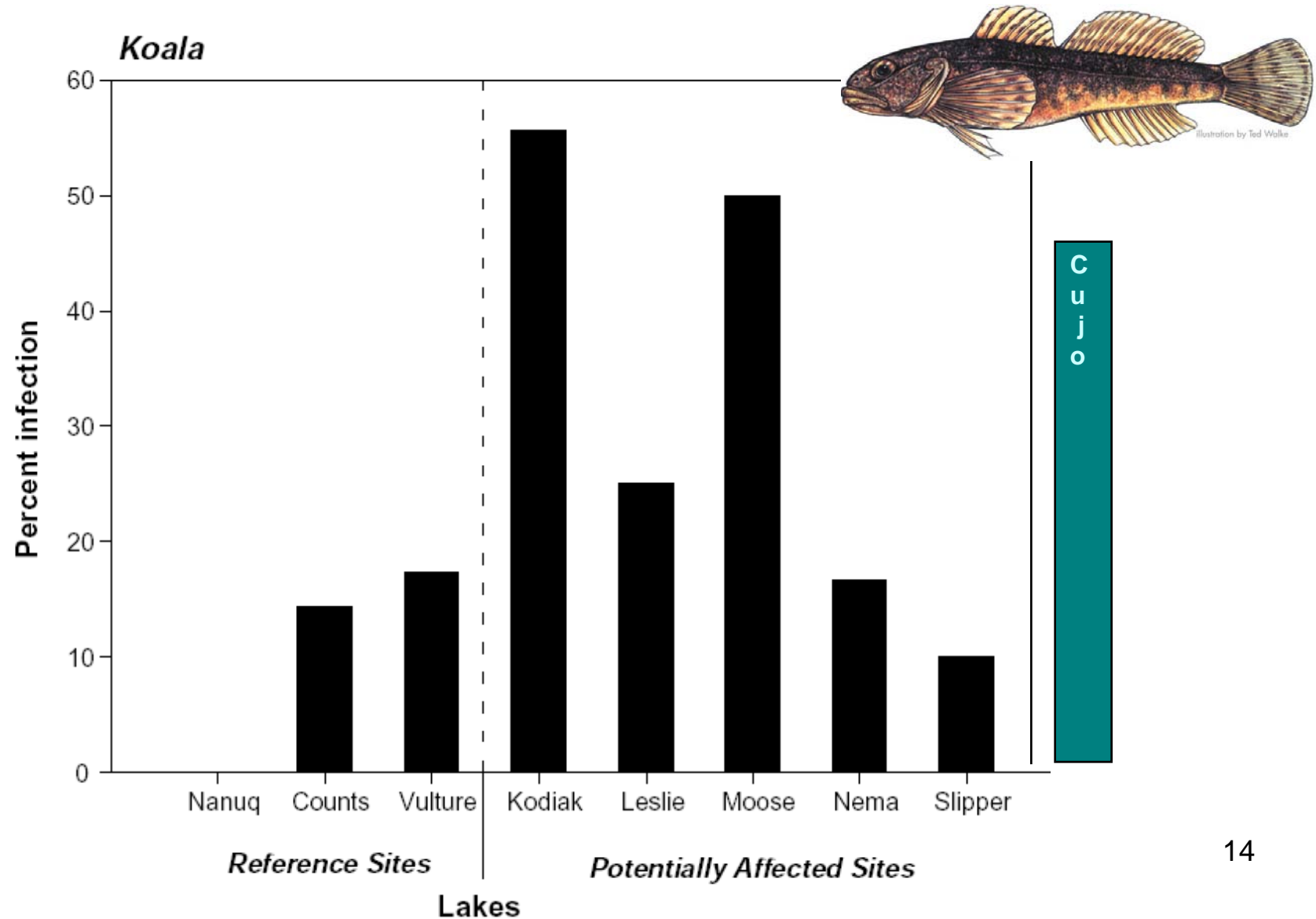
-2 out of 12 trout were from reference lakes  
-Most of these 12 trout were old (>15 yrs)



# Hydrocarbons in fish

- Traces of hydrocarbons in fish bile (trout & whitefish) in Leslie Lake
  - Phenanthrene & benzopyrene
- No impact: fish healthy and no tapeworms

# Tapeworms in sculpin



# Cell E Fish Study

- Awaiting results of study in Cell E of LLCF (done August 2008)
- Will answer 4 questions about fish
  - LLCF as source of **hydrocarbons**?
  - **Tapeworm** infestation higher in LLCF?; probable cause?
  - **Metal loads** different among species? (sculpin, trout, whitefish)
  - Changes in **abundance and biological characteristics** of Cell E fish community between 2002 and 2008?

# Grayling in Panda Diversion Channel

- fewer spawners in 2007 than previous years
- but: good fry production (within the range of 2 reference stream)
- fry physiologically equipped to survive winter (lipid content similar to that in fry of reference streams for 2<sup>nd</sup> year)



# Agency Assessment

- Increasing trends: TDS, chloride, nitrates, molybdenum and selenium in water
- Increasing trends: molybdenum in whitefish
- Source of hydrocarbons in fish needs investigation; will this be source of future impacts to fish?
- Tapeworms in sculpin of affected lakes; annual monitoring needed; is it natural or mine-related?



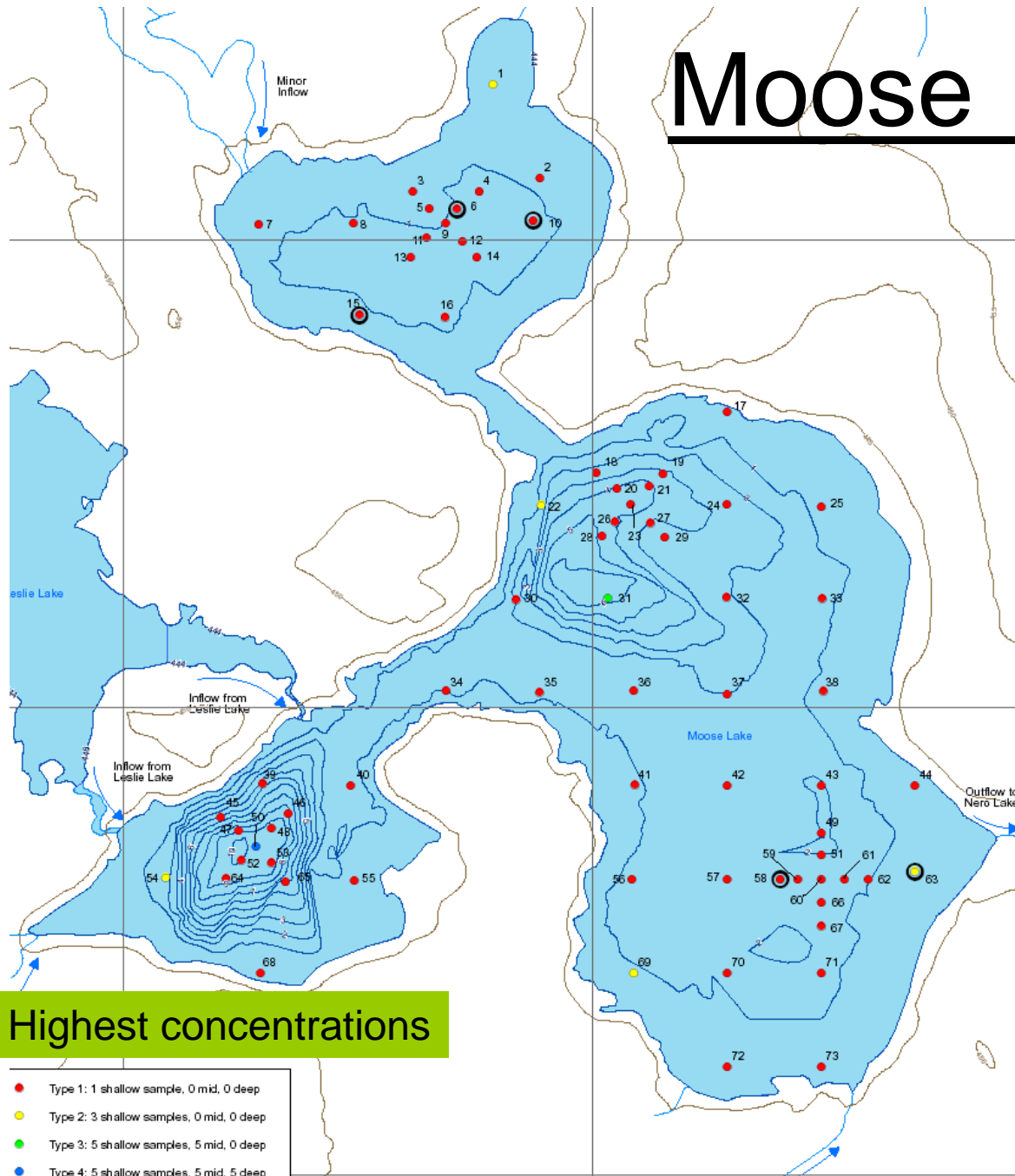
# Lake Variability Study

- - to determine if water and sediment samples taken at one spot in a lake represent the entire lake's water/sediment
- Water: 73 sites in Moose; 76 sites in Slipper Lake  
Sediment: 40 sites in Moose; 44 sites in Slipper.
- Counts of lake bottom organisms also done

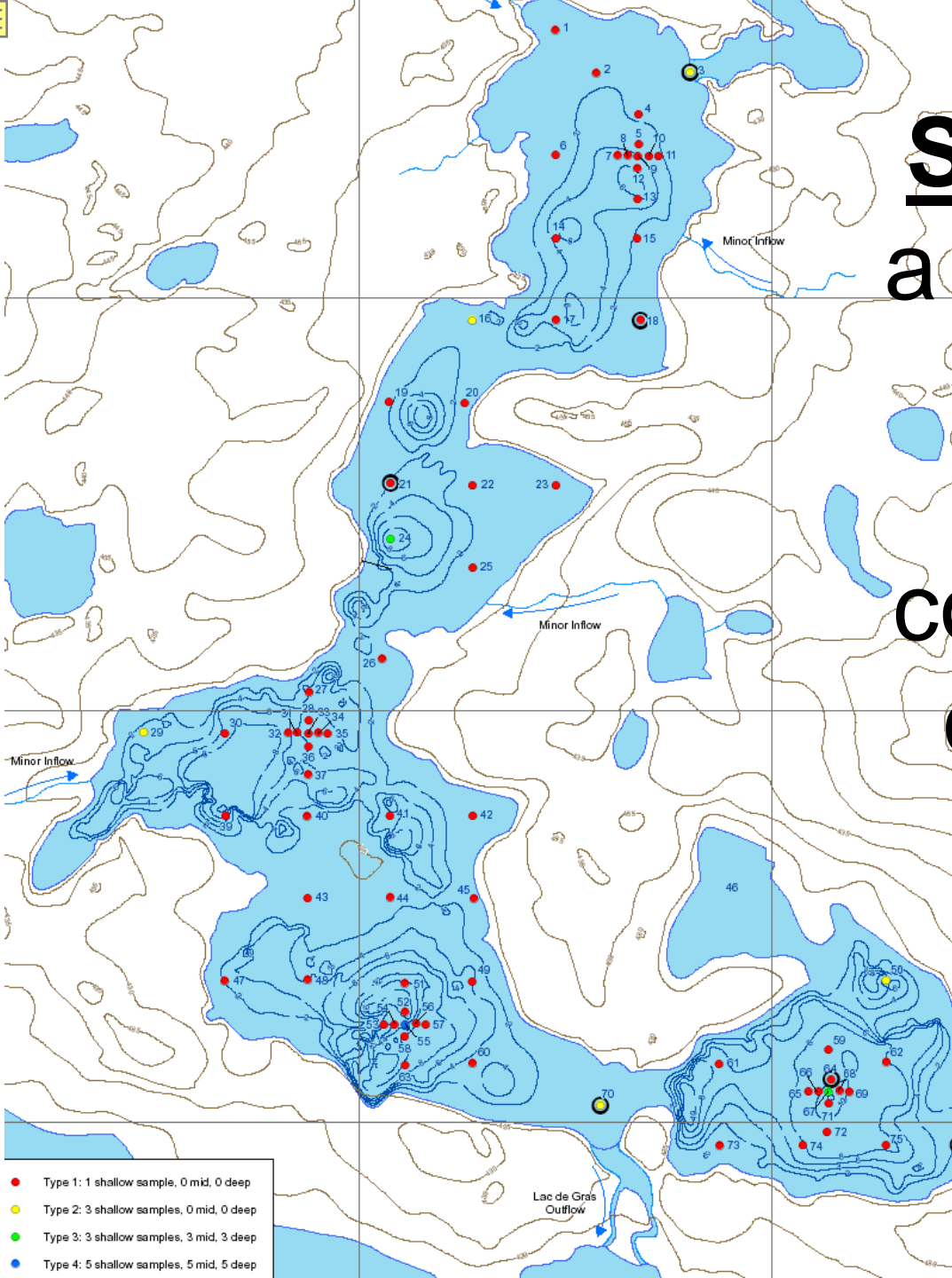
## **REPORT'S CONCLUSIONS:**

- Replicate water samples should be taken minimum 300 m apart.
  - But changing sampling sites won't improve precision of AEMP.  
Sampling error not significant source of uncertainty in AEMP results.

# Moose Lake



**Slipper Lake**  
a north → south  
gradient  
(decreasing  
concentrations  
of variables)





# **Watershed Adaptive Management Plan (WAMP)**

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# What is the WAMP ?

- water licence requirement

## BHPB's proposed WAMP

- provides an early warning that water quality variable will reach a point where over 5% of aquatic community impacted
- Warning to act: when threshold concentration will be exceeded within 3 years.

# BHPB proposes numerical thresholds for

Arsenic	Nitrate
Cadmium	Nitrite
Chromium	Phosphorus
Copper	Total Suspended Solids (TSS)
Lead	Turbidity
Molybdenum	Total Dissolved Solids (TDS)
Zinc	Chloride
	BTEX

# Agency Assessment

- WAMP significantly improves environmental management
- Need more:
  - discussion on proposed threshold concentrations
  - analysis of mitigation options when thresholds triggered





# **Long Lake Containment Facility Water Quality Model**

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# Long Lake Containment Facility Water Quality Model

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- Version 1.0
  - Description of model
  - Preliminary predictions & Sensitivity analysis
- Areas of concern identified:
  - Groundwater flow rates and chloride loadings
  - Metals in the Fox Open Pit
- Version 2.0
  - Focus on chloride and nitrate concentrations

# Agency Assessment

- Important steps forward
- Insight into source of high molybdenum
- Concern with use of mass balance model
- Lack of predictions for many parameters of interest, including Extra Fine PK
- Need to link identified uncertainties with ICRP research plan
- Need to address chemical interactions