Assessment of Water Quality Effects of Oil Sands Mining Developments in Northeastern Alberta

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Outline

- Study Area
- Objective
- Assessment Approach
- Example Application
- Recommendations

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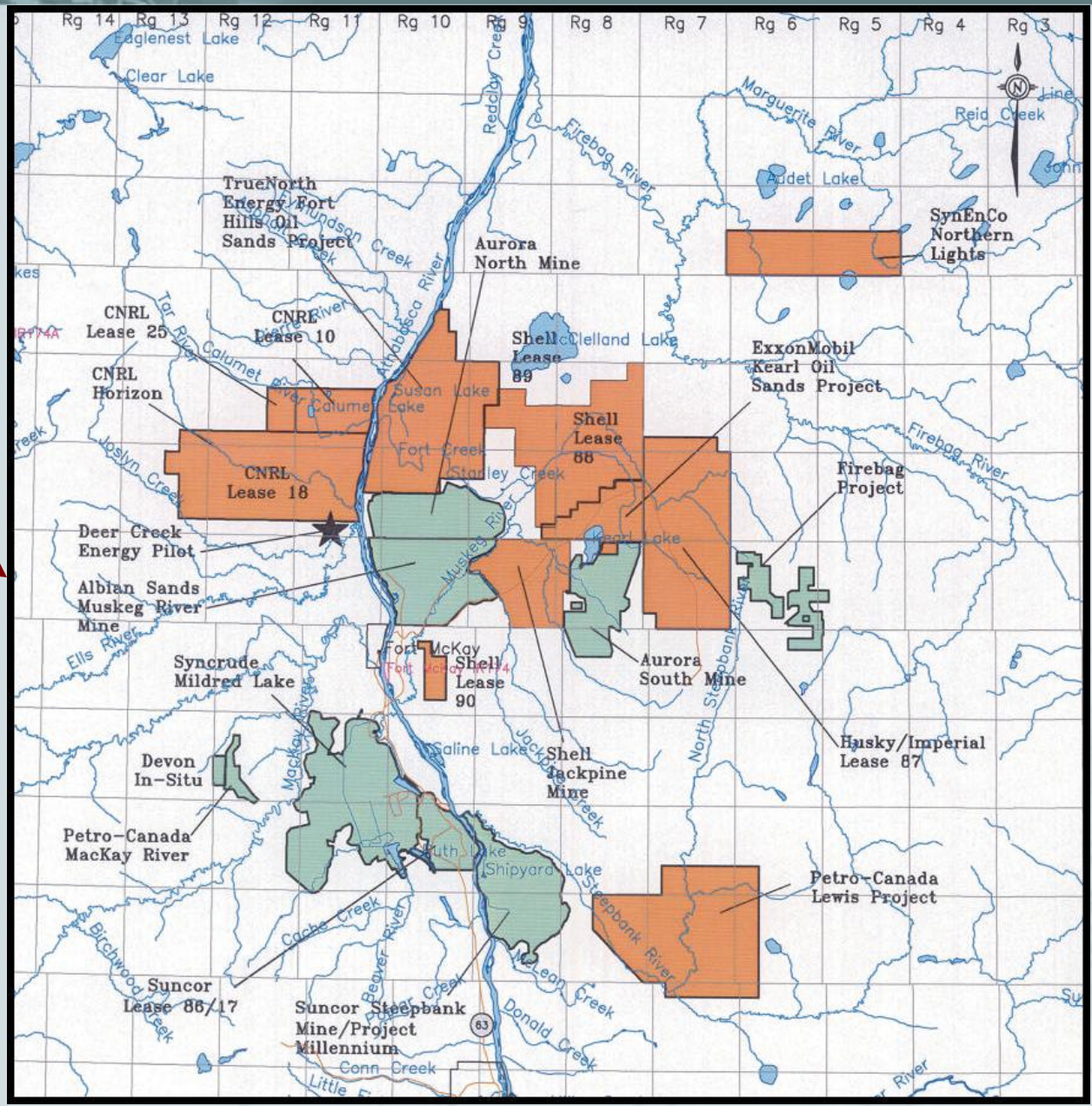
Alberta Oil Sands Region



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Objective

- Predict water quality of small streams and lakes due to oil sands developments
  - ✓ Compare predicted data with relevant guideline values
  - ✓ Use predicted data to assess aquatic life, human and wildlife health effects

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Water Quality Models Used for Oil Sands EIAs

Steady-State Spreadsheet Model

- ✓ simple algorithms
- ✓ time snapshots of water quality predictions
- ✓ conservative predictions

Dynamic HSPF Model

- ✓ watershed processes
- ✓ more realistic representation of variability in water quality
- ✓ frequency distribution for guideline comparison and receptor risk assessment

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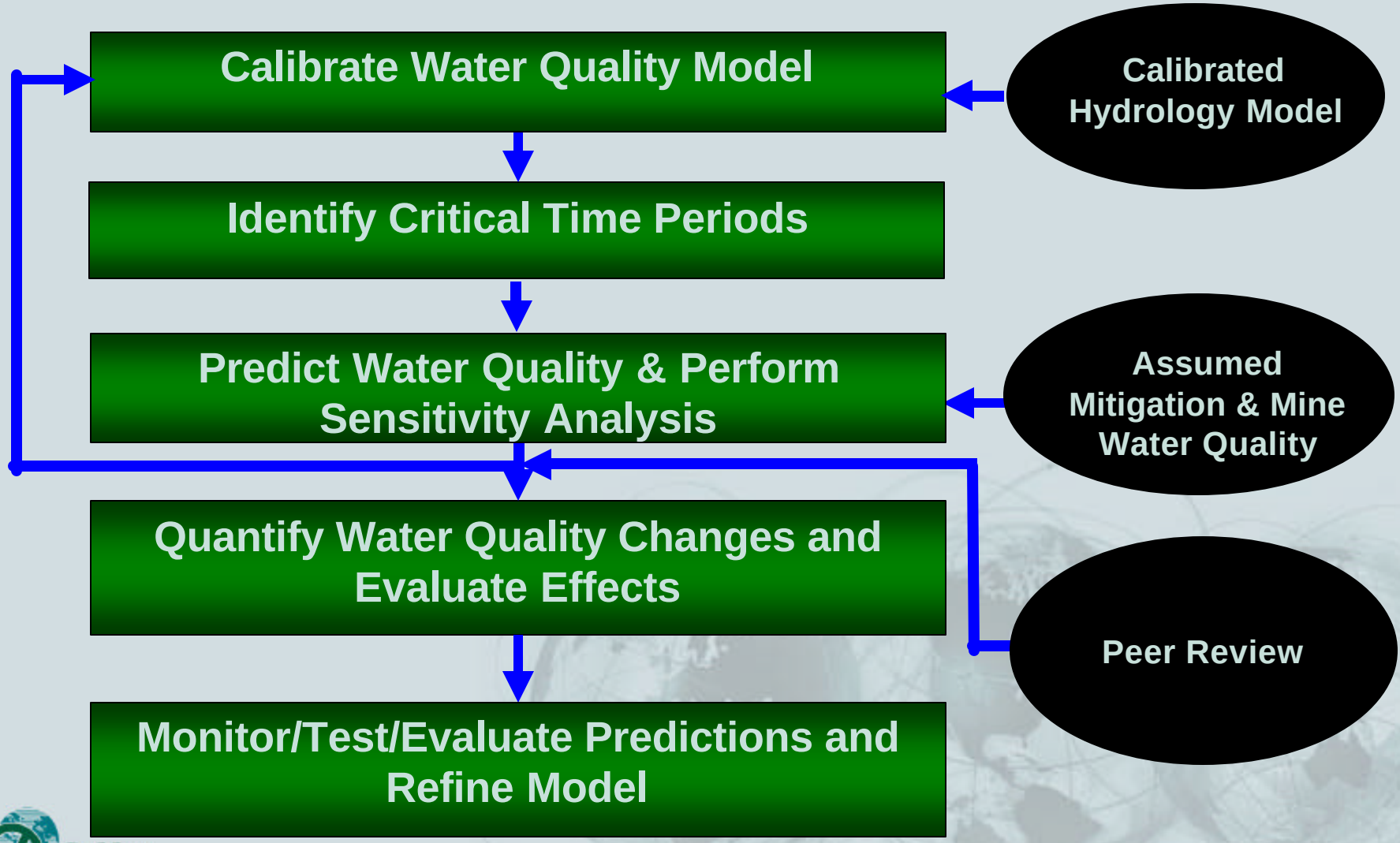
HSPF Model Application



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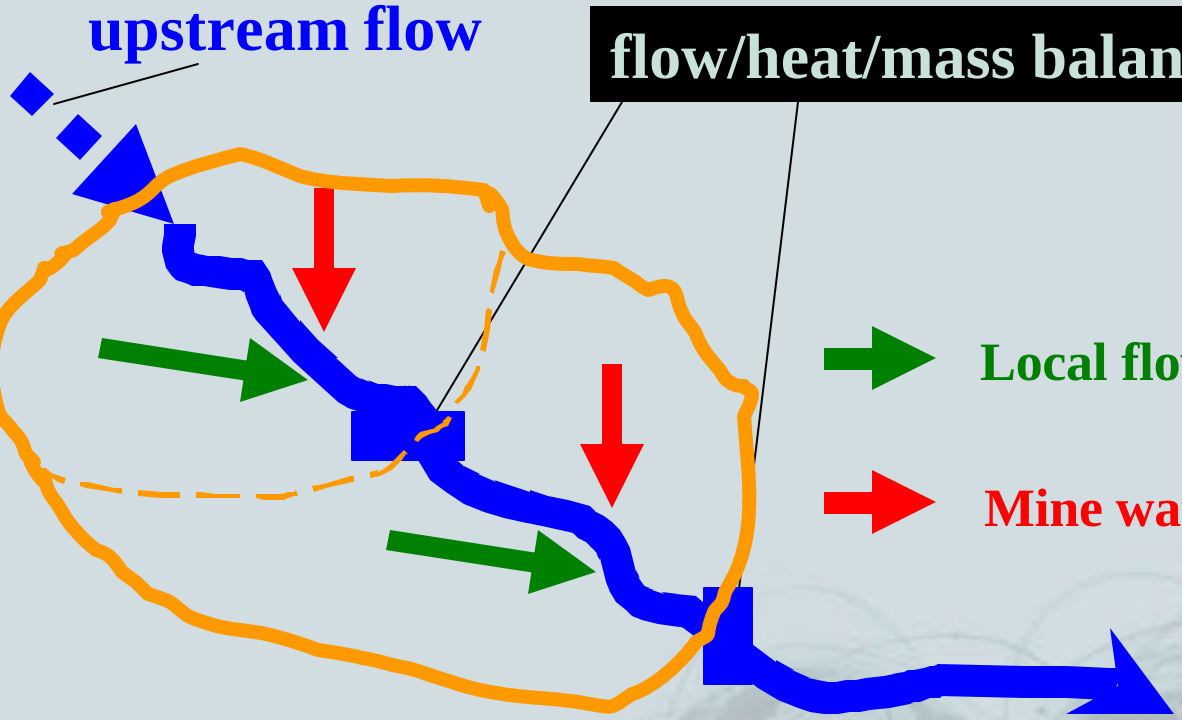
Schematic of Model



INPUTS

Meteorological
- precipitation
- temperature
- etc..

Physical
- soil properties
- channel properties
- land use, etc

Other
- seepages
- concentrations
- etc..

OUTPUTS
- stream flow
- temperature
- concentration
- etc..

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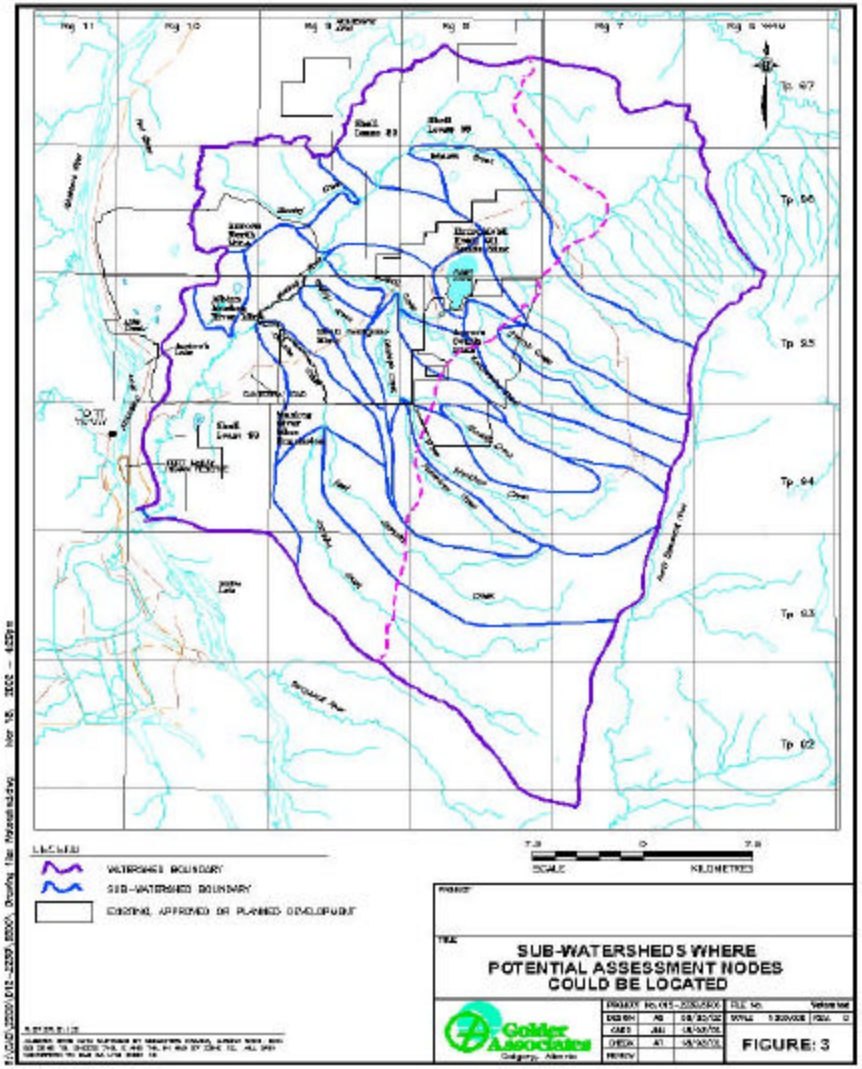
Application to Muskeg River Watershed



- ✓ Muskeg dominated
- ✓ Multiple mine developments
- ✓ Complex operational & closure diversions/drainage
- ✓ Non agricultural
- ✓ Small overland flow & mass loading

Modeled Processes

- Land segment
  - ✓ build-up and washoff processes
  - ✓ water quality of interflow & groundwater
  - ✓ runoff temperature
- Waterbodies
  - ✓ conservative (non-decaying) substances in streams
  - ✓ first order decay for organic substances in lakes/pond
  - ✓ heat balance

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Modeled Period

- Water quality: 1973 – 1999
- Temperature: 1998 – 2000

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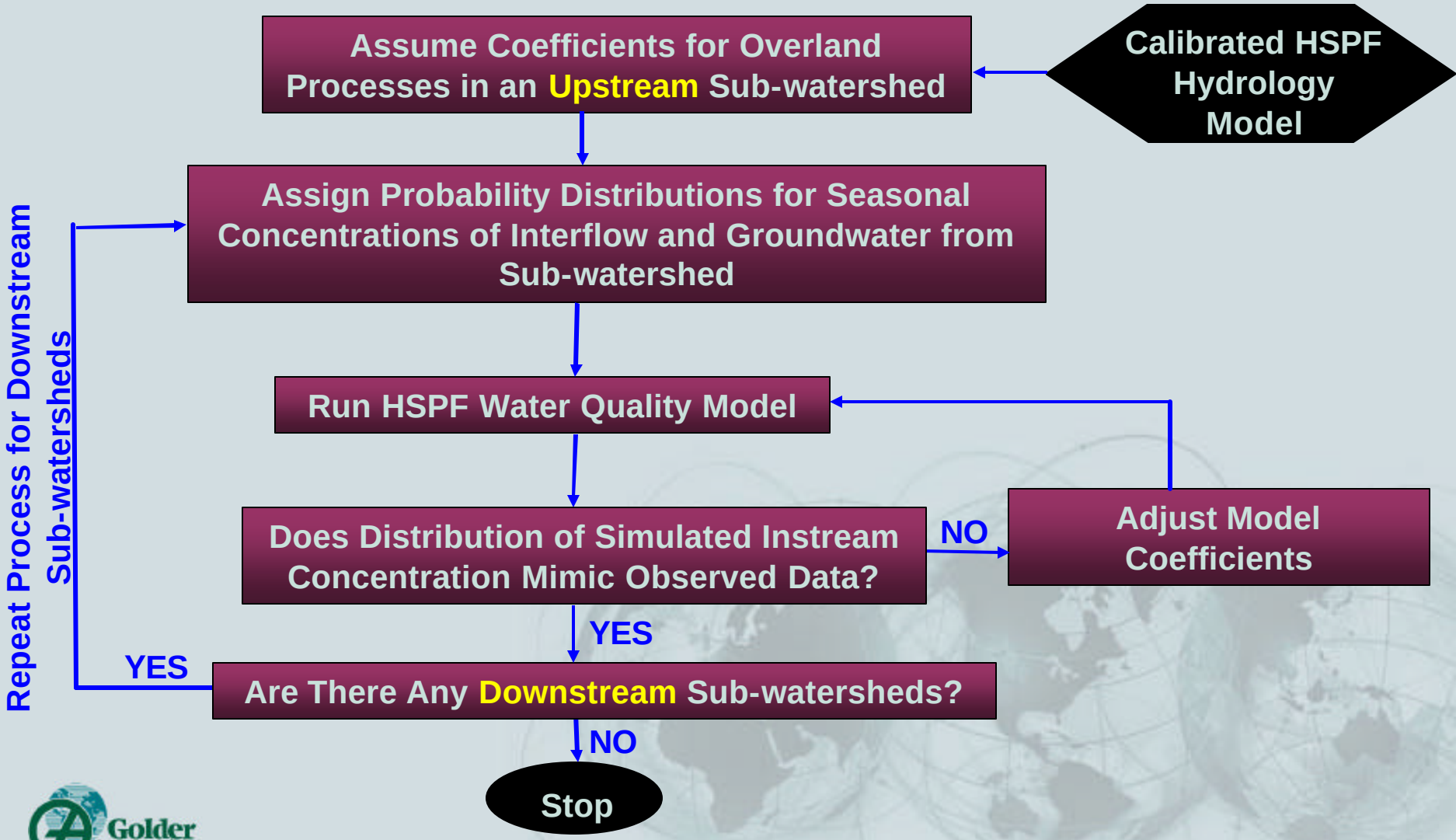
Calibration Approach



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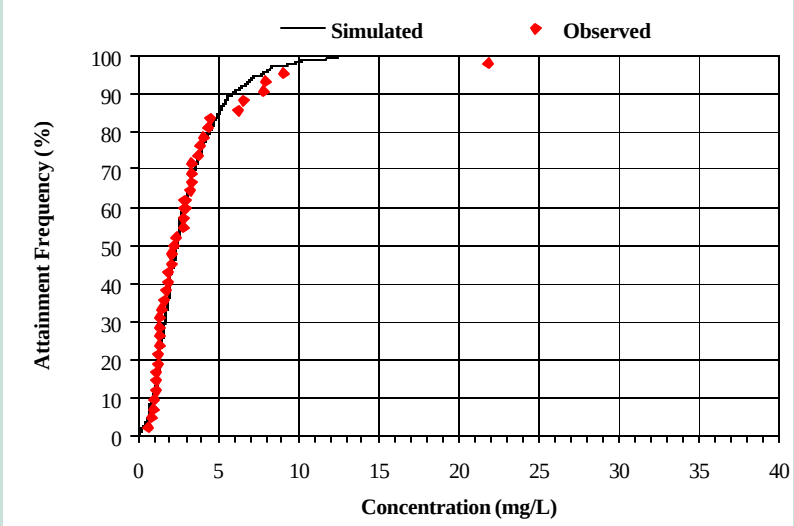
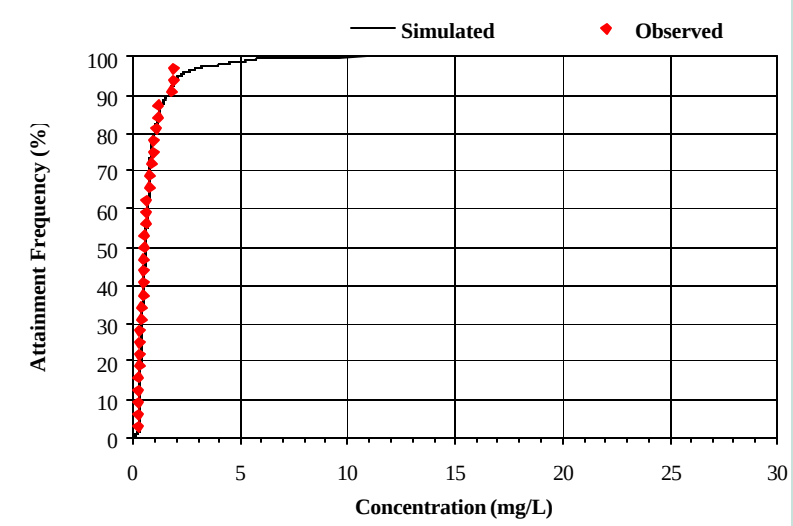
Calibration Results – *Iron at Lower Muskeg River Reach*

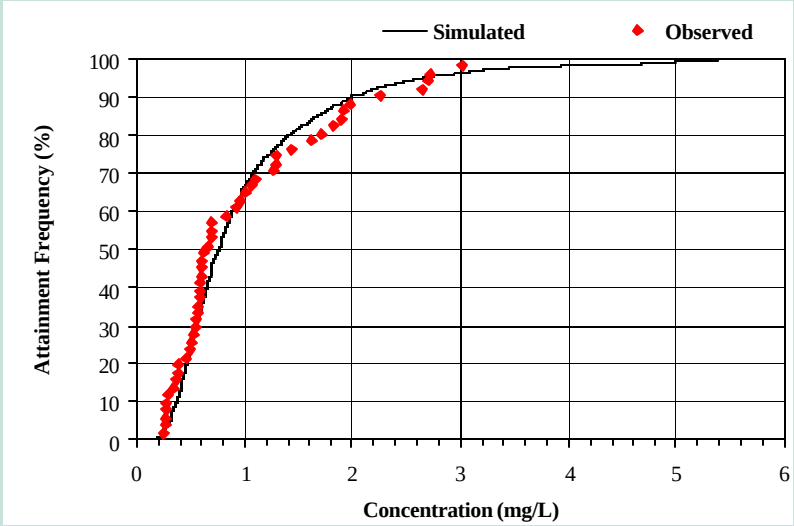
Winter



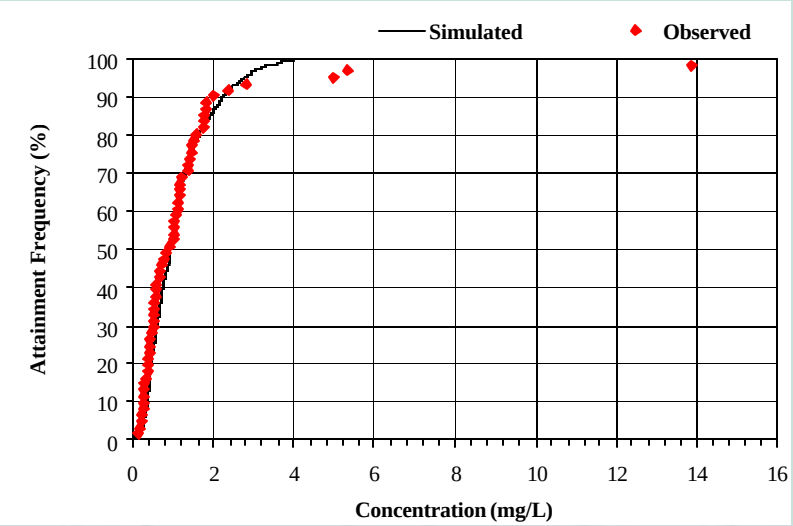
Spring



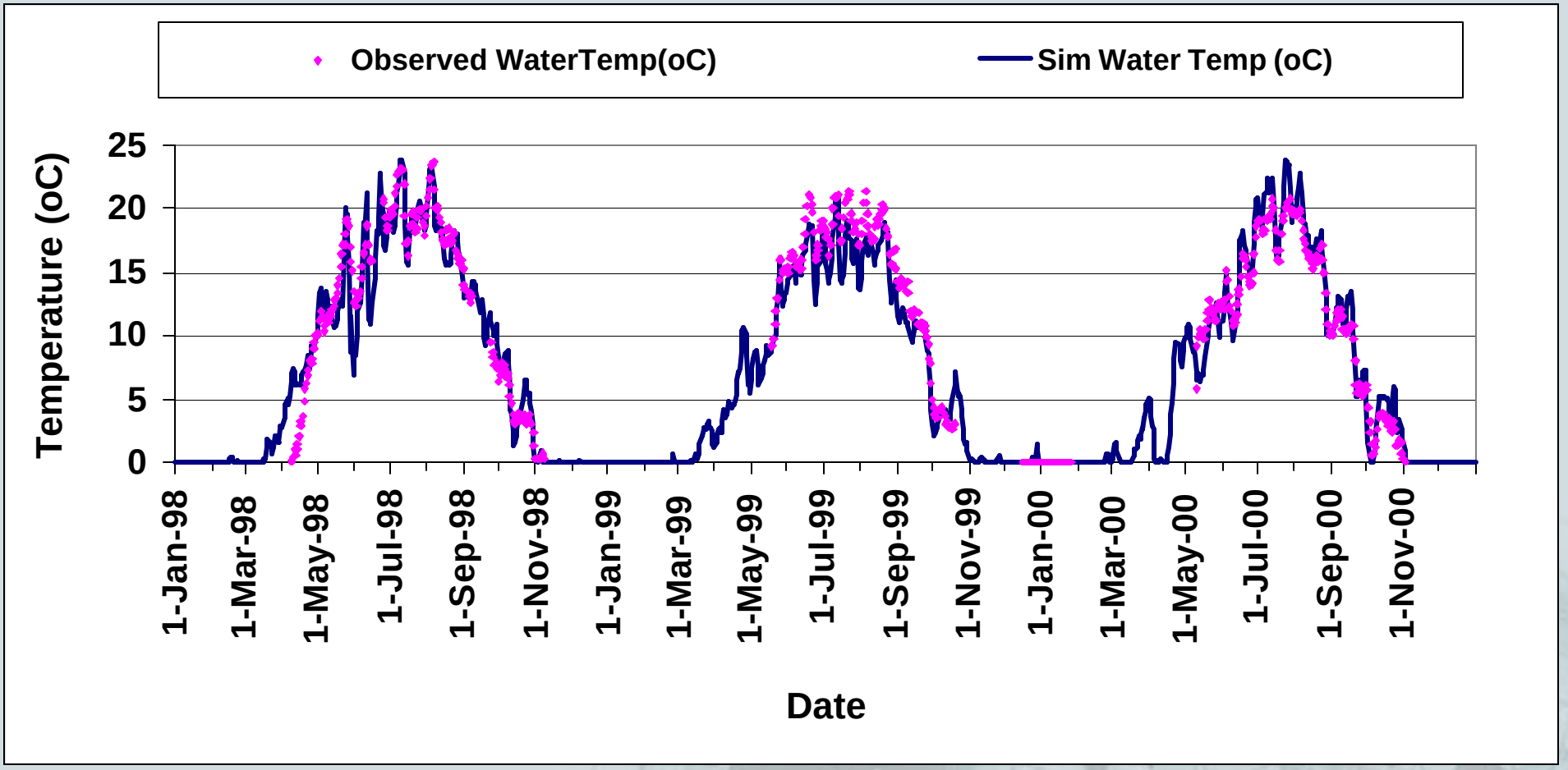
Summer



Fall



Calibration Results – *Temperature at Muskeg River Gauge*



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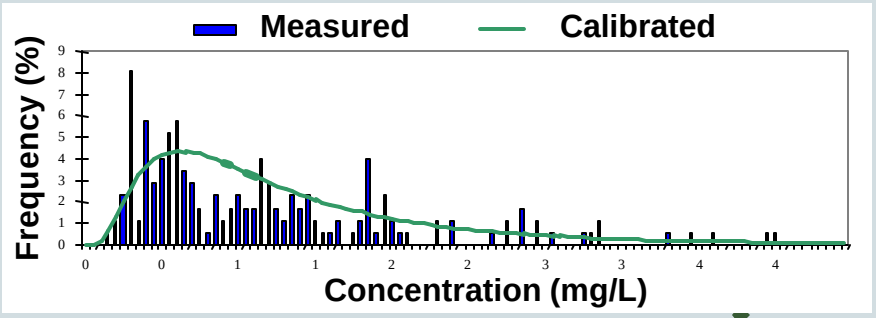
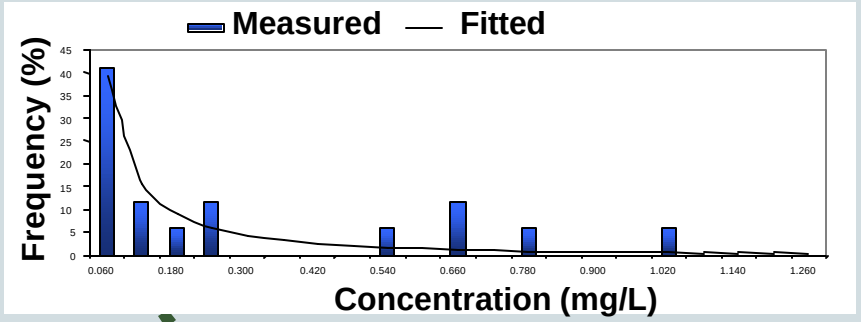
Prediction of Development Effects

Background Concentration



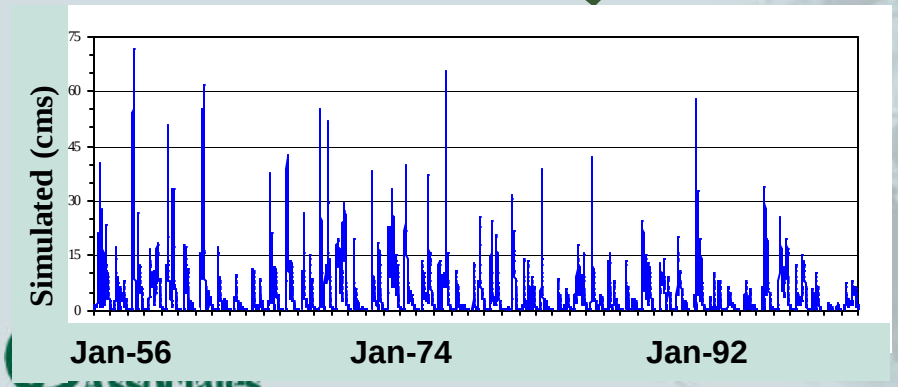
Mine Water Concentration



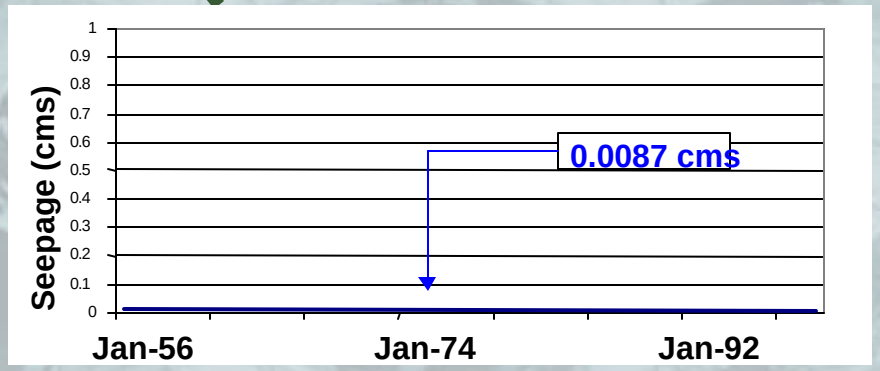
Predicted Concentration at Time t

HSPF Water Quality Module

Surface Runoff

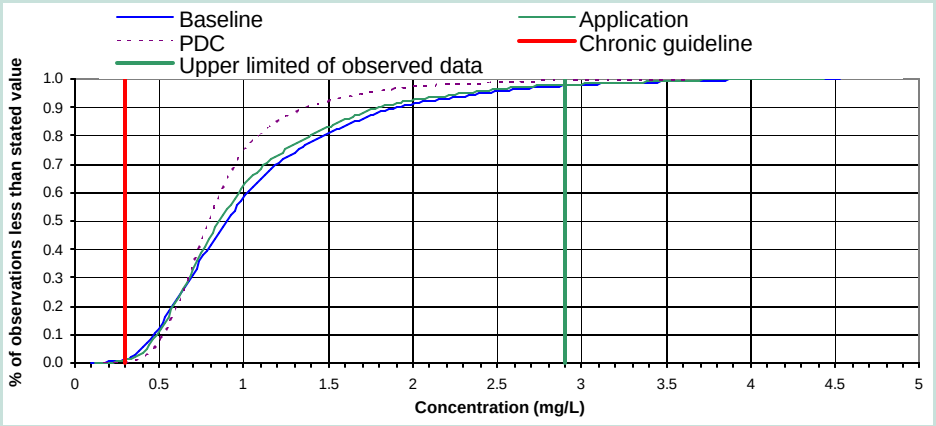


Mine Water Inflow

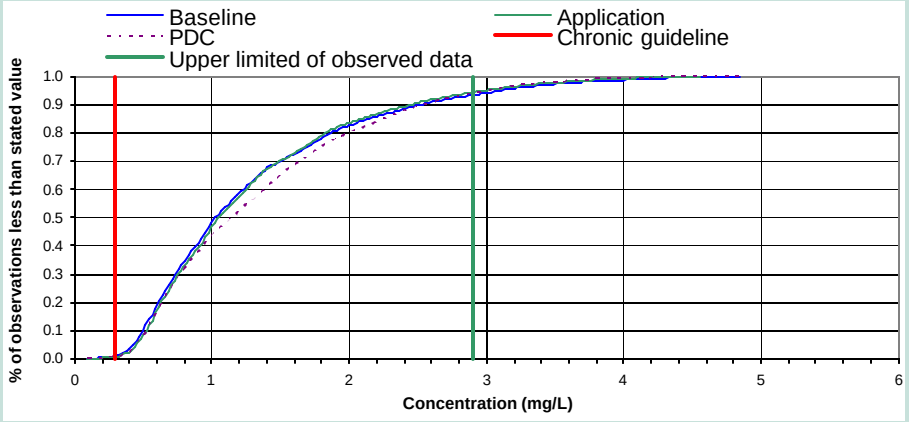


Prediction Results – *Iron Near Mouth of Muskeg River*

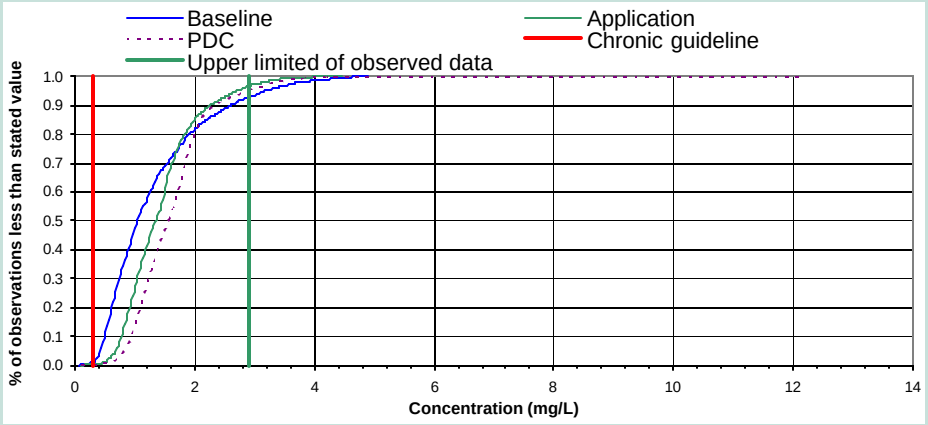
Year 2007



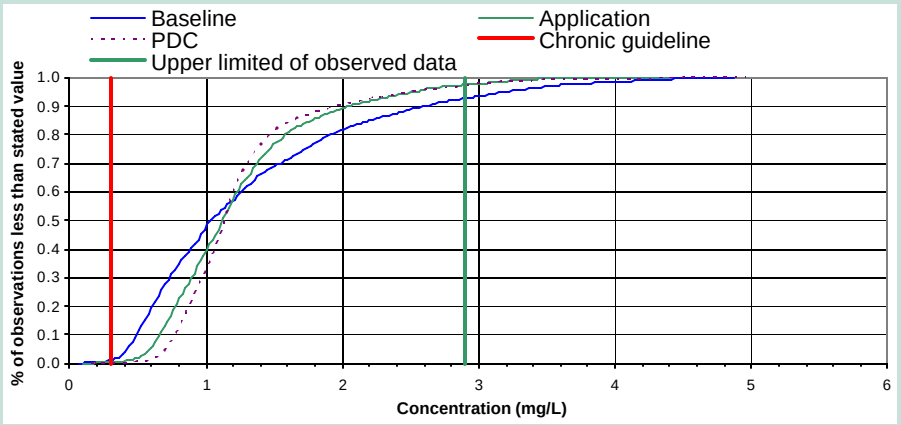
Year 2031/2039



Year 2040/2044



Far future



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Recommendations

- Sensitivity and uncertainty analysis required
- Continue monitoring hydrologic and water quality data for both natural/reclaimed areas
- Continue model testing and refinement

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- **Successfully used for two recently approved oil sand developments**

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