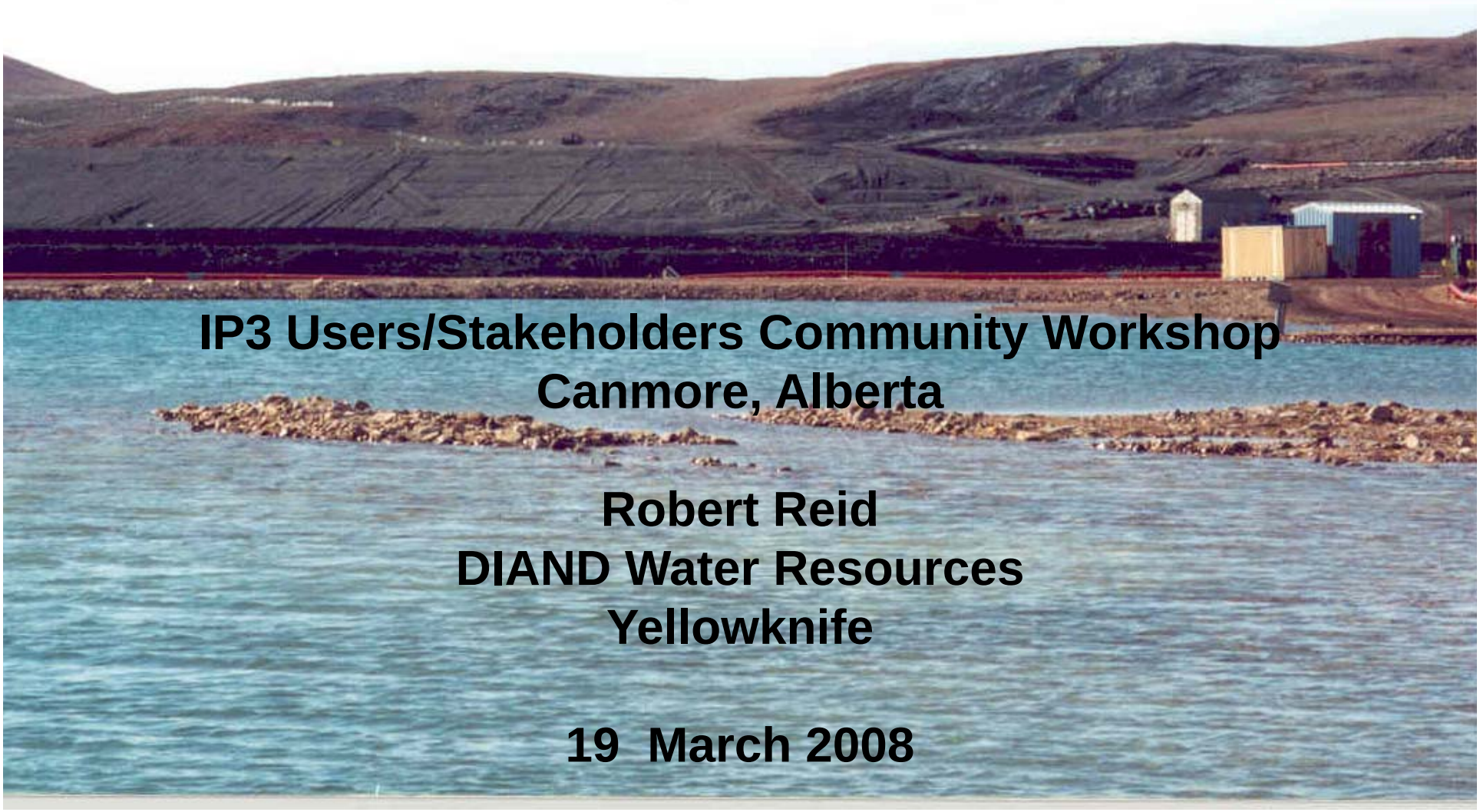
Hydrologic Information Needs for the Mining Industry in Northern Canada



IP3 Users/Stakeholders Community Workshop
Canmore, Alberta

Robert Reid
DIAND Water Resources
Yellowknife

19 March 2008

Water Information Needed by Mining Industry for:

- Fresh Water Supplies
  - Relative abundance in Western Arctic
  - Shortages in Eastern Arctic: low precipitation, snow and ice storage, release at freshet
- Waste Water Treatment: Domestic and Metallurgical Processes
  - Minimize volumes treated = cost savings

Information Needs

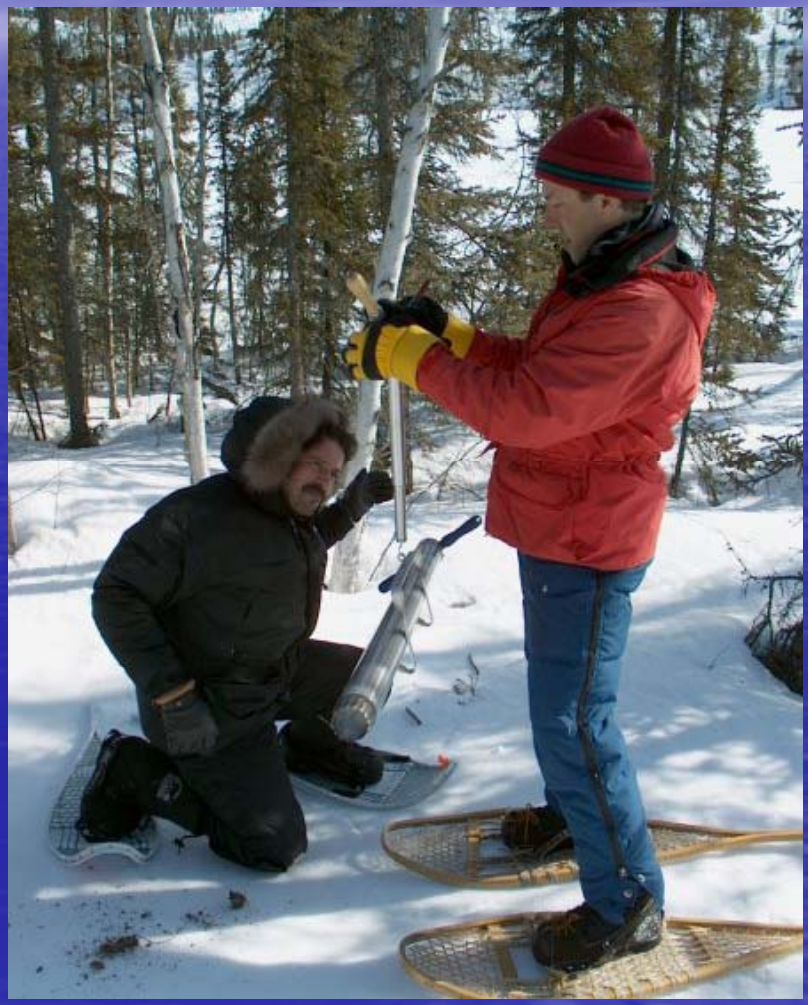
- Long Term Data
  - Networks are sparse
  - Industry timelines are short
  - Government programs focus on large regional, national scale
  - Industry needs are small scale: 1 to 100 km^2

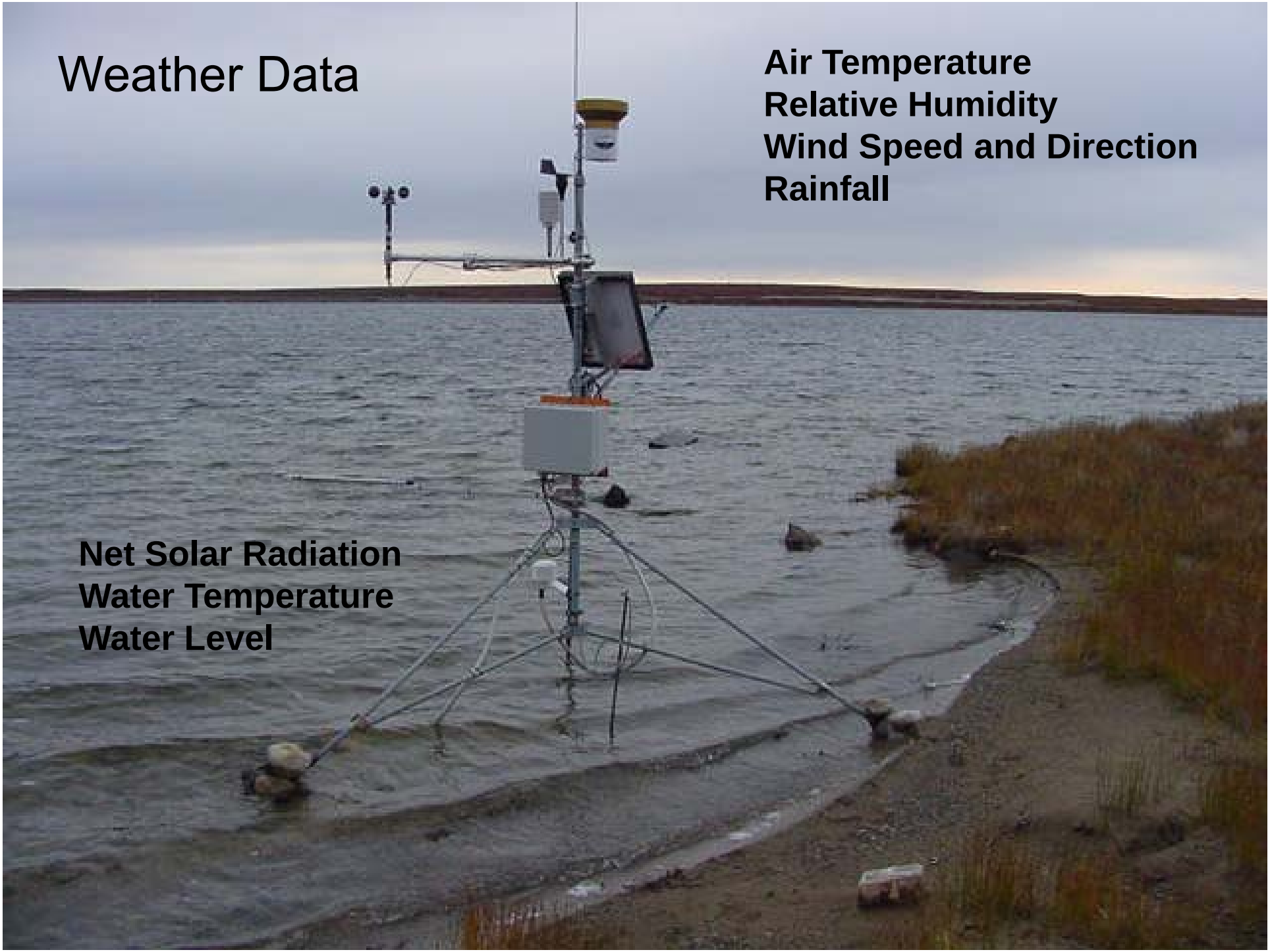
Science Needs

- Standardized Water Balance Models
  - Design of Water Treatment Facilities
    - Treatment Plants
    - Tailings Ponds
  - Operations of Facilities
  - Site Reclamation and Closure

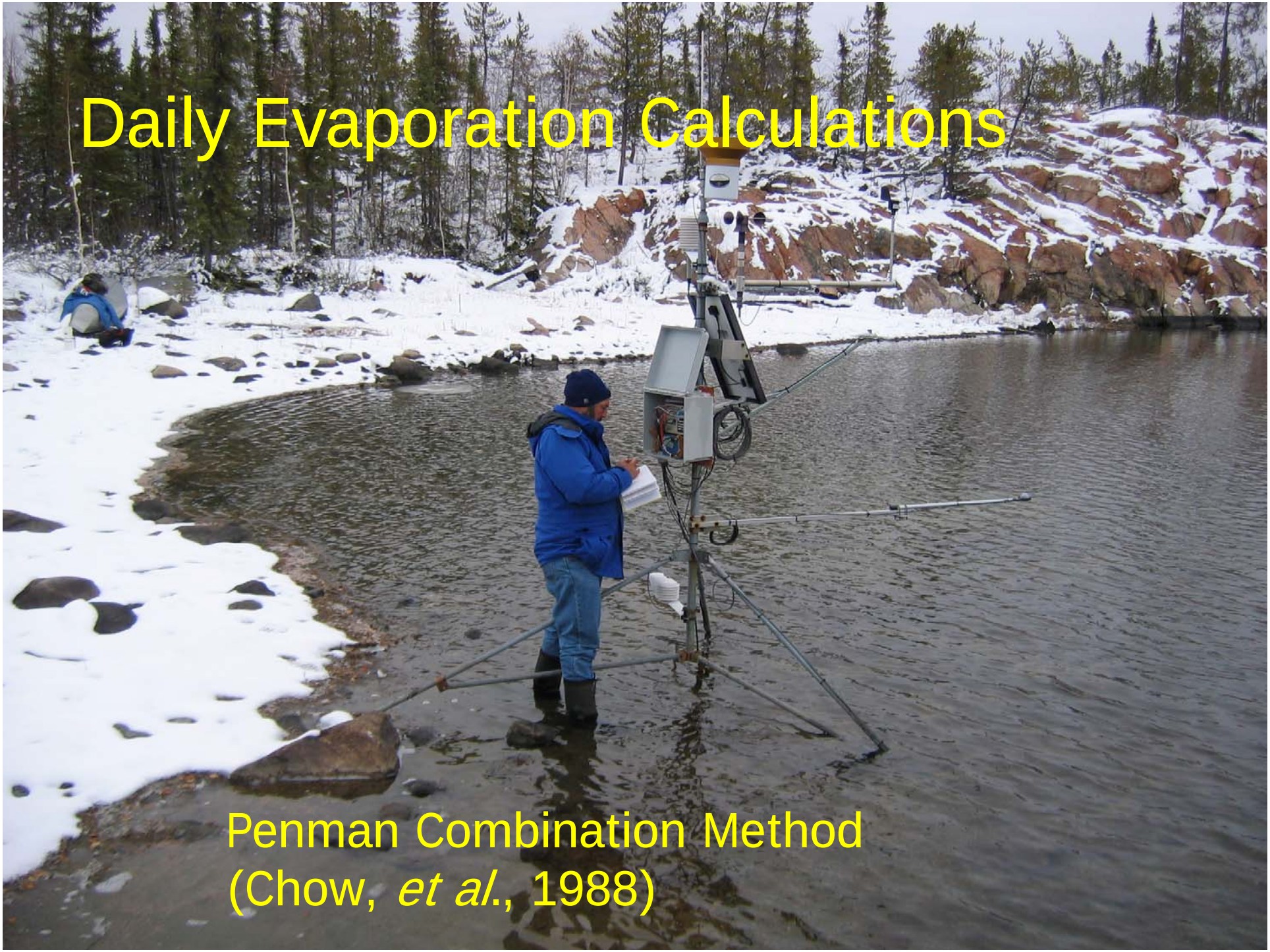
Data Collection Programs

Snow-Water Equivalent




Weather Data
Air Temperature
Relative Humidity
Wind Speed and Direction
Rainfall
Net Solar Radiation
Water Temperature
Water Level

Daily Evaporation Calculations



Penman Combination Method
(Chow, *et al*., 1988)

Data Needed

- Sublimation
- Infiltration
- Active Layer infiltration
- Terrestrial Evaporation
- Transpiration
- Run-off ratios
- Timing of flows
- Small streams, over-ice flows

Water Balance Data

- Mining Industry uses water balance data to:
  - Design of water management facilities at mine sites
  - Manage of tailings ponds at operating and abandoned mine sites
    - Water cover over sulphide tailings can minimize acid rock drainage
  - Determine water volumes for treatment and discharge

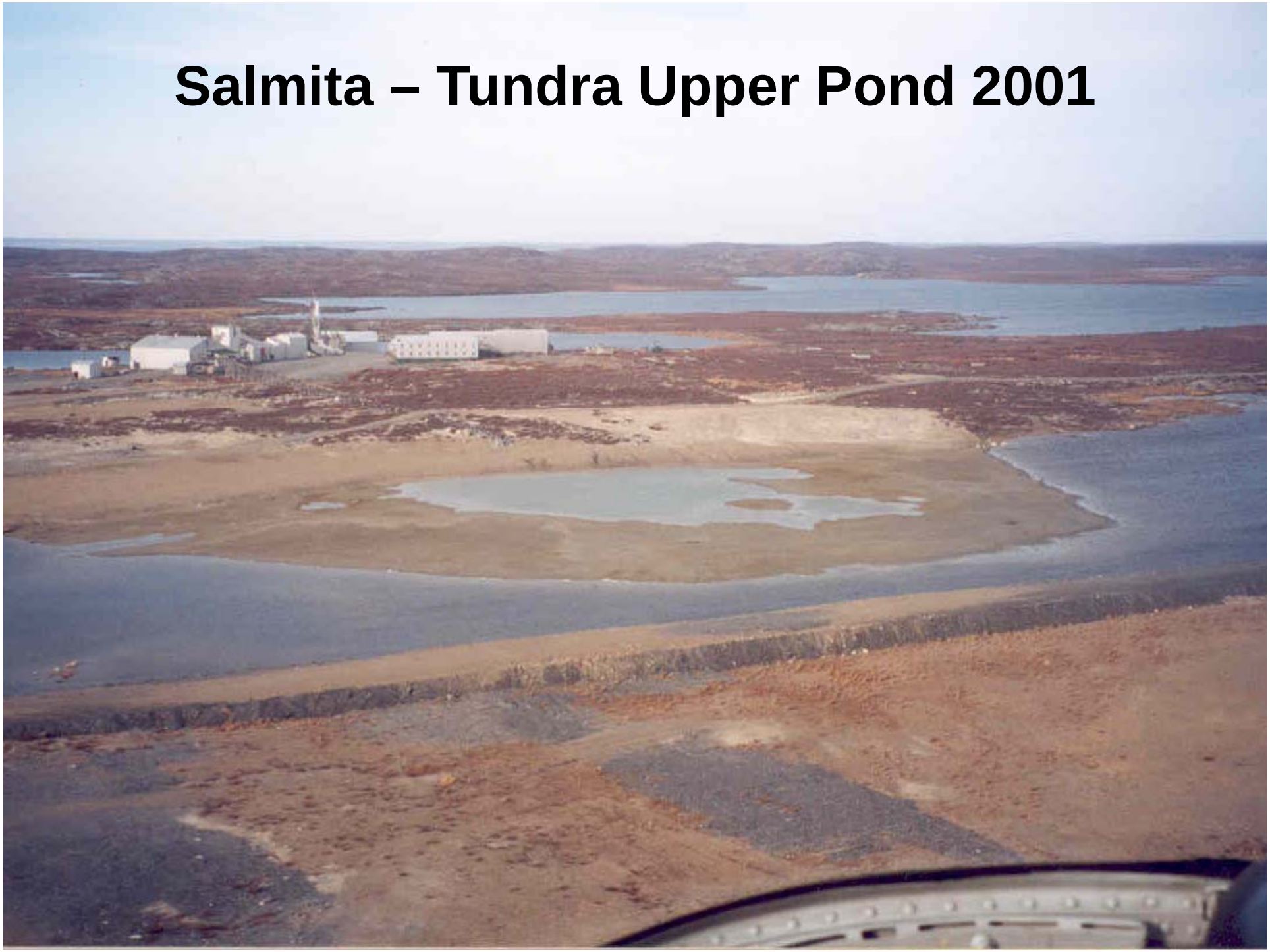
Giant Mine Site near Yellowknife

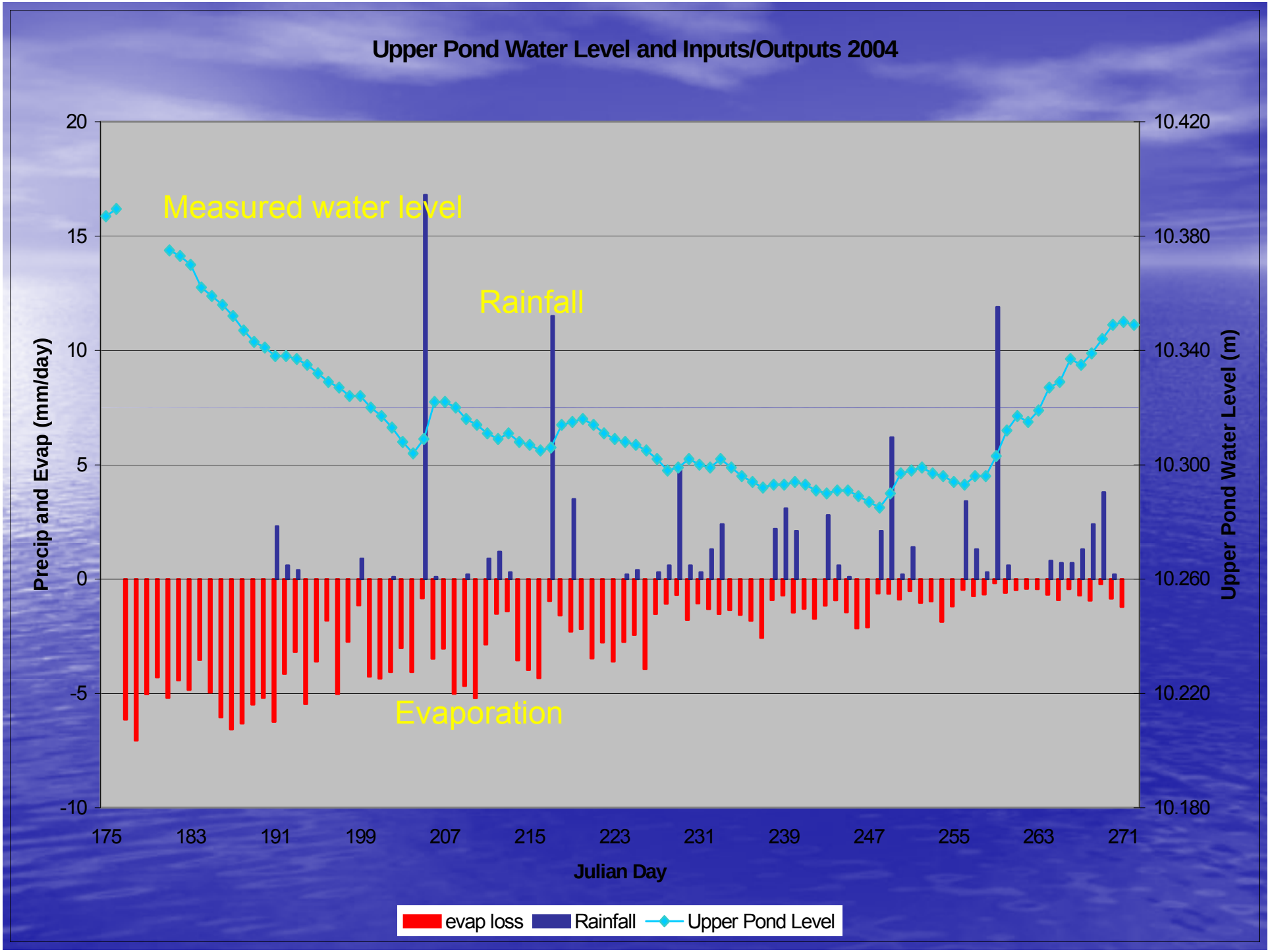
Giant Mine Site Tailings Ponds - inactive since 1999

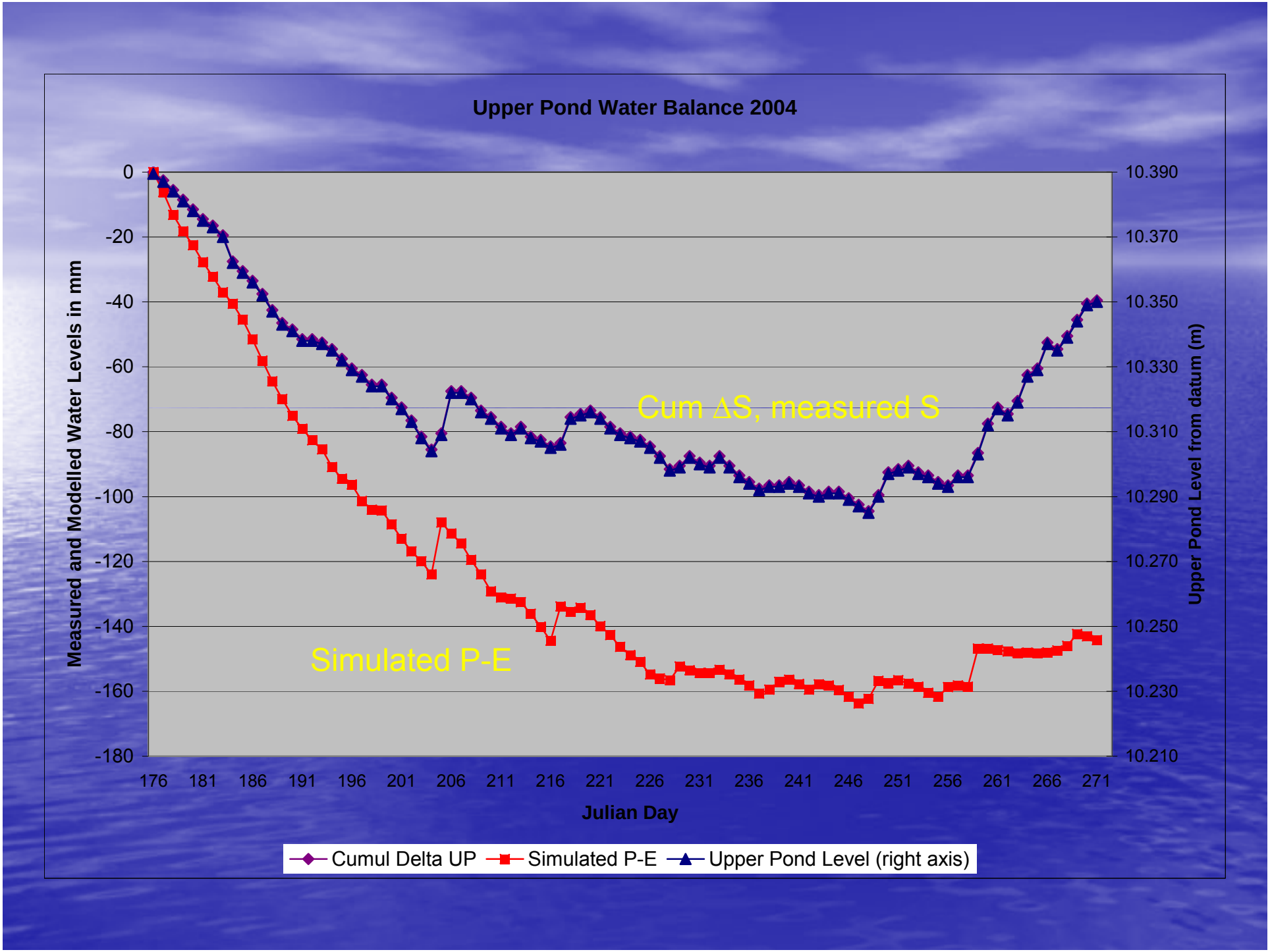
Salmita-Tundra Mine Site

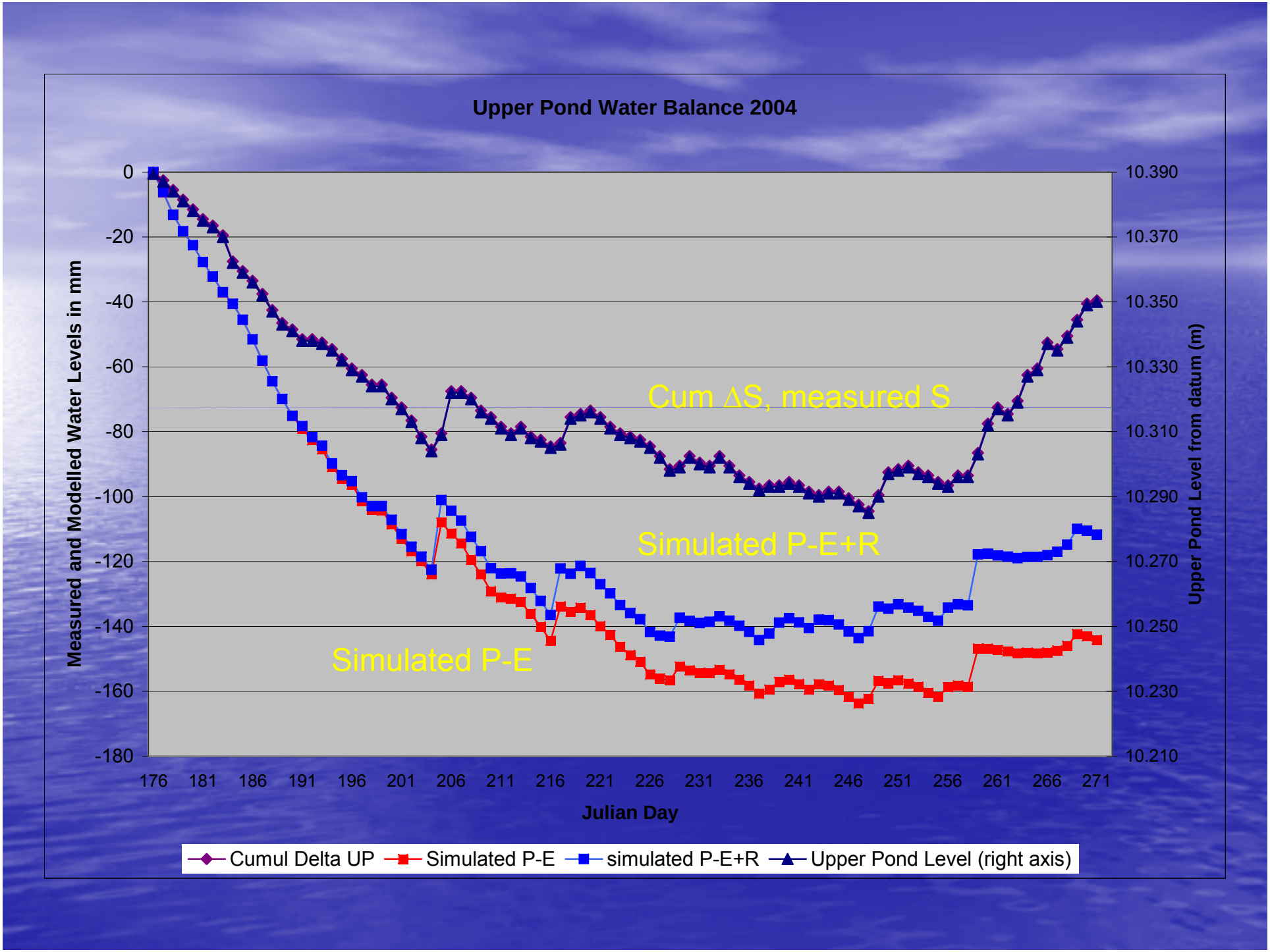
Salmita – Tundra Mine Upper Pond 1992

Salmita – Tundra Upper Pond 2001




Upper Pond Water Level and Inputs/Outputs 2004
Measured water level
Rainfall
Evaporation
Precip and Evap (mm/day)
Upper Pond Water Level (m)
Julian Day
20
15
10
5
0
-5
-10
10.420
10.380
10.340
10.300
10.260
10.220
10.180
175
183
191
199
207
215
223
231
239
247
255
263
271
evap loss
Rainfall
Upper Pond Level


Upper Pond Water Balance 2004
Measured and Modelled Water Levels in mm
Upper Pond Level from datum (m)
Julian Day
Cum ΔS, measured S
Simulated P-E
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
10.390
10.370
10.350
10.330
10.310
10.290
10.270
10.250
10.230
10.210
176 181 186 191 196 201 206 211 216 221 226 231 236 241 246 251 256 261 266 271
Cumul Delta UP
Simulated P-E
Upper Pond Level (right axis)


Upper Pond Water Balance 2004
Measured and Modelled Water Levels in mm
Upper Pond Level from datum (m)
Julian Day
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
10.390
10.370
10.350
10.330
10.310
10.290
10.270
10.250
10.230
10.210
176
181
186
191
196
201
206
211
216
221
226
231
236
241
246
251
256
261
266
271
Cum ΔS, measured S
Simulated P-E+R
Simulated P-E
Cumul Delta UP
Simulated P-E
simulated P-E+R
Upper Pond Level (right axis)

Conclusions

- Some water balance parameters are relatively easy to measure and model
  - Evaporation - modelled from weather data
  - Rainfall - measured with rain gauge
  - Snowfall - depth/density surveys
- Others more difficult
  - Infiltration
  - Evapotranspiration
  - Runoff ratios

Conclusions

- Mining Industry needs information to design and operate water management facilities
  - Water treatment plants
  - Water covers of tailings to limit acid rock drainage
- ? Climate change ?

Questions?