

# The Role of Groundwater in Alpine Lake Chemistry

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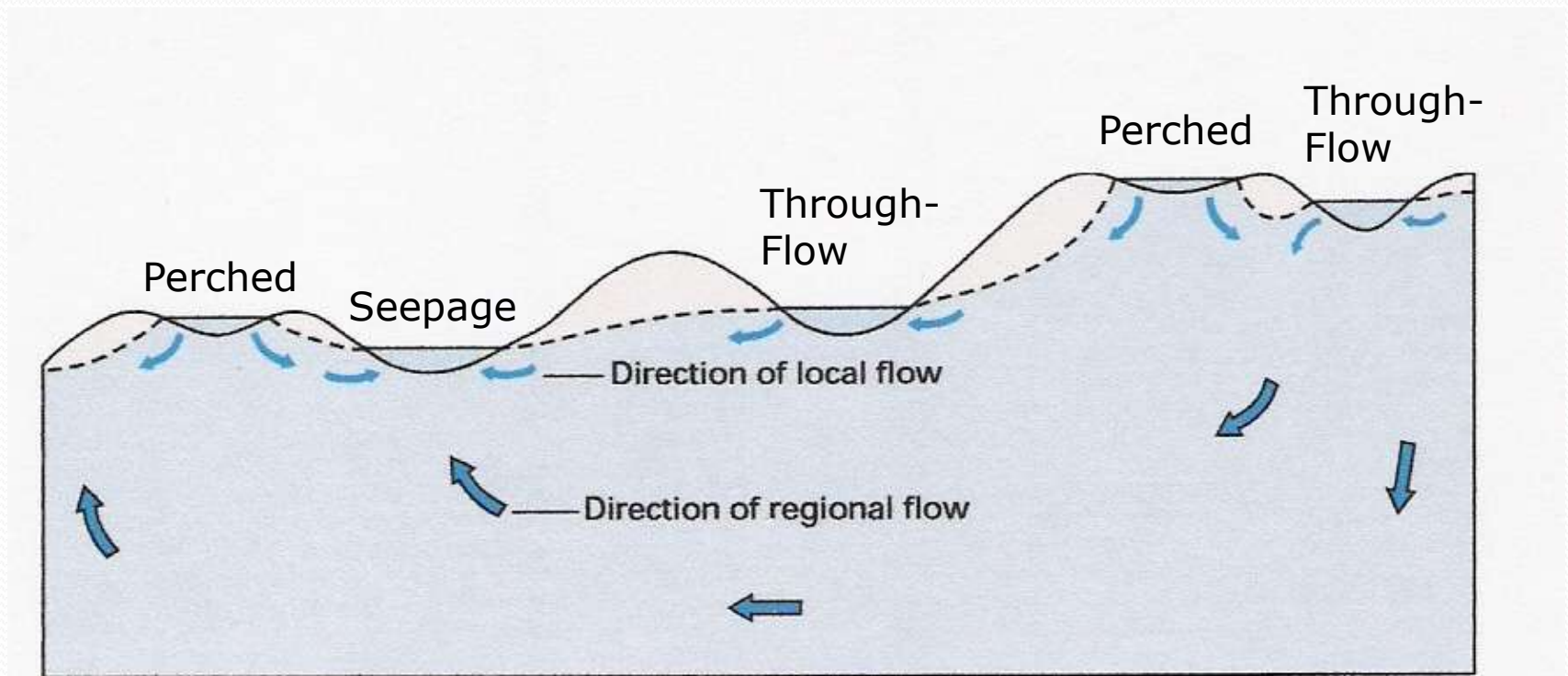
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# Groundwater Influences Lake Chemistry

## Conclusions from the Literature

- **“The one important factor that susceptible lakes have in common across regions is minimal groundwater input.” (Eilers et al. 1983)**
- **“Groundwater inflow can mitigate the effects of acid deposition on lakes.” (Anderson and Bowser, 1986)**
- **“Lakes set in small groundwater basins or located close to a groundwater divide, as well as lakes with relatively small groundwater inputs should respond more rapidly to changes in atmospheric chemistry.” (Anderson and Bowser, 1986)**
- **“Regulatory agencies should include groundwater hydrology as a criterion for determining sensitivity indices of lakes.” (Anderson and Bowser, 1986)**

# Hydrogeologic Settings of Lakes



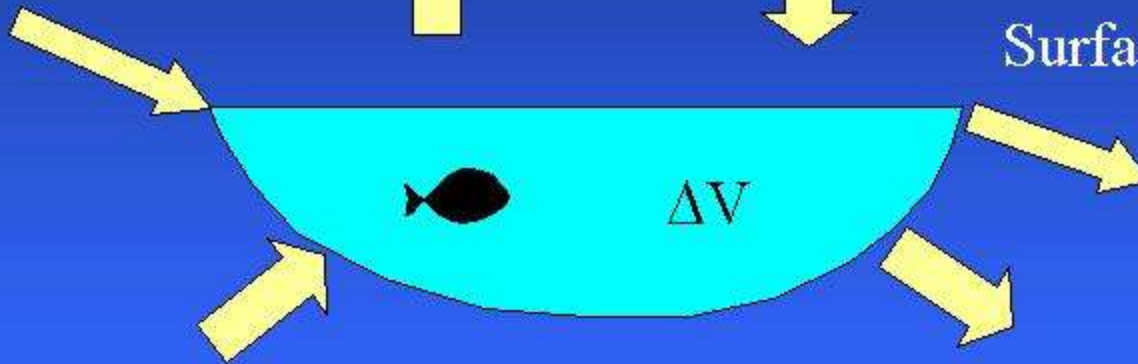
# Lake Water Balance

Evaporation    Precipitation

Surface Water In



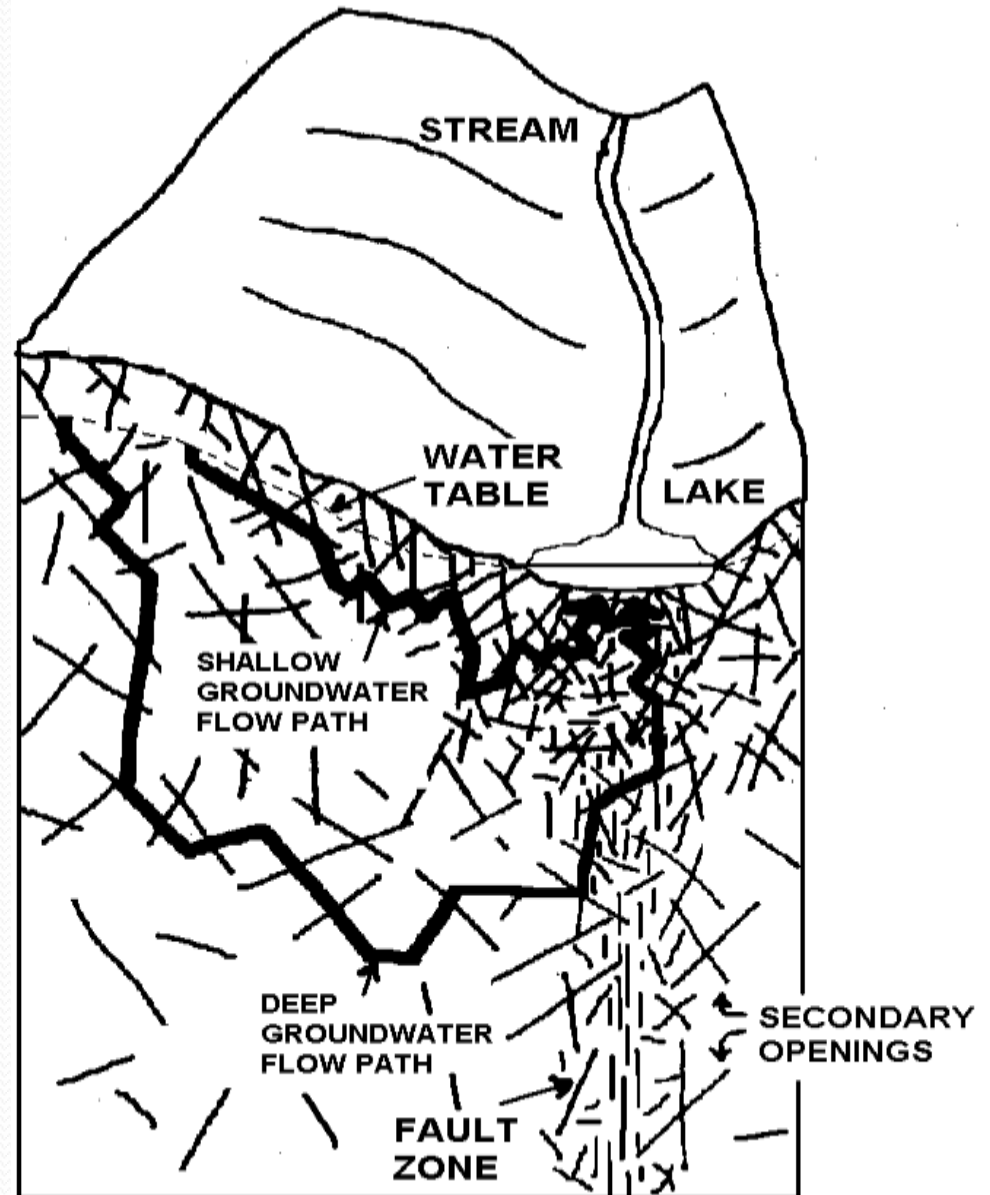
Surface Water Out



Groundwater In

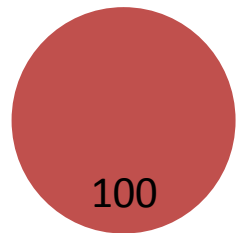
Groundwater Out

# Groundwater Flow Paths



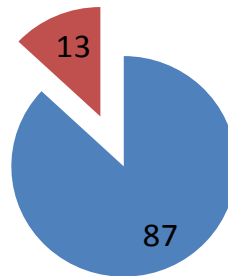
# Source of Solute Load to Lakes

## Copper Lake

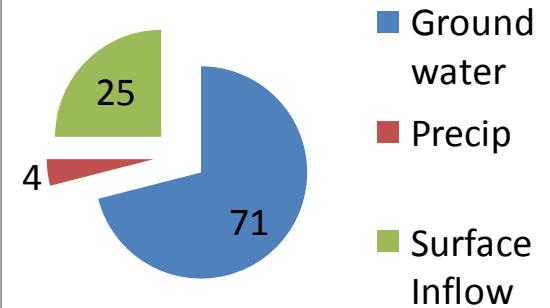


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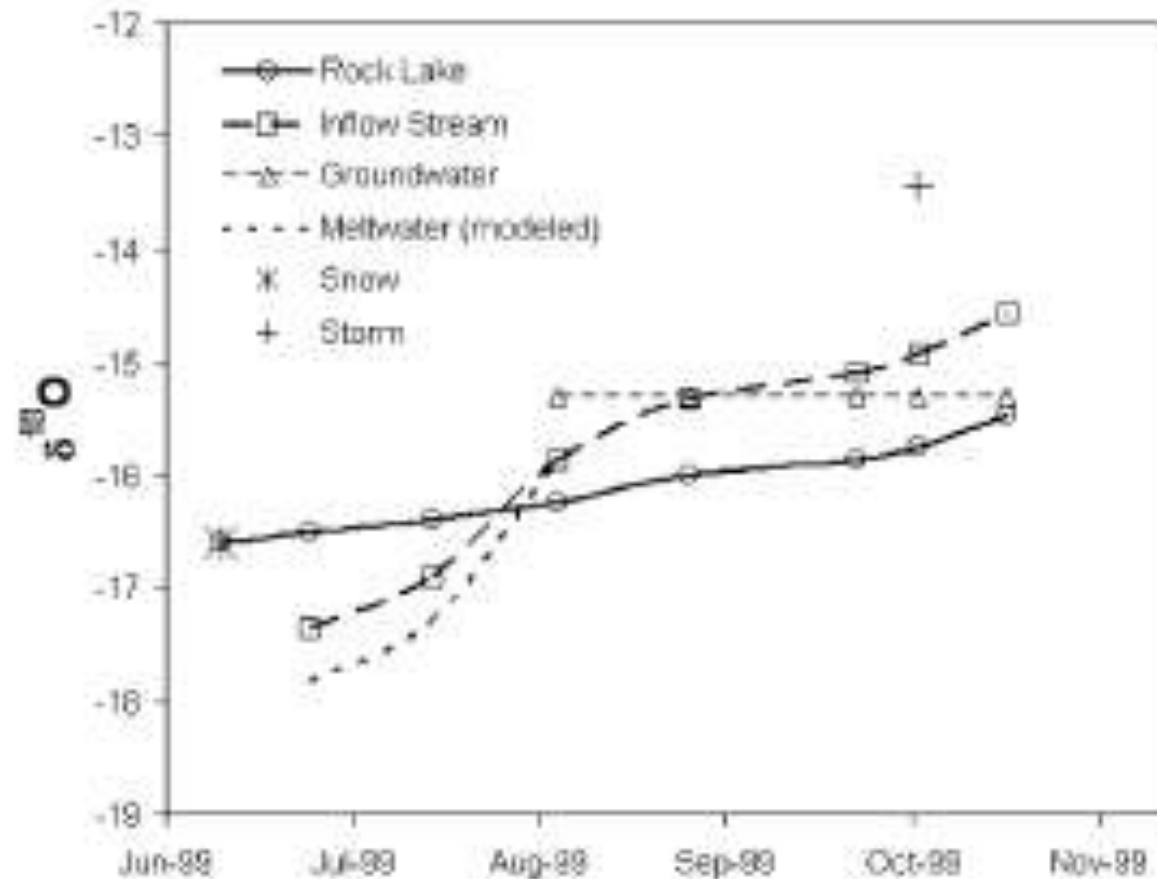
## Cliff Lake



## Rock Lake



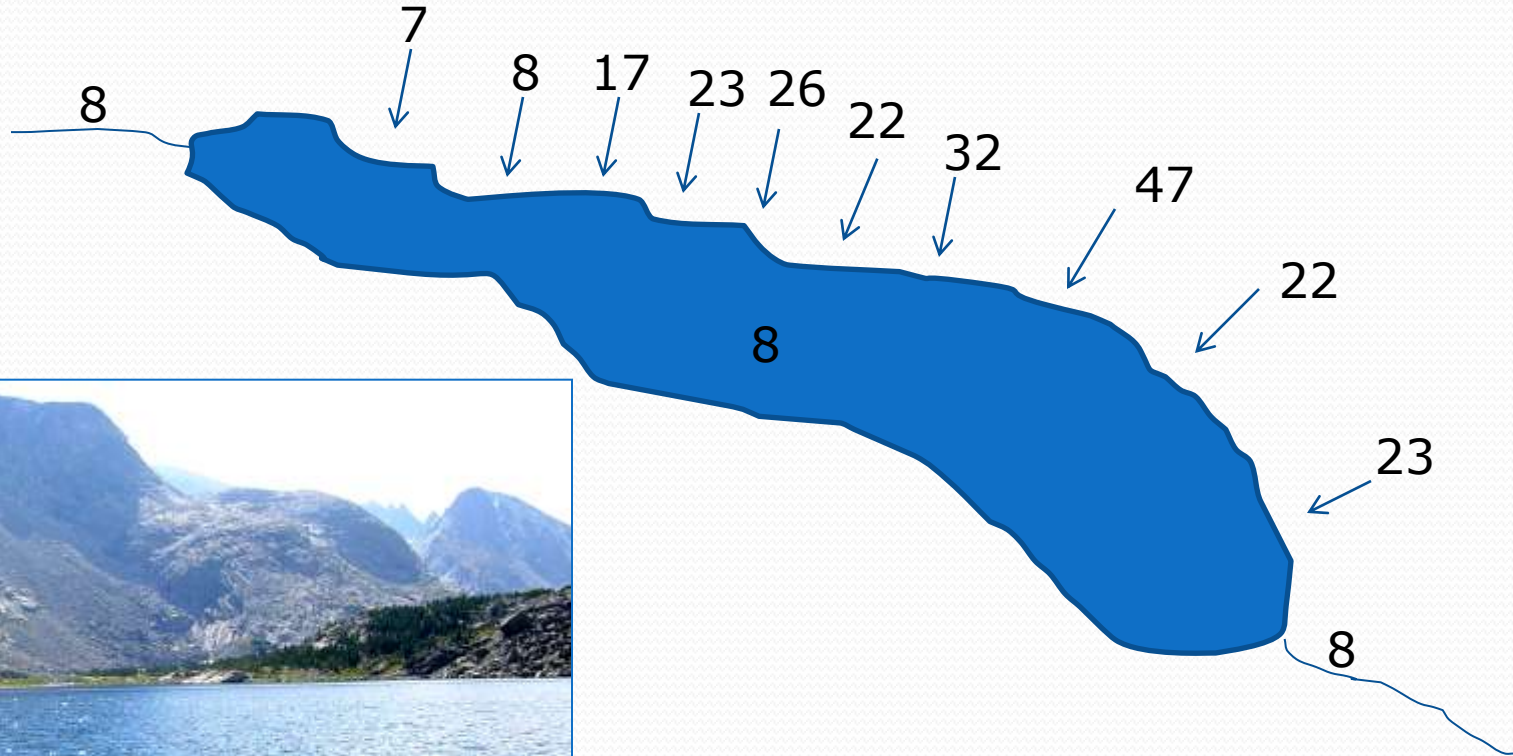
# Rock Lake - Chemical Evolution



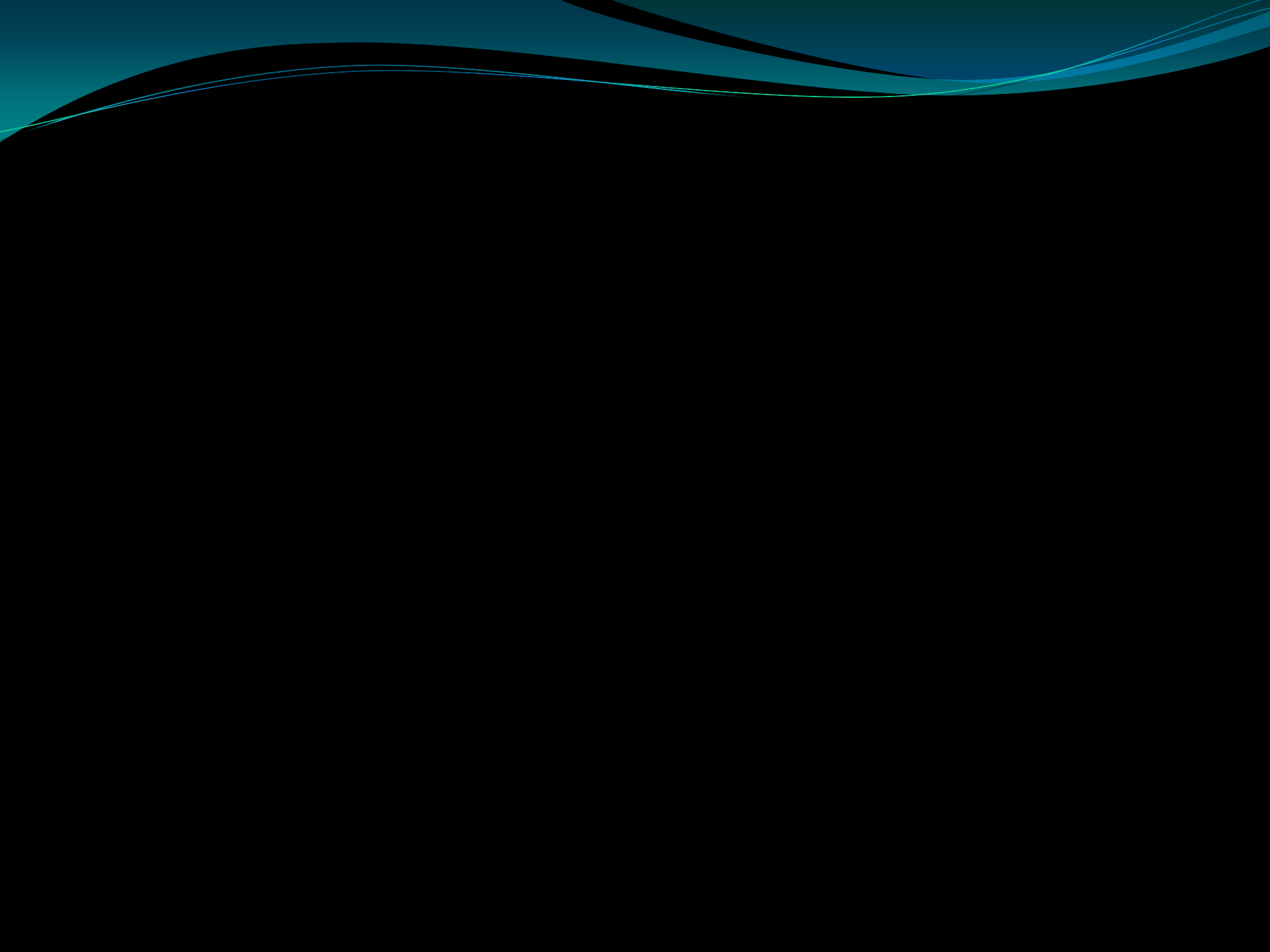
Source: Gurrieri and Furniss, 2004

# Black Joe Lake, EC of Groundwater Inflow

## August 2006







# Data Analysis

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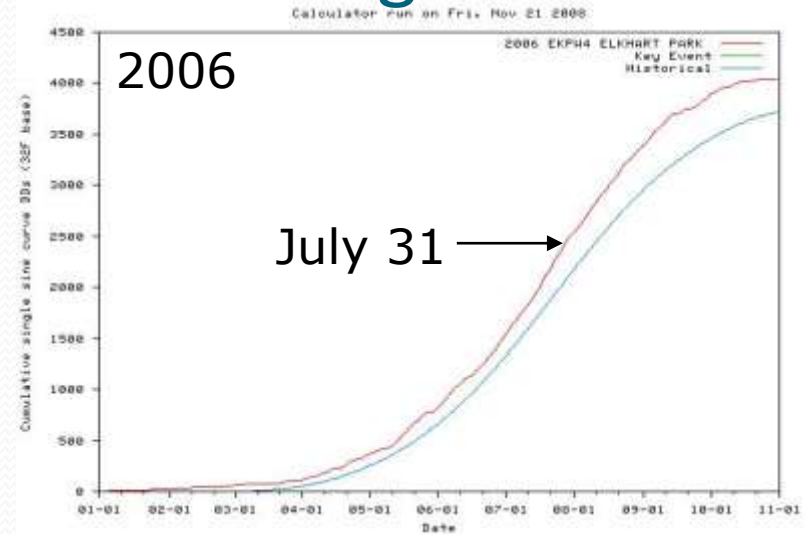
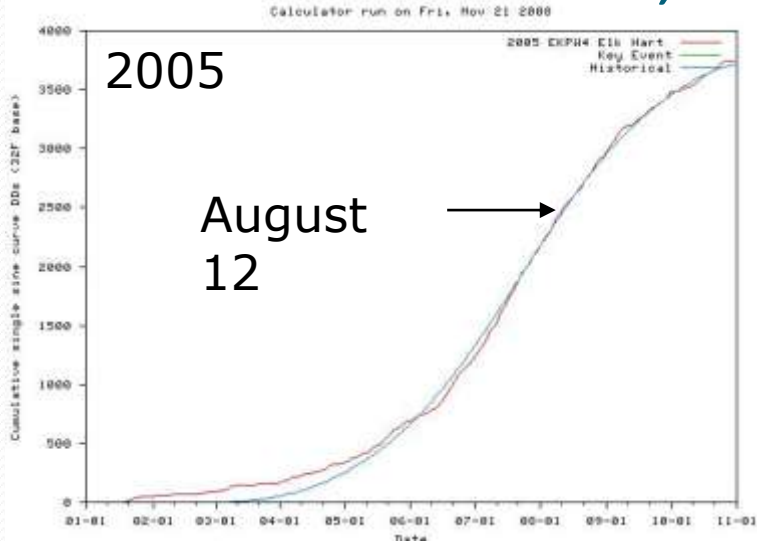
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# Major Data Analysis Issues & Suggested Solutions

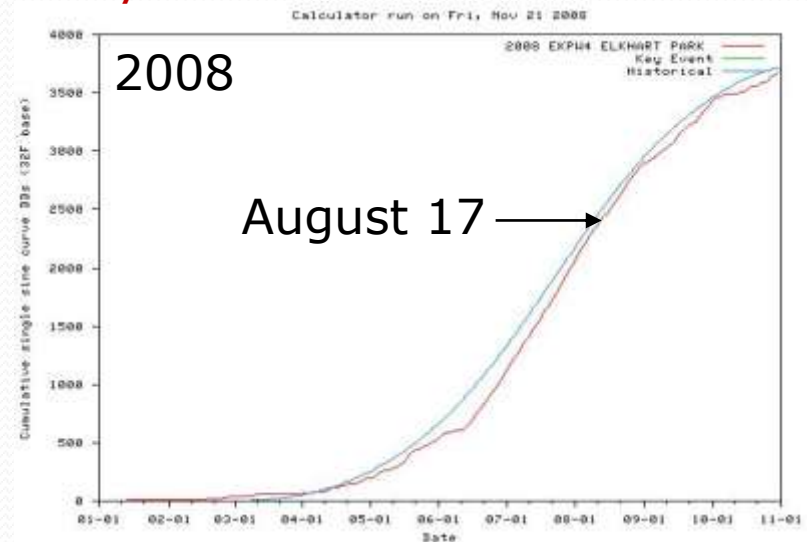
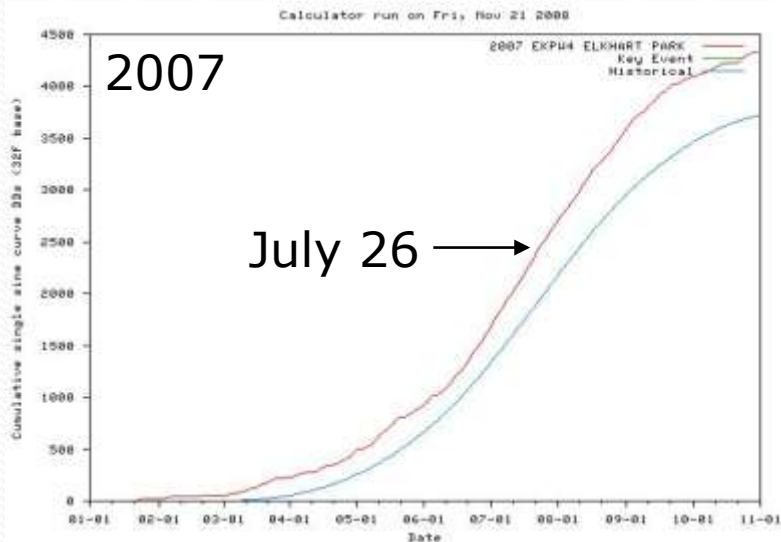
- Seasonality
  - Degree day tracking
  - Inflow/outflow data
- Publish an analysis protocol
  - IRB request

# Using Degree Days to Determine Sampling Dates

## Elkhardt Park Snotel, Wind River Range



### Cumulative degree day curves



Degree Day: A unit of measurement equal to a difference of one degree between the mean temperature on a certain day and a reference temperature.