

THERMAL STRATIFICATION PATTERNS OF CALLANDER BAY, ONTARIO

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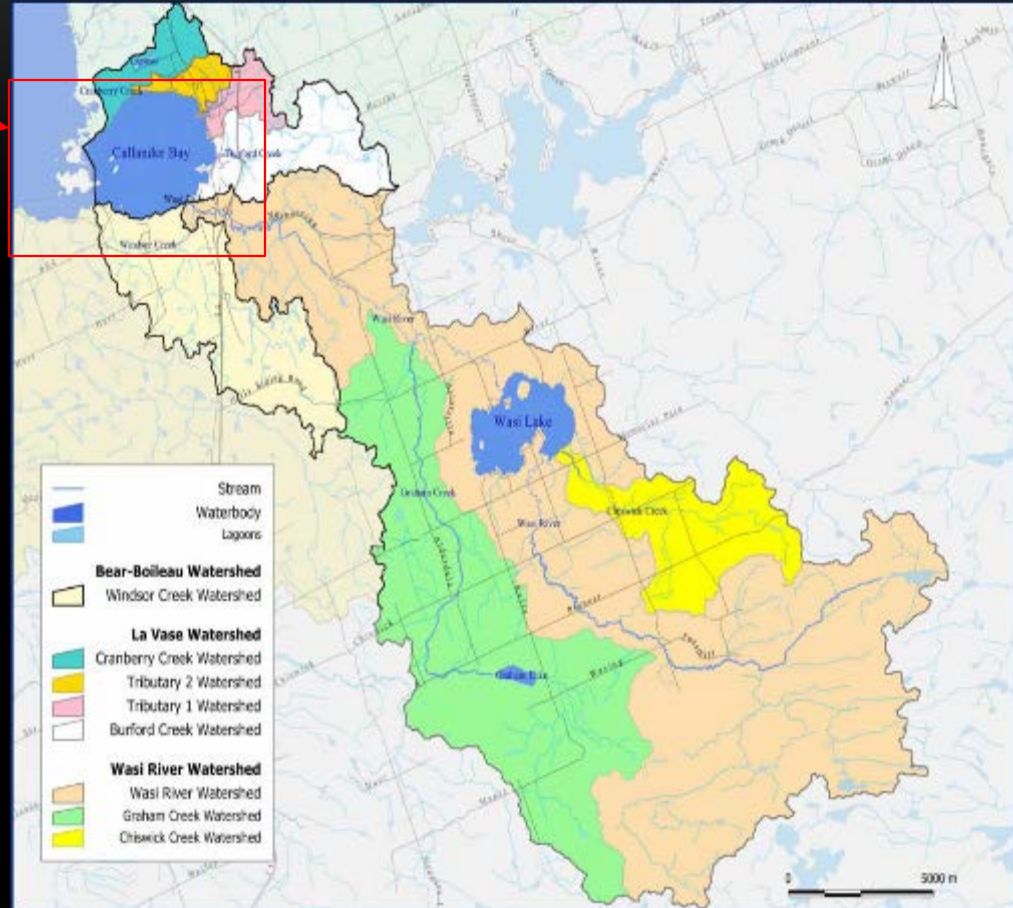
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BACKGROUND

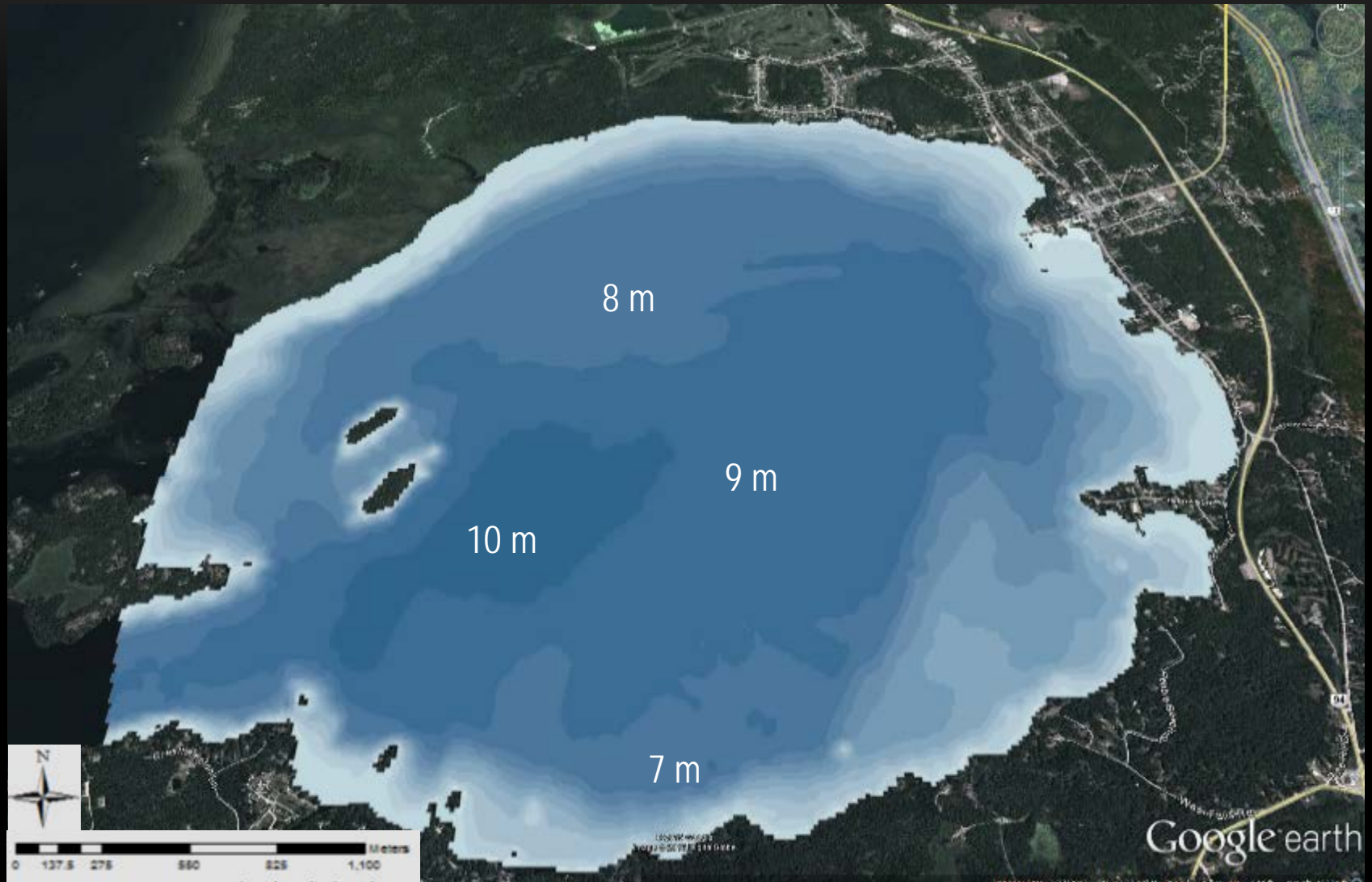
❖ Callander Bay

- ❖ Catchment area of ~296 km²
- ❖ Surface area of ~12 km² (Hutchinson Environmental Sciences Ltd. 2011).
- ❖ Municipal drinking water source
- ❖ Recreational use - swimming, boating fishing
- ❖ Reoccurring algal problem



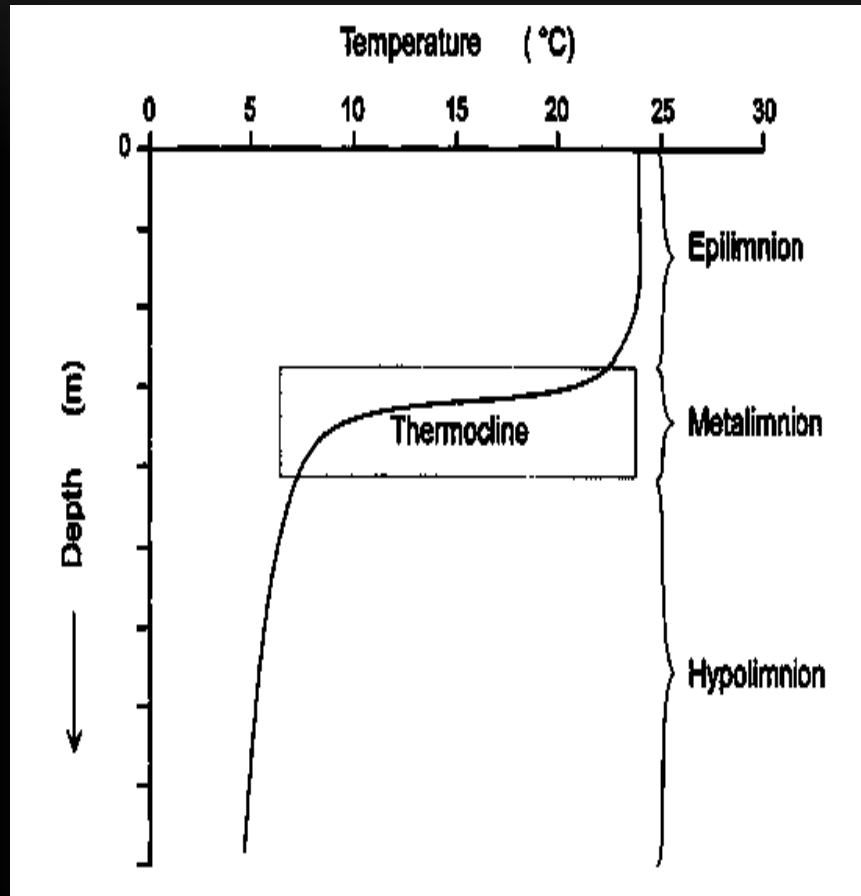
Land classes of Callander Bay. Courtesy of Hutchinson Environmental Sciences Ltd. (2011).

BATHYMETRY

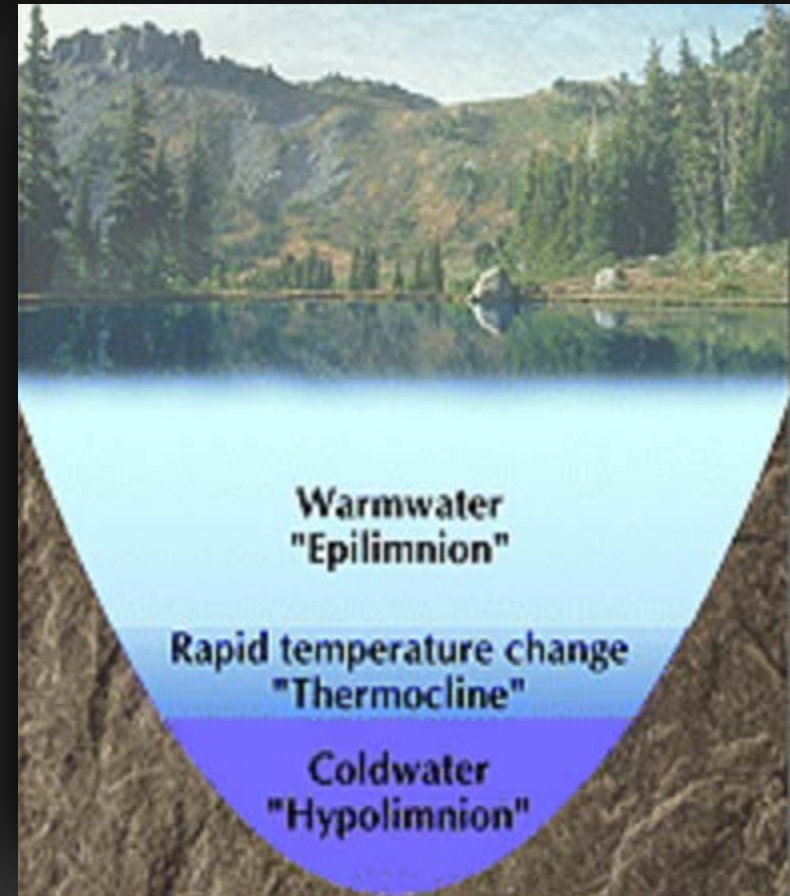


Callander Bay bathymetry. Map digitized courtesy of Dr. Krys Chutko. Landscape courtesy of Google earth, 2013.

THERMAL STRATIFICATION

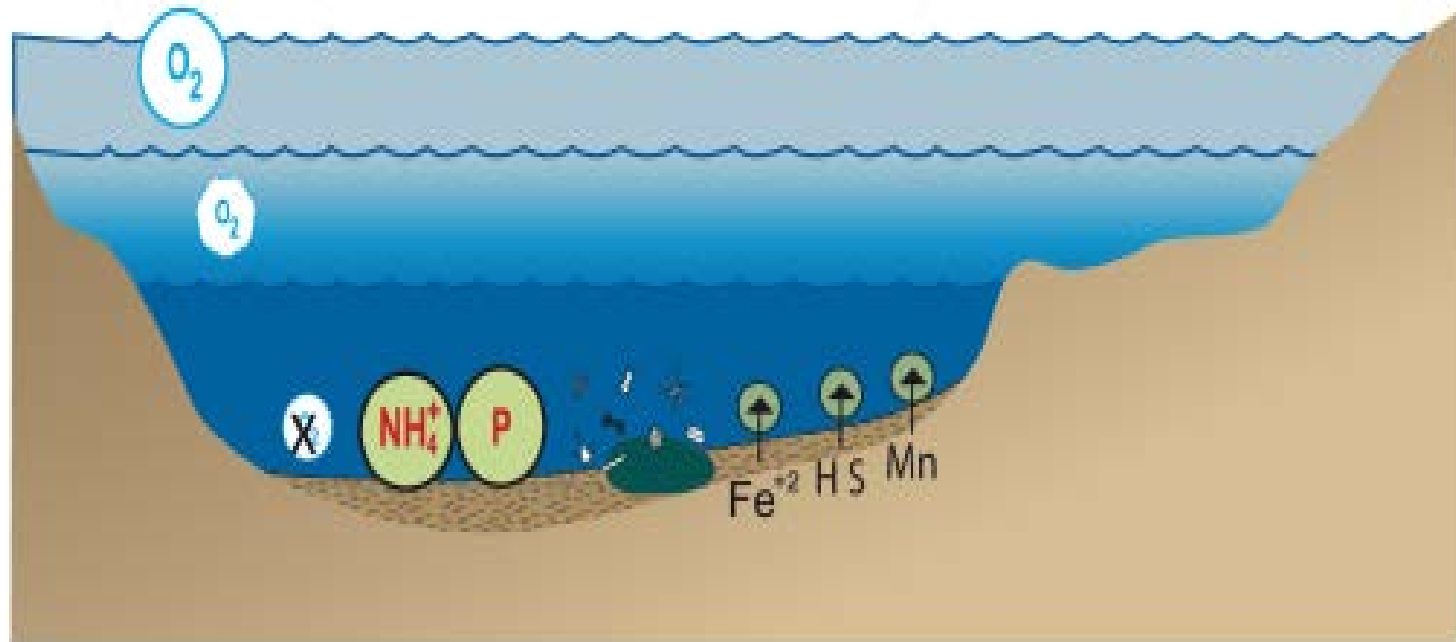


Typical temperature profile from a temperate stratified lake showing three layers based on differences in density. Courtesy of Thomas *et al.* (1996).



Lake image of summer stratification showing different layers in density. Courtesy of University of Guelph, (2013).

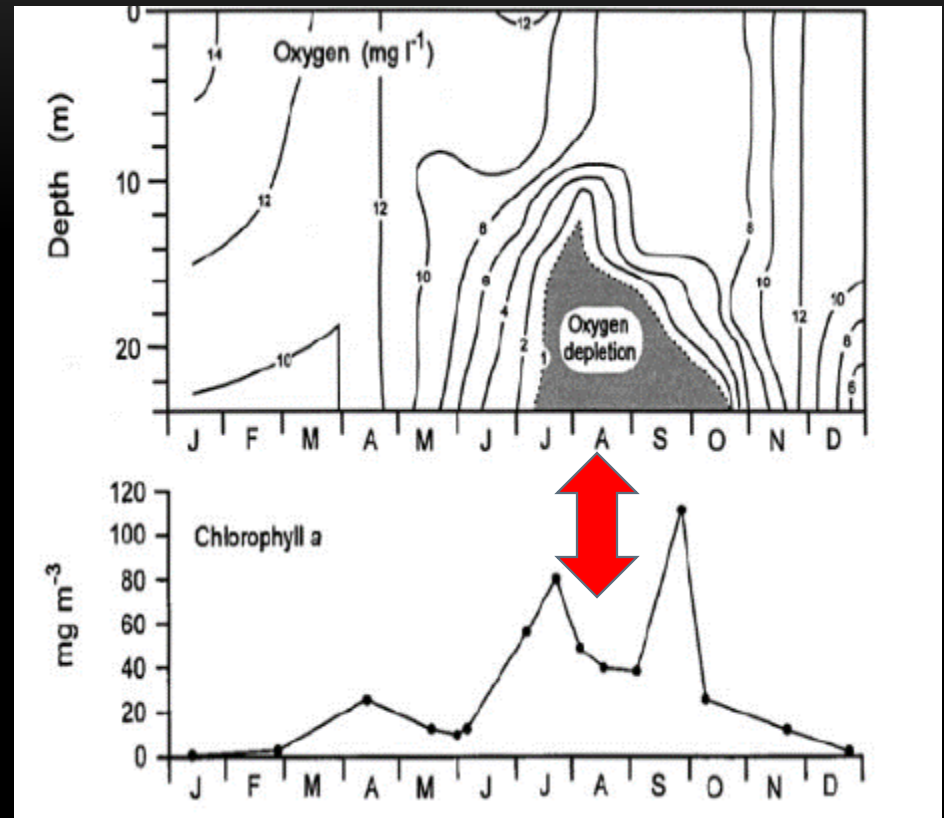
Implications of Stratification



Coastal and subcoastal non-floodplain sand lake—Window – Hydrology, WetlandInfo, Department of Environment and Heritage Protection, Queensland.

INTERNAL LOADING

- Sediments act as a sink for nutrients with the exception of periods of anoxia (lack of oxygen).
- During anoxia, nutrients are released into the hypolimnion (bottom waters) (Pettersson, 1998).
- Anoxia = < 1 mg/L of dissolved oxygen



Oxygen concentration and chlorophyll *a*. Notice as oxygen depletion occurs chlorophyll *a* concentration increase in the summer months. Courtesy of Thomas *et al.* (1996).

RESEARCH OBJECTIVES AND SIGNIFICANCE

- ❖ Evaluate the trophic state (algal biomass) of Callander Bay.

 - ❖ Measure chlorophyll-*a*, Secchi depth

- ❖ Assess the stratification pattern and determine whether anoxia occurs.

 - ❖ Measure vertical profiles of temperature/dissolved oxygen

- ❖ Can thermal characteristics help to explain bloom formation?

- Municipal drinking water source
- Callander Bay brings revenue/tourism
- Excess nutrients cause blue-green algae problems - poses a health threat



Blue-green algae bloom in Callander Bay.
Photo courtesy of Paul Smylie, 2011.

Buoy Installation June 2013

Much thanks to MNR – North Bay



Dr. Chutko and I after buoy installation, 2013.



MNR crew and Dr. Walters helping with installation, 2013

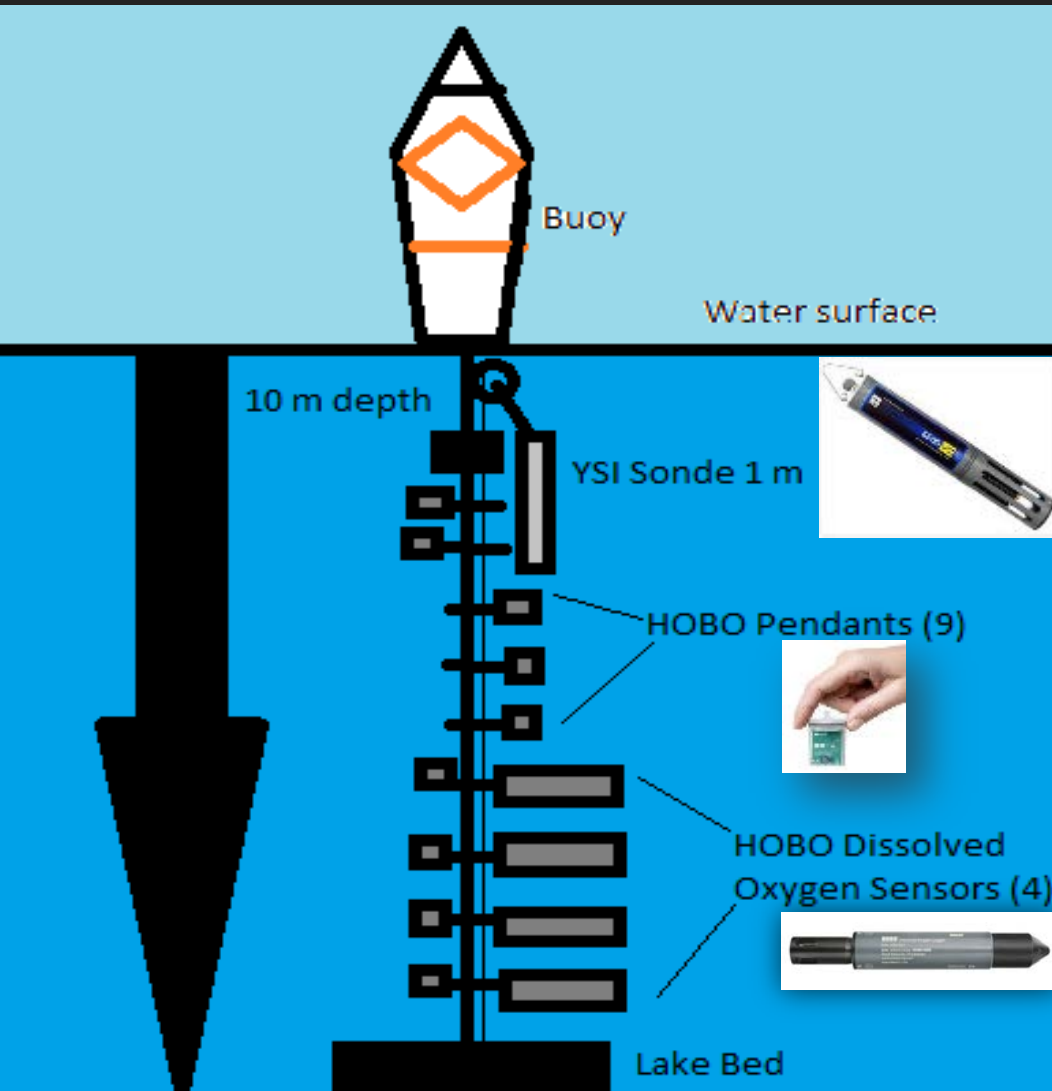
Buoy Removal October 2013

Much thanks to our colleagues
at Callander Bay Harper's
Marina!

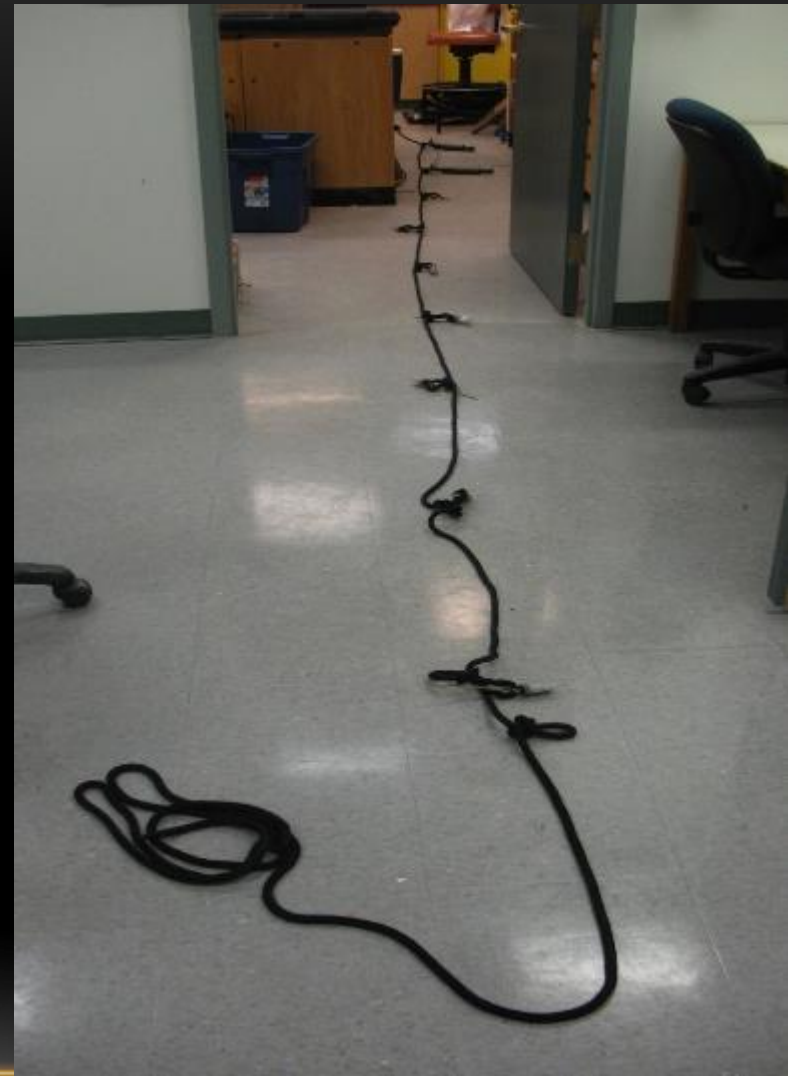


Crew from Harper's Marina and Dr. Walters. Photo
courtesy of Dr. James. 2013

EQUIPMENT ON BUOY

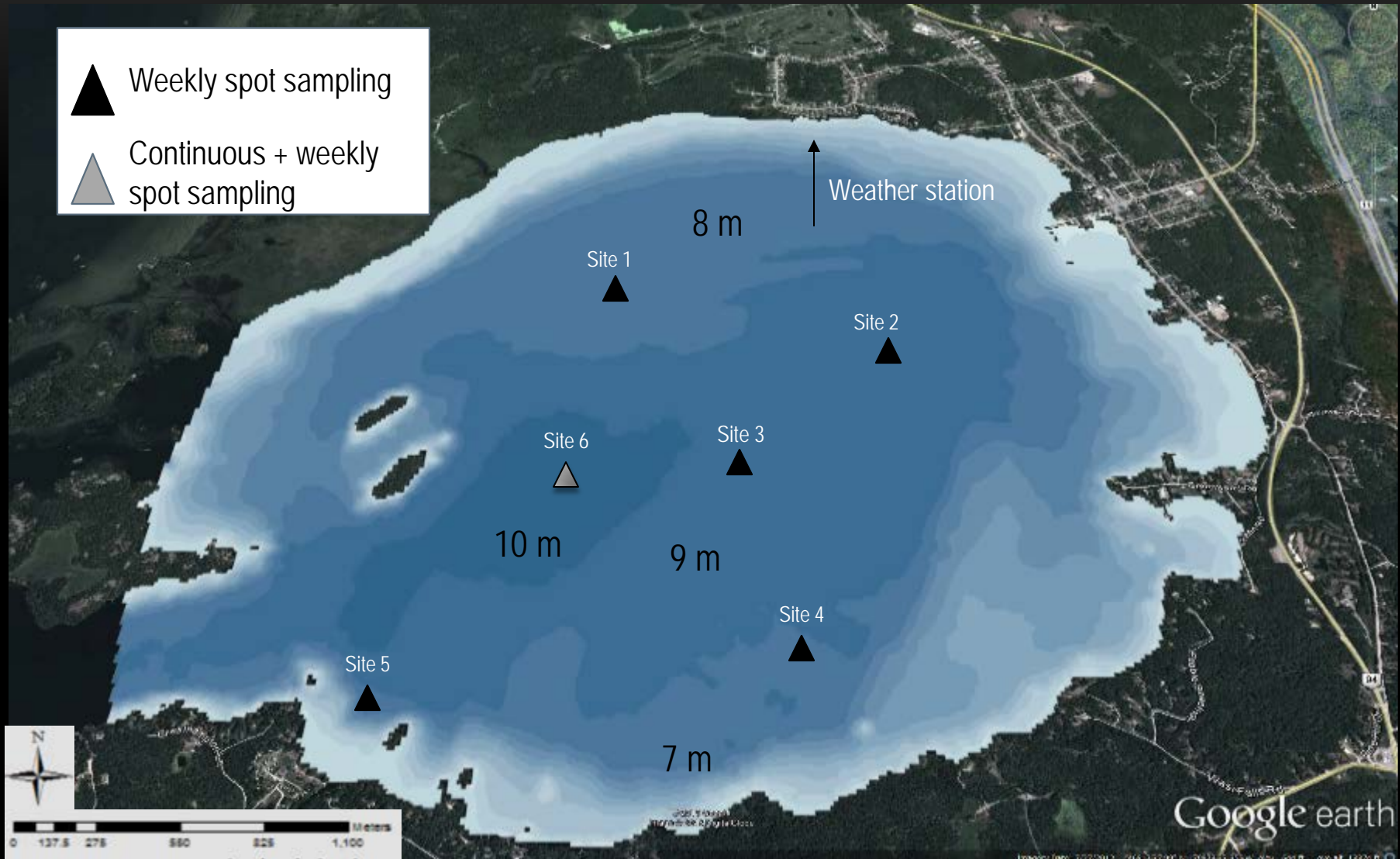


Schematic of buoy installation and suspended equipment, 2013



Rope with equipment that was suspended from buoy, 2013.

BUOY (SITE 6) AND SPOT SAMPLING SITES



Callander Bay bathymetry. Map digitized courtesy of Dr. Krys Chutko and landscape courtesy of Google earth, 2013.

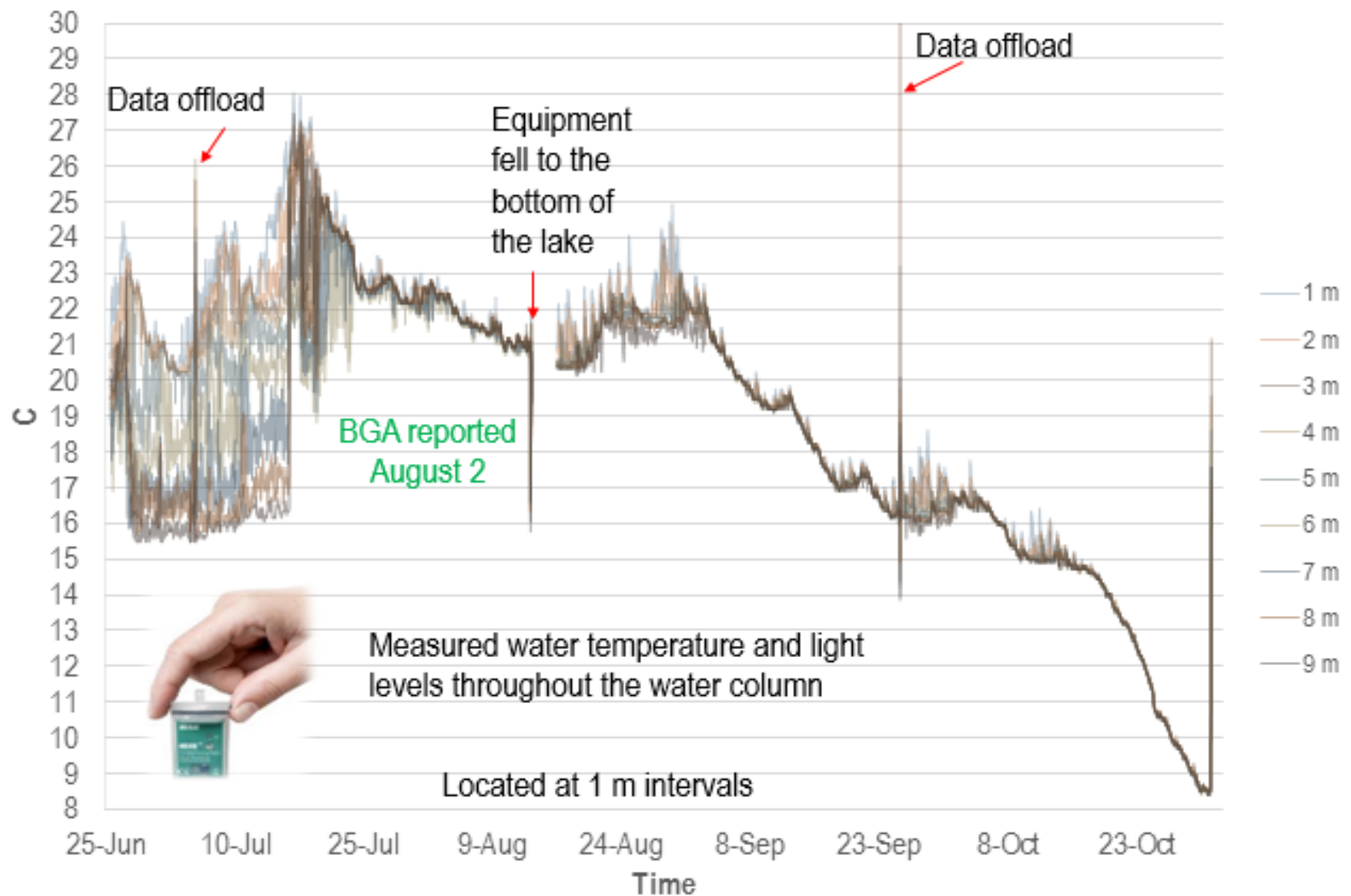
WEATHER STATION

- Continuous data
 - Air temperature
 - Wind direction
 - Wind Speed
 - Barometric pressure

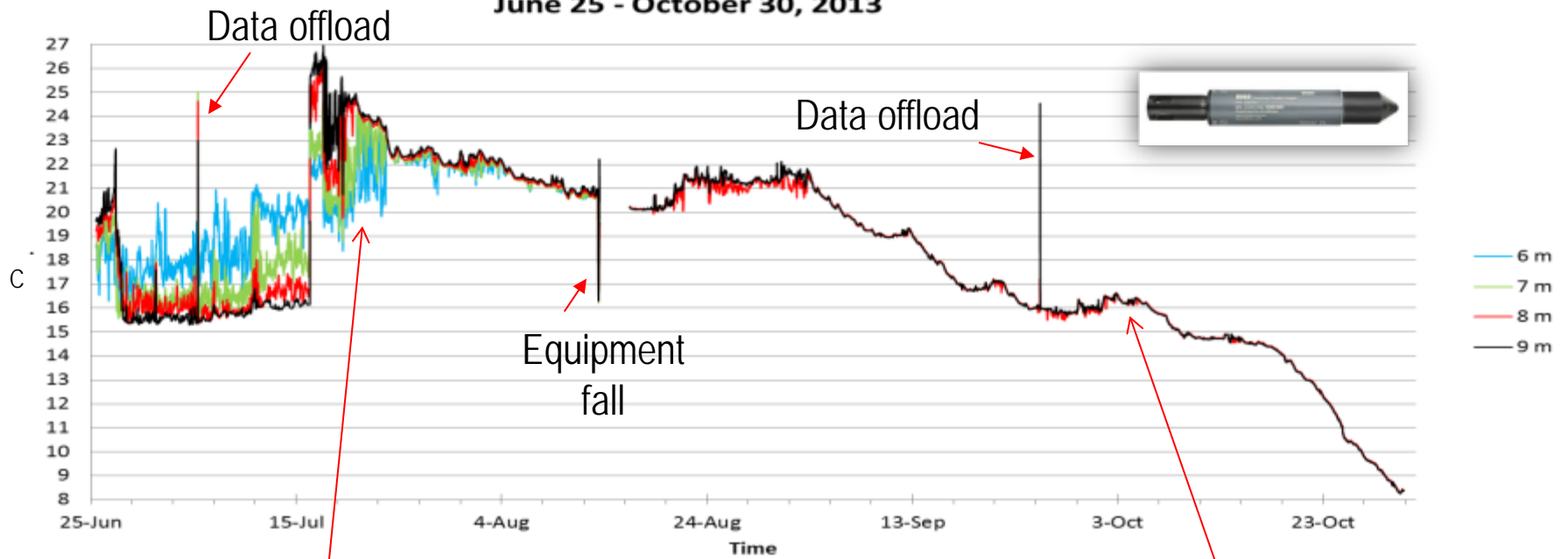
Many thanks to Mayor
Hector Lavigne!



Temperature profile from June 25 to October 31, 2013

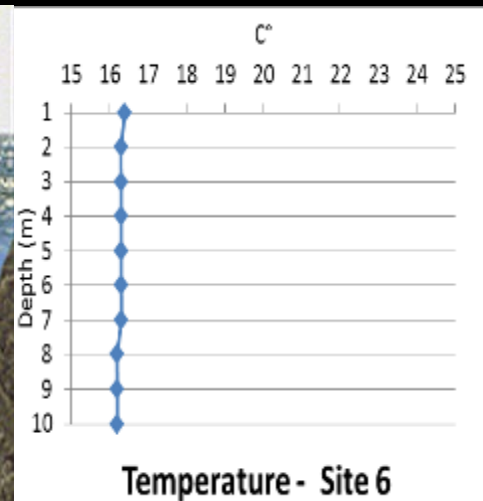
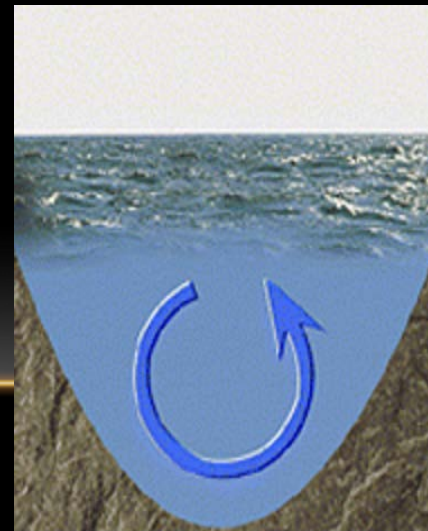
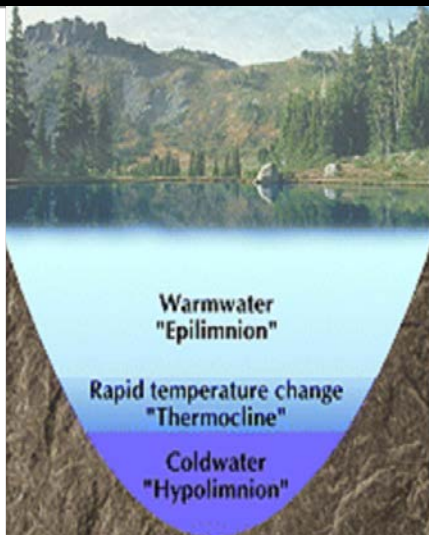
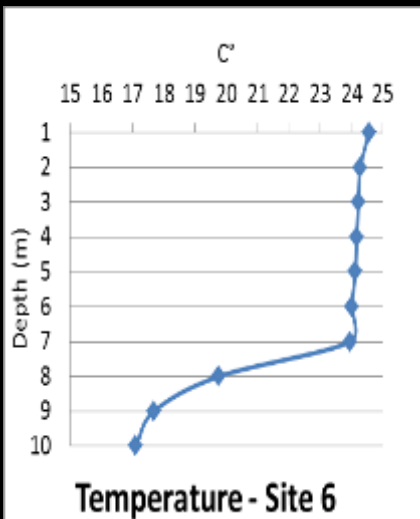


Temperature - 6 to 9 m depth June 25 - October 30, 2013

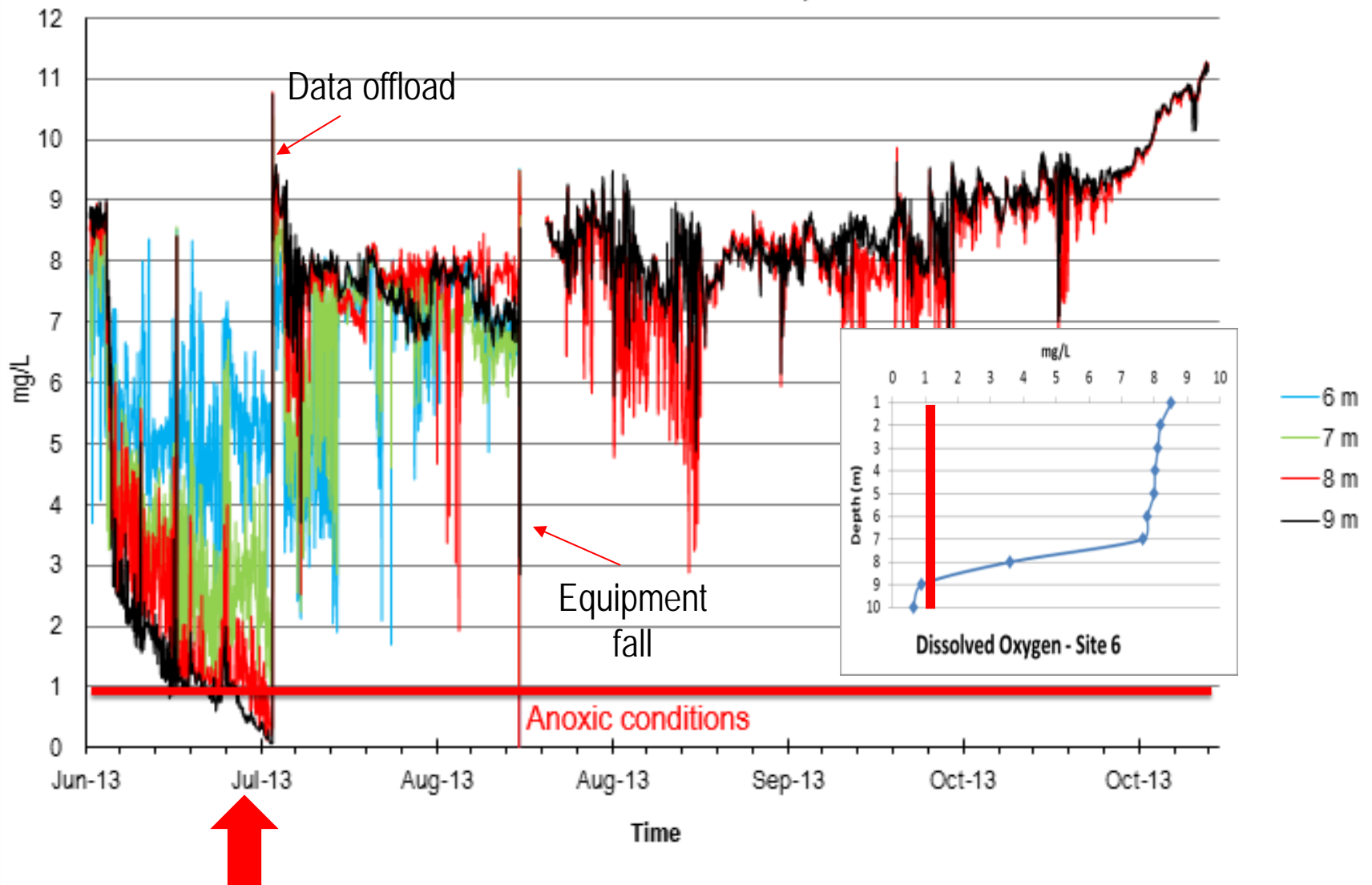


Stratified

Isothermal

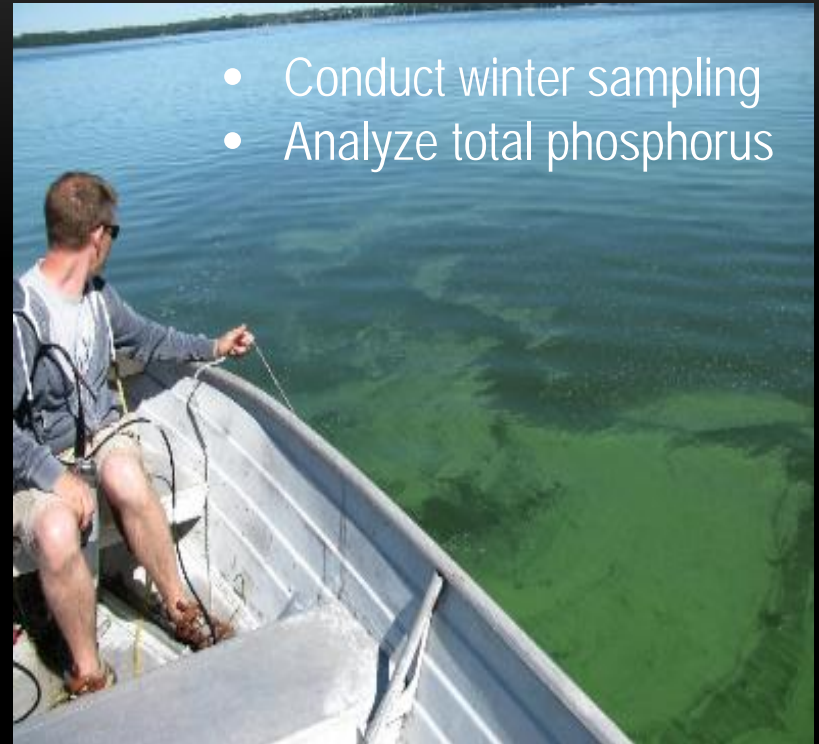


Dissolved Oxygen - 6 to 9 m depth June 25 - October 30, 2013



SUMMARY & FUTURE

- Successful 1st year of a multi-year study
 - Data from early summer through late fall.
- Early comments on stratification patterns
 - Early season – the system is stratified; late season we lose this stratification – system mixes
- The spot sampling
 - acting as useful checks & allowing some comment on spatial extent of similar conditions
- Evidence of anoxic conditions at depth – could this promote internal loading?



- Conduct winter sampling
- Analyze total phosphorus

Dr. Walters sampling water. Photo courtesy of Paul Smylie 2011.

Questions/Comments/Suggestions