Site Description (OS Grid Ref: TG 0764 3984)
The lake probably owes its origin to fish ponds constructed in the Middle Ages. From the mid-19th century the lake was managed simultaneously with the gardens as an ornamental lake. It is now very shallow (<1m) and filled with silt and leaves. The lake is visited regularly by students from the Holt Hall Field Study Centre.

History of Holt Hall Lake recorded in its sediments
Lake sediments provide a natural archive of changes that have taken place in the lake as well as pollution deposited on the lake and its catchment. A 155 cm core was collected in 2008. We have measured sediment properties, concentrations of metals and atmospheric contaminants in samples down the core. Dating the sediments by measuring the concentration of natural and man-made radioactive isotopes and the vertical distribution of contaminants in the core tells us that the sediment core records more than 200 years.

- We have generated a well-resolved sediment history back to the start of the 20th century (~ 55 cm depth). There is a significant amount of core that is un-dated.
- Lake sediments have varied in organic and carbonate content. LOI 550 C is a measure of organic matter determined by combustion at high temperature. The leaf and organic rich sediments in the top 10cm are identical to that at 110-130cm depth.
- \(^{137}\mathrm{Cs}\) (Caesium-137) is a man-made radioactive isotope that has been released historically by global atmospheric nuclear weapons tests and reactor accidents. We see a rapid increase from the late 1940s, to a peak in the mid-1960s. This corresponds to the history of nuclear weapon atmospheric testing that was banned in 1963.
- SCPs (spheroidal carbonaceous particles) are released into the atmosphere from high temperature combustion of fossil fuels in power stations. Our record of SCPs in the lake starts at low concentrations pre-1940 rising to a peak in the 1970s. Around this time in the UK, emission controls from power stations were introduced.
- \(^{206}\mathrm{Pb}/^{207}\mathrm{Pb}\) is a ratio of Pb isotopes in the sediment. Lead sources from around the world have historically had different isotopic ratios that allow us to help date sediments and determine the source of lead found in lake sediments.
- Because of the lakes location and history it is perhaps surprising to find elevated levels of metals in the sediments. We can see that concentrations of Hg (mercury), Pb (lead), Ni (nickel), Cu (copper) and Zn (zinc) increase from at least the 19th century.
**Water Temperature Monitoring**

We have been constantly measuring water temperatures at Holt Hall Lake with a submerged data logger (0.5m depth) and during our quarterly visits. The figure (left) is a summary of the depth/temperature data since May 2008. What we observe is that there are strong seasonal changes but very little change of temperature with depth. This would be expected as the lake is very shallow and easily mixed by the wind.

*Maximum temperature from profile data: 18.3 ºC (August 2008)*

*Minimum temperature from profile data: 2.4 ºC (January 2010)*

**Water Chemistry Monitoring**

The analysis of water samples collected every 3 months since May 2008 are providing us with useful data on chemical and biological processes in Holt Hall Lake. Data gathered during the OPAL project shows how the water in the pond changes over the year and the overall quality of the water.

- Suspended solids is a basic measure of all matter found floating in the water, i.e. plankton and sediment particles. Levels in Holt Hall Lake are low. The peak in April 2011 is the result of a bacterial bloom that turned the lake milky.
- Phosphorus - a nutrient in aquatic systems - shows a strong seasonal pattern, due to biological activity in the lake and inputs from the catchment.
- Chlorophyll levels are low but have increased significantly when algae levels are high.
- Our monitoring of mercury (Hg) and lead (Pb) concentrations in the water show that amounts available to be incorporated into the sediment (see overleaf) vary seasonally.
- We are also monitoring how diatoms and phytoplankton change through the year, along with zooplankton numbers.