Site Description (OS Grid Ref: SK 6351 7053)
Thoresby Lake was created by constructing a dam across the River Meden valley. Ambitious estate landscaping in the 18th century extended the lake, including the construction of an island at the western end. The lake is an important breeding habitat for wildfowl and its wetland margins sustain a nationally important diversity of plant species.

History of Thoresby 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 100 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 100 years.

- We have generated a well-resolved sediment history back to the mid-1940s (~ 60 cm depth).
- The sediment composition shows that the lake shifted from a shelly/carbonate depositing environment to its current state around the early 20th century. The lake must have been very different then. Zr (Zircon) is a mineral element and reflects soil inputs. LOI 550 is a measure of organic content. Both can see to have varied through time.
- $^{137}$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 broad increase from the late 1940’s, corresponding 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, controls on emissions from power stations were introduced.
- $^{Pb}_{206}/Pb_{207}$ is a ratio of Pb isotopes in the sediment. Lead sources from around the world have different isotopic ratios that allow us to determine the source of lead found in lake sediments.
- We can see that concentrations of Pb (lead), Ni (nickel), Cu (copper) and Zn (zinc) increase from the mid 20th century. The corresponding pattern of SCPs in the core indicates that atmospheric deposition from fossil fuel combustion may have been a significant source along with other industrial and domestic sources.

- We are also investigating how the lake biology has changed by examining the remains of diatoms (a type of algae) and other fossils.
**Water Temperature Monitoring**

We have been constantly measuring water temperatures at Thoresby Lake with a submerged data logger (0.5m depth) and during our quarterly visits at 0.5m depth intervals (max 3.5m). 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 little change of temperature with depth. This would be expected as the lake is well mixed by wind and wave action.

- **Maximum temperature from depth profile data:** 20.1 ºC (July 2009 & 2010)
- **Minimum temperature from depth profile data:** 3.4 ºC (Feb 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 Thoresby 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. The lake was drained and lowered in April 2010 so were unable to sample at that time.

- **Total suspended solids (TSS)** is a basic measure of all matter found floating in the water, i.e. plankton and sediment particles. Levels in Thoresby Lake are relatively low.
- **Phosphorus** - a nutrient in aquatic systems - shows a strong seasonal pattern related to biological activity in the lake and inputs from the catchment.
- **Chlorophyll levels** are low but peak in summer due to green/blue algae growth.
- **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. For Pb a hypothesis could be more Pb is entering the lake in winter due to higher rainfall and runoff from the catchment.