Windermere & Bowness Town Council

Mill Beck Water Testing Report 2024

At the annual parish meeting in April 2023, it became clear that the quality of water in Lake Windermere was a key concern for our residents. In response the Town Council set up a Lake Water Quality Advisory Group.

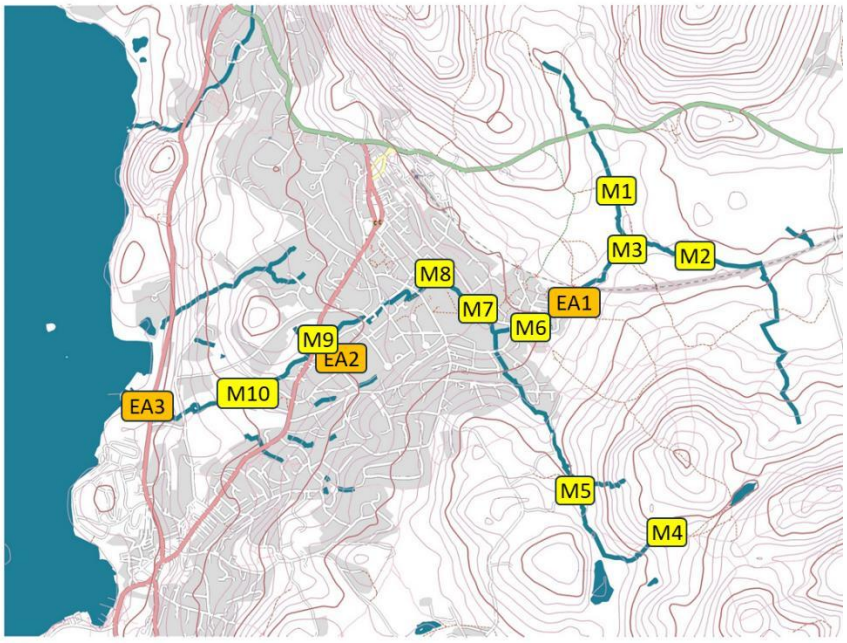
A group of Town councillors began researching the issues and attended talks by a wide range of experts including the Freshwater Biological Association (FBA), Lancaster University and the UK Centre for Ecology and Hydrology (UKCEH). They conducted site visits and spoke with a range of different organisations such as Love Windermere, Save Windermere and United Utilities. They also made contact with other local groups who shared their concerns about water quality such as the Clean Up River Kent Campaign (CRKC) and Ambleside Action for a Future (AAFAF) to learn about what they were doing.

One thing became apparent, despite the statutory bathing water sampling and irregular testing at three other locations carried out in our parish by the Environment Agency and large citizen science projects such as The FBA's Big Windermere Survey, there was a lack of independent data about the water flowing into our lake on a regular basis. The Town Council resolved to fund a trial project carrying out weekly sampling in the Mill Beck from the start of April through to October.

The testing began in April 2024 and five test points in the town (M6-10 below) have been tested on a weekly basis and then analysed for phosphate, ammonia and pH level. In May we were lucky enough to get an offer of help from the Matson Ground Estate to add five more sample points (M1-5 below) to enable us to test the upper reaches of Mill Beck and Scout Beck (which drains into Mill Beck). They collect the samples and deliver them to the Town Council for testing.

Environment Agency
EA1 – Gill Cottage F/B
EA2 – A5074
EA3 – A592

Windermere Town Council
M1 – Footpath Crossing
M2 – Near Railway
M3 – Above Confluence
M4 – Ford below School Knott
M5 – Near Pinethwaite
M6 – Limethwaite Road Bridge
M7 – Top of Park
M8 – Upper Oak Street Bridge
M9 – Baddeley Clock Gardens
M10 – Sheriffs Walk



Why Mill Beck?

Mill Beck was chosen because it flows from an upland farmed catchment area with several small tributaries on the land around School Knott, through the most built-up part of the town at Queen's Park and down to Baddeley Clock Gardens, then out under the A592 and into the lake near the Jetty Museum. Conversations with residents also suggested that there was occasional evidence of pollution entering the beck from the appearance of the water and anecdotal evidence of a reduction in the number of native white clawed crayfish found in it. This pollution might be caused by a "misconnect" where part of the water or sewage network has not been properly connected. Finding the location of the misconnect would enable us to point it out to United Utilities and the Environment Agency so it could be fixed.

There has long been debate about the impact of the different sectors on the nutrients going into the lake. How much of it comes from the sewage treatment works, how much from farmers or septic tanks? While our research isn't going to be able to answer that for the whole catchment it will certainly help to broaden our understanding of the question in relation to this particular stream.

Why only test from April to October?

The equipment used to test the water samples is only able to detect the target nutrients in a specific range. When there is high rainfall the nutrients entering the system are often too dilute to detect. April to October were expected to be drier months and if there were nutrients entering the beck it was hoped we would pick them up in that period. They also represent the peak of the tourist season when the population and pressure on the network would be at its greatest.

How does the testing work?

A sample is collected from the beck and has to be tested within 24 hours. The testing is done on simple scientific instruments such as those used to test the water in home aquariums. This means that the equipment was affordable to enable us to test regularly and easy to transport. Unfortunately, this means that our data can only be indicative of an issue and would not be sufficiently robust to be used in court. We can however use it to indicate to other agencies such as the Environment Agency where we believe there to be a problem.

What are you testing for?

We test for two key pollutants **phosphorus** and **ammoniacal nitrogen**. The former in excess can contribute to the growth of algal blooms in the lake, whilst the latter in higher concentrations can threaten aquatic life itself.

We also test whether the water is acidic or alkaline (the pH level) as this is important in calculating ammonia concentrations. Pure water has a neutral pH of 7 whilst the water in the Lake District is naturally slightly acidic and has a pH value of around 6.5.

Phosphate can indicate the presence of a misconnect with either sewage or grey water containing detergents entering the stream or else farming run-off from fertilisers or manures. It can also indicate tap water leaks as drinking water is dosed with phosphate to counteract the risk from lead pipes. The Environment Agency is targeted to manage streams and rivers to Good ecological status. This is demonstrated by measuring the amount of chemicals shown in micrograms (ug) per litre (l) of water. In the case of Mill Beck this good status is represented by a maximum phosphate level of 16 ug/l.

Ammoniacal nitrogen at higher levels typically indicate sewage pollution, either animal or human in origin. It exists in two forms, **ammonium ions** and **aqueous ammonia**, with the balance between them a function of water pH. In the slightly acidic waters naturally found in the Lake District (pH 6.5), **ammoniacal nitrogen** exists almost completely in the form of ammonium ions and is of no danger to fish.

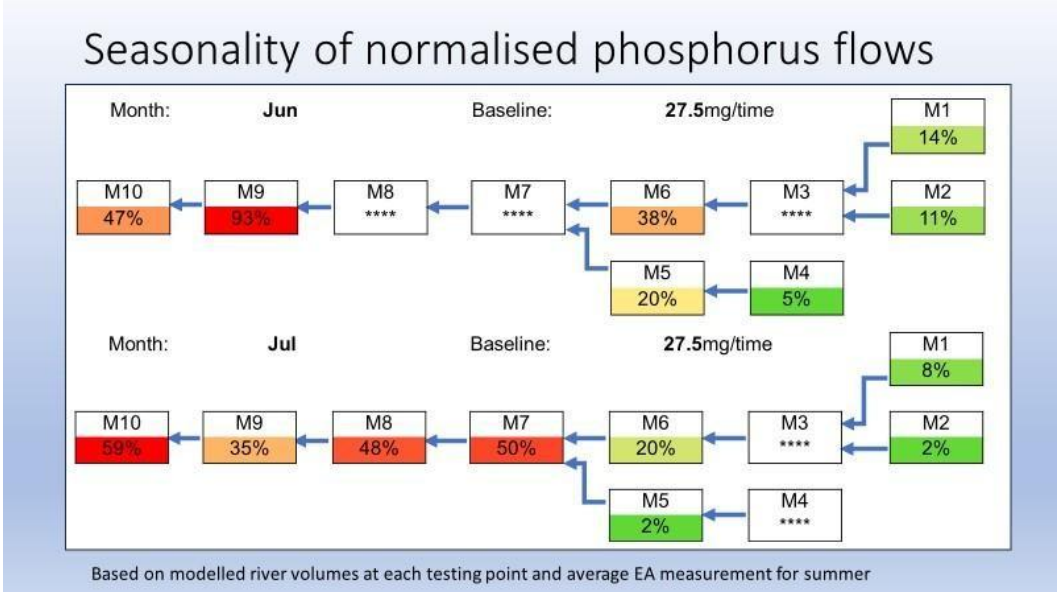
However, at the higher pH levels often found in polluted streams, the balance shifts towards ammonia, with levels above 50ug/l of the latter regarded as toxic to aquatic wildlife and even higher levels causing mass fish deaths. At a pH of 8, 5% of the ammonium exists as ammonia; at pH 9 this rises to 36%; and at pH 10 it is 85%. Hence whether ammonia is of concern depends on both the total concentration of ammoniacal nitrogen and the pH of the water it is dissolved in.

Whilst pure water has a neutral pH of 7, increased pH in water bodies such as lakes can be caused by algal blooms, indeed regular pH testing in Windermere by the UK Centre for Ecology and Hydrology (UKCEH) indicates that in recent years pH has been rising in summer - likely an effect of increased algae levels. However, the higher levels found in Mill Beck are most likely caused by human pollution such as storm water runoff or contamination by fertilisers.

What do the results show?

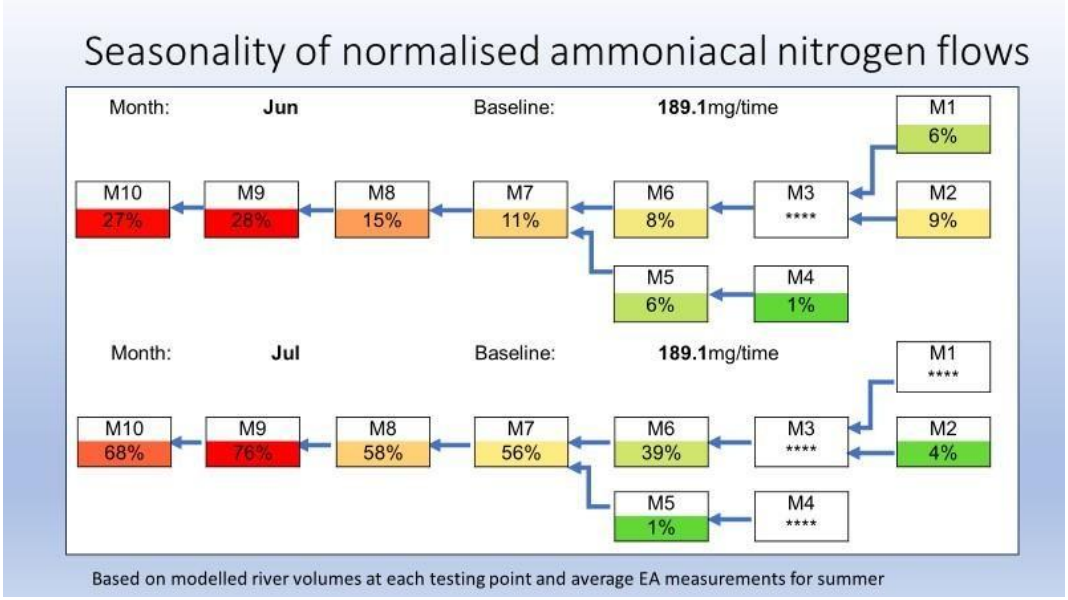
The spring and summer of 2024 were unusually wet and lacked the long dry periods of previous years, making it harder to detect any increased levels of nutrients entering the stream. Phosphate was more often detected later in the season as water levels decreased and population levels increased. Similarly, there were higher ammonia and pH reading detected in later weeks.

Phosphorus results over the testing period are shown graphically in the Appendix, fluctuating between Good and Moderate quality. Whilst the highest concentrations were found in June in the headwaters, these represent only a small fraction of the total pollution content as river flows there are low, and hence only a small amount of phosphorus is needed to create a higher concentration. By adjusting concentrations to take account of varying flow volumes, then sites can be directly compared as shown below, with most phosphorus being detected in urban sites (M6-10).



pH levels (see appendix) were generally higher than expected throughout the spring and summer, frequently above 8, showing some pollution is highly likely, in particular in the lower reaches of the beck.

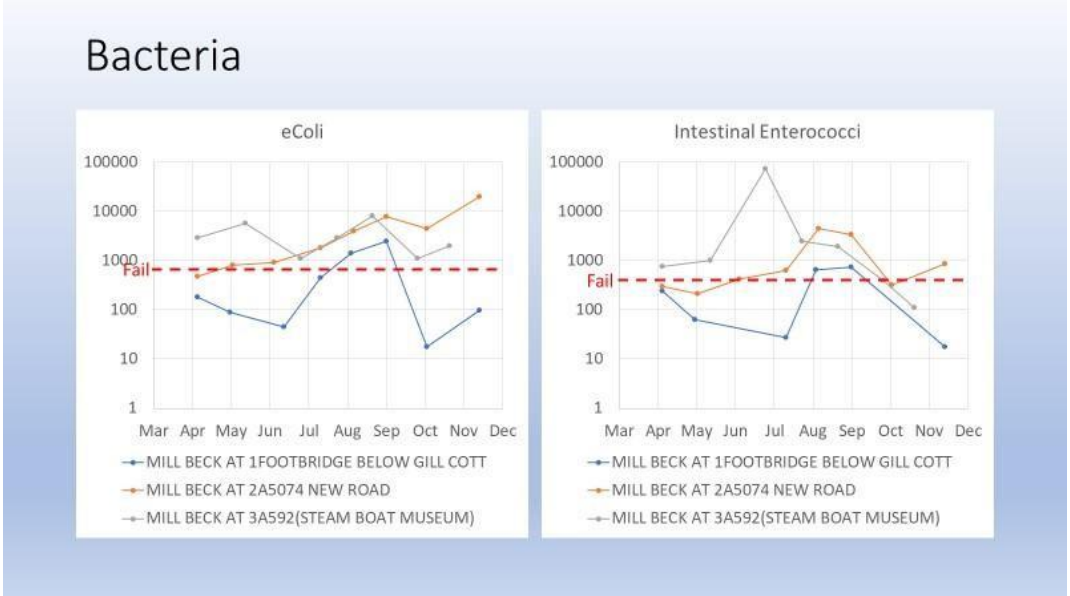
Ammoniacal nitrogen levels (see appendix) jumped significantly at the beginning of July. By again adjusting to take account of river flows, the chart below shows that almost all enters the beck within the urban boundary and is therefore unlikely to be of farming origin.



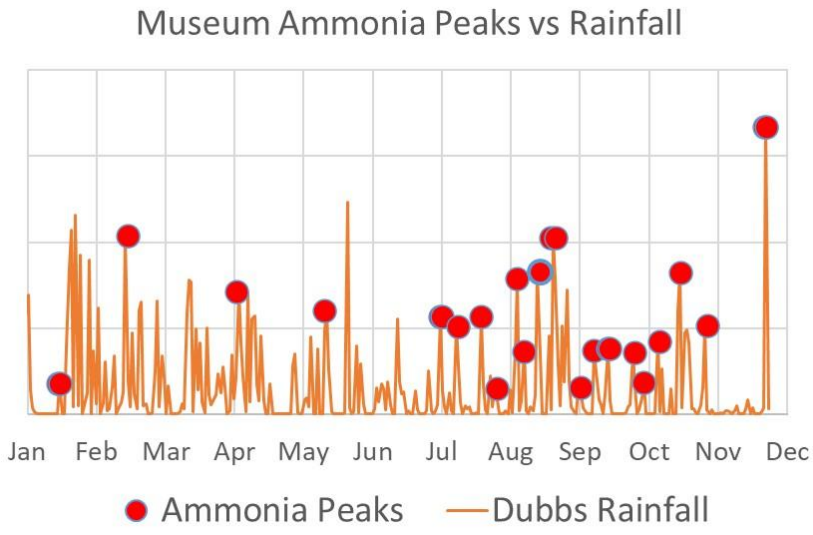
When these high summer levels are combined with the higher pH alkalinity then calculated ammonia levels approach the 50ug/l level where they may be impacting aquatic life in Mill Beck.

Bacteria

Adding to the analysis are the EA's own measurements of bacterial pollution in the beck. Both eColi and Intestinal Enterococcus levels in the lower beck would completely breach bathing water failure levels, were it to be designated as such. Indeed, in one reading in June, they were 200 times the failure threshold! Even higher up the stream, whilst bacterial levels were lower, they would still be of concern. **Overall therefore, caution should be exercised by anyone one coming into contact with the water in Mill Beck.**



When this bacterial data is combined with the high levels of ammoniacal nitrogen, **then there is clear evidence of sewage pollution in Mill Beck.** Analysis of rainfall data (below) shows that the largest peaks in ammoniacal nitrogen correspond to high intensity rainfall events with many occurring in the peak summer tourist period, so it is likely that a type of overflow mechanism is occurring, albeit currently no clear way of identifying its source.



Further testing next year should enable better conclusions to be drawn. If ammonia and phosphorus can be detected in the river during a drier spell, such as in the spring of 2023, when overflows should

not occur, then that would indicate potential misconnections that could be isolated to particular reaches of the beck. Similarly, testing immediately after heavy rainfall would do the same for potential overflow locations. In between, it is important to continue to update the baseline data so that comparisons can be made to EA data.

The Town Council would like to thank:

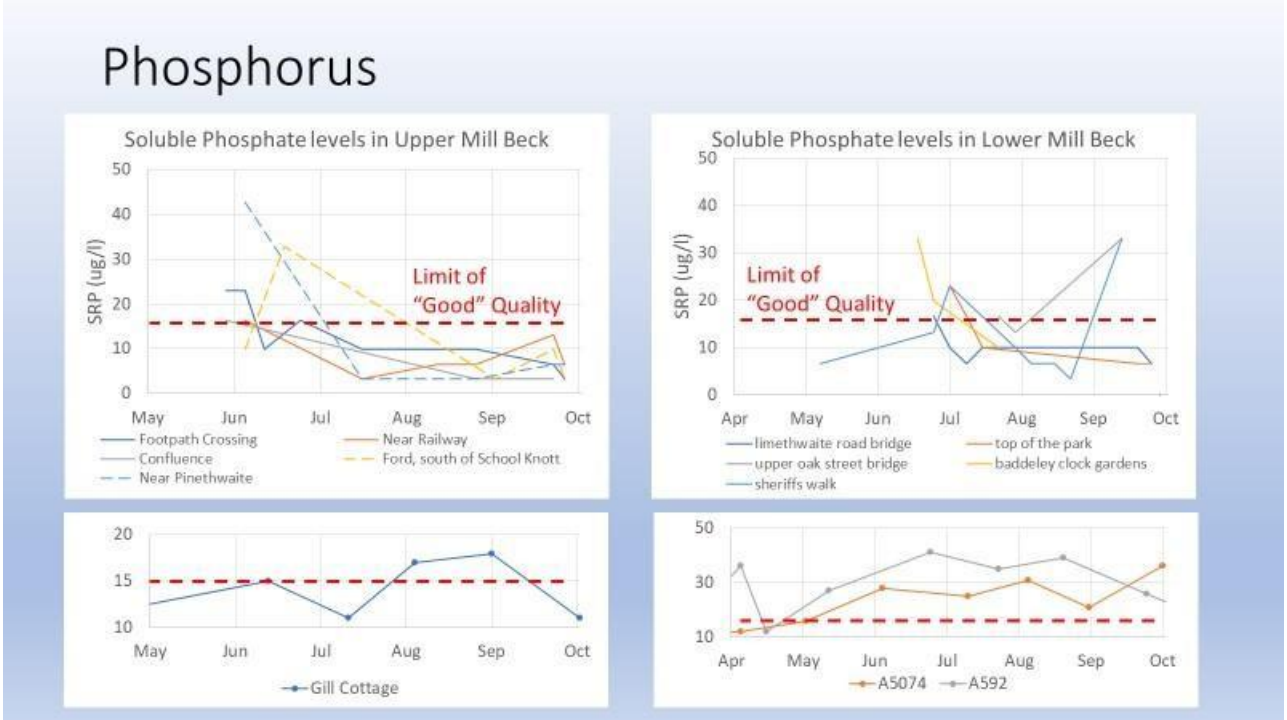
Caroline and Brian Kearney for their tireless testing.

AAFAF, particularly Tim Boden, for their support in sharing their knowledge about setting up a testing program and interpreting the results.

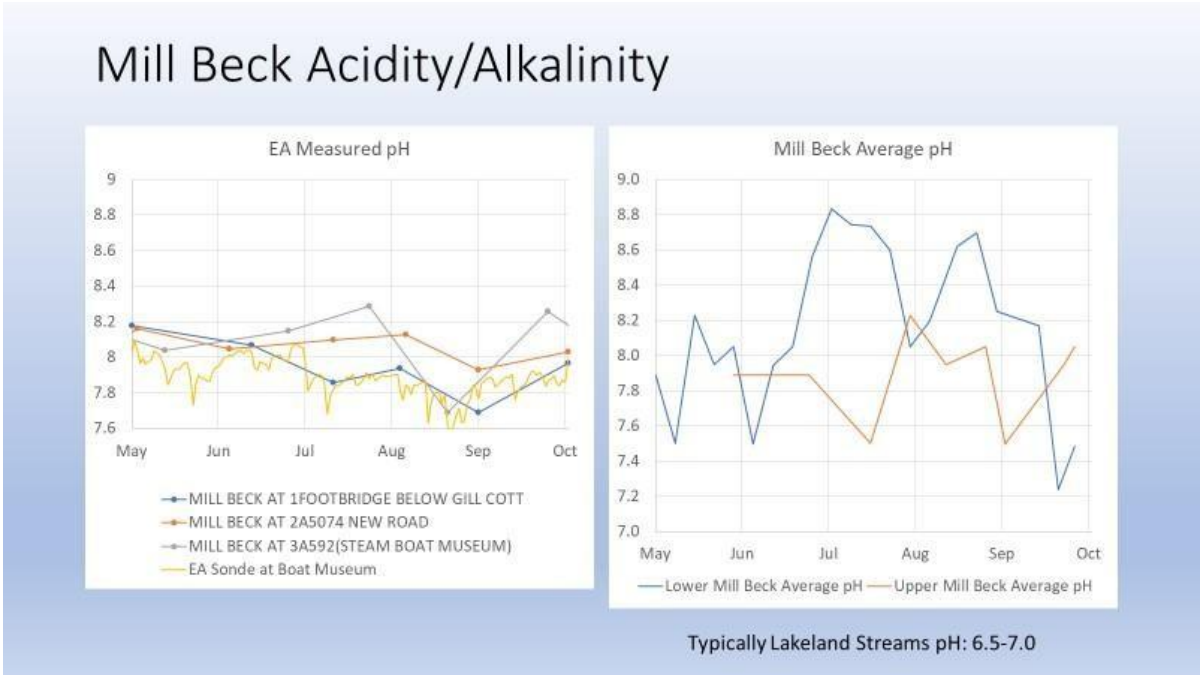
Matson Ground Estate Ltd for enabling us to gather data from the upper section of Mill and Scout Becks with practical and financial support.

Appendix:

Phosphorus levels measured in Mill Beck (upper graphs) with relevant EA readings plotted on the lower graphs for comparison



pH levels measured in Mill Beck (right graph) with relevant EA readings plotted on the left graphs for comparison



Ammonia levels measured in Upper Mill Beck (left graph) and Lower Mill Beck (right graph) with the EA readings from the Museum plotted for comparison.