

WildFish. SmartRivers

Windermere data report



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Summary of results

The health of every river sampled in the Windermere catchment was found to be impacted by United Utilities' assets according to SmartRivers data.

The abundance of pollution sensitive riverfly species was found to be particularly impacted below, compared with above, United Utilities' wastewater treatment works (WwTW). The starkest evidence of this was on the River Rothay, Cunsey Beck and Wilfin Beck:

- Average **64% reduction** on the River Rothay below Ambleside WwTW's storm overflow pipe.
- Average **76% reduction** on Cunsey Beck below Near Sawrey WwTW.
- Average **75% reduction** on Wilfin Beck below Far Sawrey WwTW.

The number of invertebrates below United Utilities' assets on these rivers were found to be **as low as two individuals** compared with hundreds upstream of the works.

The first year of Windermere results are very concerning and provide solid evidence for WildFish and Save Windermere to continue lobbying United Utilities and the Environment Agency (EA) to ensure urgent action is taken to stop sewage, treated and untreated, degrading the Windermere catchment.

Photo: Sewage discharge pipe on Cunsey Beck.



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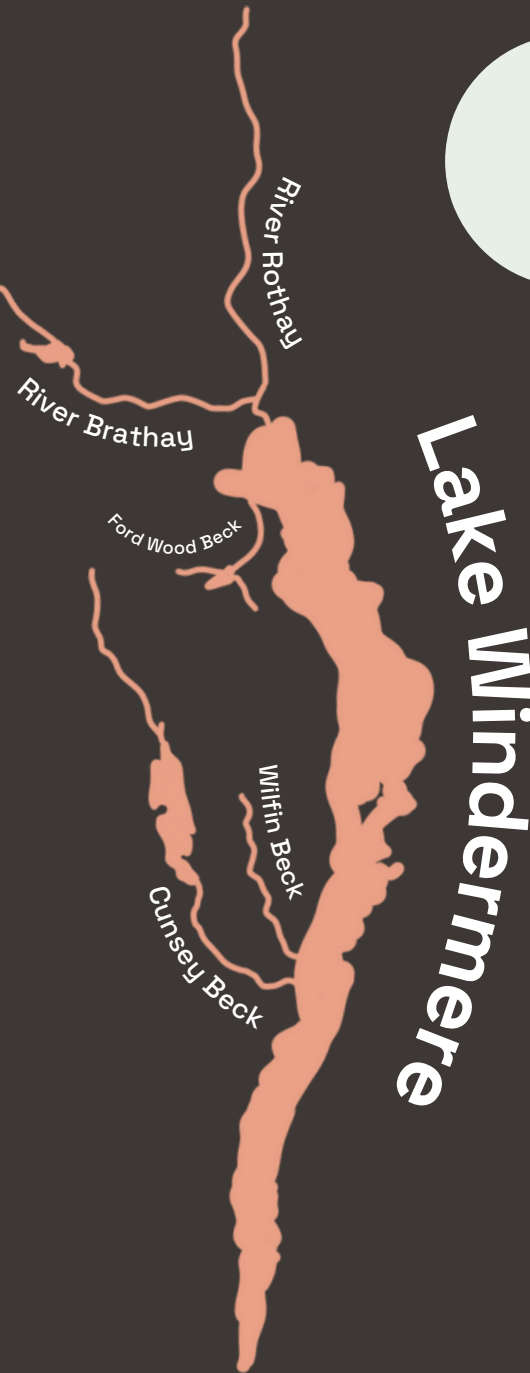
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The Lake

Lake Windermere is the **largest natural lake in England** having been formed by glaciers over 13,000 years ago. The waterbody is located in the Lake District in the north-west of England.

Each year the Windermere catchment welcomes millions of visitors who come to marvel at its natural beauty, in 2019 this amounted to **12 million visitor days**.^[1] With the number of permanent residents less than 20,000, the catchment's wastewater infrastructure has to cope with severe fluctuations in population pressure. The Windermere catchment is vital to the regional economy generating hundreds of millions of pounds annually. In 2019, the catchment's total revenue amounted to £750 million.^[2]

The Windermere catchment is an area of national ecological importance as it is home to Atlantic salmon, sea trout, Arctic charr, freshwater pearl mussel, sea lamprey, European eel and otter. Many of these species are facing considerable declines. For example, sea trout numbers on the River Leven, which flows from Lake Windermere to the sea, **plummeted by over 98%** from 1980 to 2021 (Holker Estate Fisheries Catch Report 2022). Furthermore, the Arctic charr is now believed to be extinct in Windermere's southern basin.^[3]



Since 2020, United Utilities' assets have **discharged untreated sewage** into the Windermere catchment for **over 18,000 hours**⁵

The problem

Sewage, both treated and untreated, poses arguably the greatest threat to the health of Lake Windermere and the wildlife that it supports.

This problem appears most visibly when algal blooms erupt across the lake – this phenomenon is triggered in part by excess phosphorus input. United Utilities manages the wastewater into the catchment and has admitted to being the largest contributor of phosphorus loading into the catchment.^[4]

Since 2020, United Utilities' assets have discharged untreated sewage into the Windermere catchment for over 18,000 hours.^[5]

Untreated sewage can contain a toxic mix of human waste, pharmaceuticals, industrial chemicals and microplastics. Untreated sewage also adds large quantities of nutrients into receiving waters, which can increase the demand for oxygen, placing a burden on freshwater ecology. Data analysis by Windrush Against Sewage Pollution (WASP) identified that several of United Utilities' works, in the Windermere catchment, discharge untreated sewage illegally.^[6]

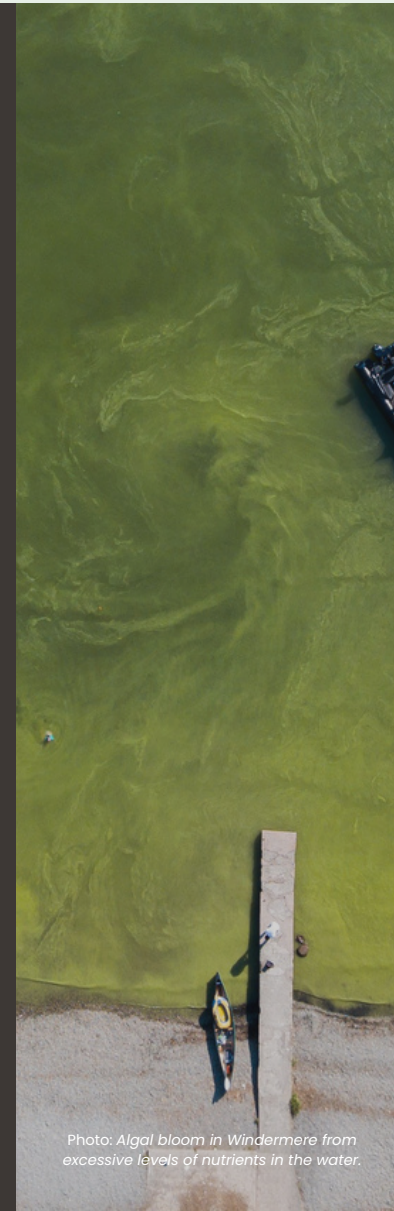


Photo: Algal bloom in Windermere from excessive levels of nutrients in the water.

SmartRivers

Monitoring to save Windermere

SmartRivers is an invertebrate monitoring programme run by WildFish.

SmartRivers offers the highest tier of monitoring through the collection and microscopic identification of river invertebrates. The current total number of rivers covered by SmartRivers since its launch in 2019 is 92.

A SmartRivers 'hub' is made up of citizen scientists trained to near-professional standards who collect invertebrate data twice a year. The data is used to assess the health of their local waterbody and pinpoint sources of pollution.

In 2023, Matt Staniek, Director of Save Windermere, founded a SmartRivers Hub in the Windermere catchment. Matt was concerned by the lack of independent monitoring being conducted in the catchment downstream of United Utilities' assets, therefore the Hub's sample sites are primarily selected to assess the impact United Utilities is having on the rivers that flow into the lake (Fig.1).

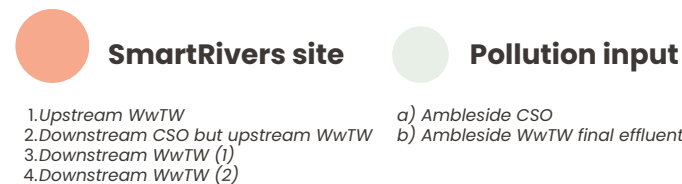
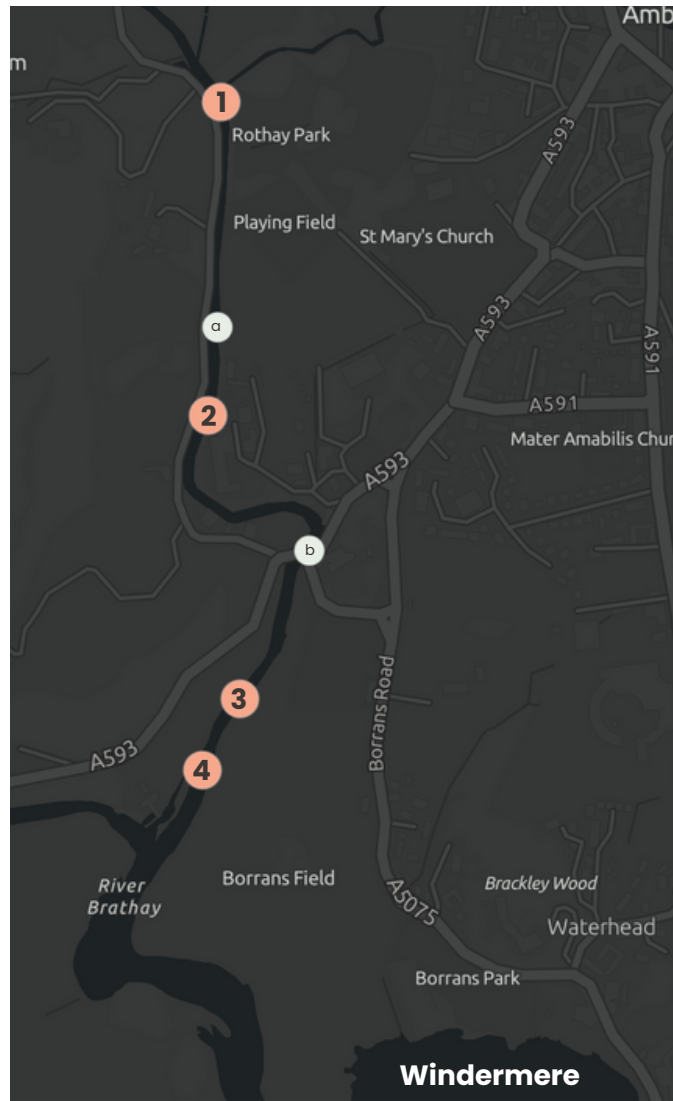


Fig. 1: Locations of SmartRivers sample sites on the River Rothay and main pollution inputs.

From sample to score...

Collect invertebrate sample

Pick out species and quantities from sample

Look up species and abundances against tolerance tables

Calculate water quality stress score

How does the data work?

The invertebrates collected for SmartRivers include river insects, leeches and molluscs.

Invertebrate communities are a key component of a river's food web. So, if we see a drop in invertebrates, it is likely we'll also observe a reduction in more charismatic species such as salmon, otters and kingfishers.

Invertebrates are collected from a river using the industry standard three-minute kick sweep sample. The invertebrates are then identified to species level, where possible, under a microscope.

Invertebrates are present in rivers for months, or even years. As they will be exposed to pressures over this period, they provide an indication of a river's health over time.

Individual species have varying tolerances to certain pressures. Therefore, the impact of organic pollution, nutrient enrichment, sediment, chemicals and flow stress on a river can be assessed by the presence of species found in a sample.

River Rothay

The town of Ambleside is a visitor hotspot with many following the River Rothay north to Grasmere for day excursions.

Though Ambleside WwTW is the second largest works in the catchment, it still has insufficient capacity to handle seasonal population spikes and has been found to operate illegally as a result.

There is a marked visual difference above and below the treatment works with prolific algal growth covering the riverbed downstream of the work in the summer months (Staniek documented with video evidence, 2022).

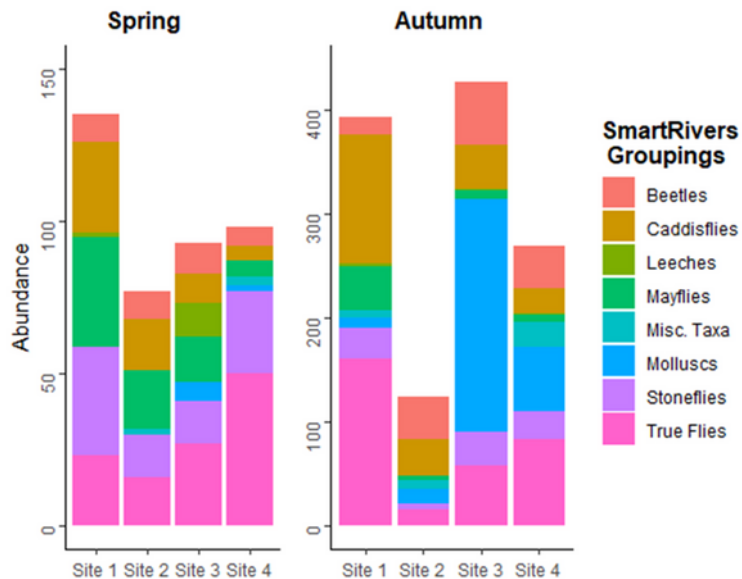


Fig 2. Proportions of invertebrate groups at the River Rothay SmartRivers sites in spring and autumn 2023.

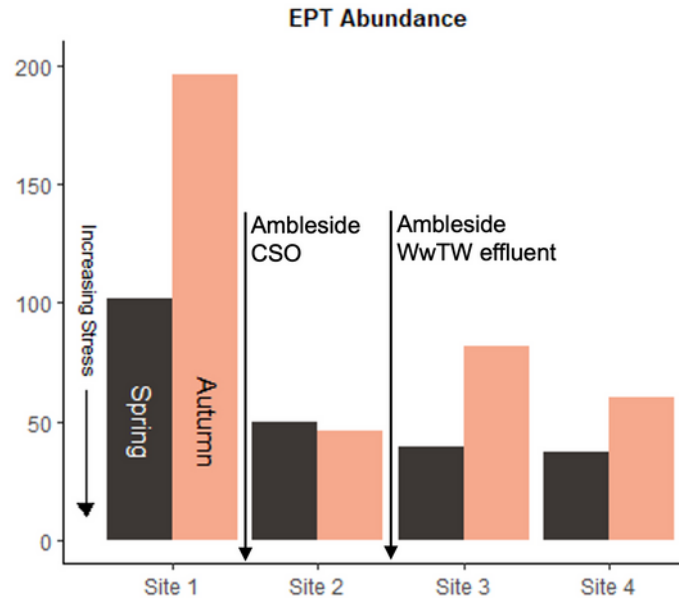


Fig 3. Abundance of Ephemeroptera, Plecoptera and Trichoptera (EPT) riverfly species at the River Rothay SmartRivers sites in spring and autumn 2023.

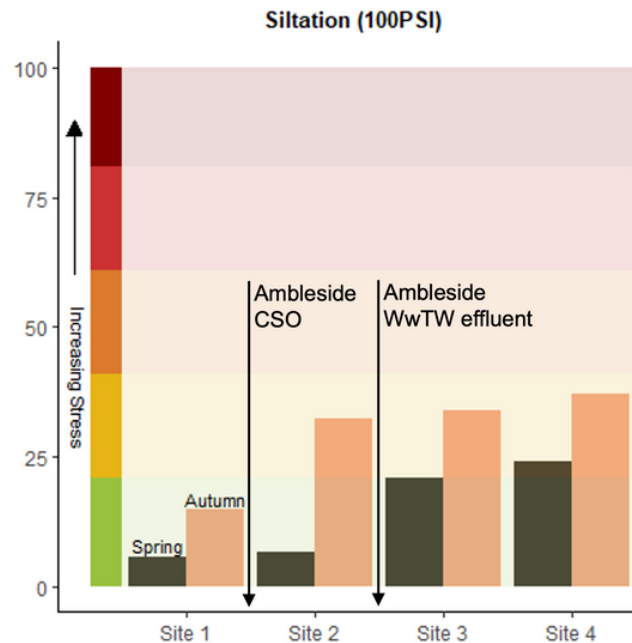


Fig 4. Sediment stress exhibited by the invertebrate communities at the River Rothay SmartRivers sites in spring and autumn 2023.

Nearly **2 million litres** of treated sewage can be discharged from Ambleside WwTW every day⁷

What is the data telling us?

Site 1, which is upstream from Ambleside wastewater discharges, had the highest abundances of pollution sensitive riverflies in spring and autumn (Fig.3).

In spring, Site 1 also had the highest overall abundance (Fig.3). In autumn, the overall abundance at Site 3 was highest due to a large population (49% of the sample) of invasive, pollution tolerant, snails (Fig.2).

Over both seasons, Site 2, which is directly below Ambleside WwTW's storm overflow, had the lowest total abundance and low abundance of pollution sensitive species, particularly in autumn (Fig.2&3).

The results indicate that Ambleside CSO is active and having an adverse impact on the health of the Rothay. The Rothay is one of the biggest rivers in the catchment and flows directly into Lake Windermere.

Sediment pressure is highest at the sites downstream of Ambleside WwTW's treated sewage pipe (Fig.4).

Cunsey Beck

Though designated as a Site of Special Scientific Interest (SSSI), sections of Cunsey Beck appear uninhabitable – particularly downstream of Near Sawrey WwTW where sewage fungus coats the riverbed (photo taken immediately downstream of Near Sawrey WwTW). This works has operated outside of its permit for a number of years according to WASP's investigation[8].

Near Sawrey WwTW is one of four assets owned by United Utilities that discharges directly or indirectly into Cunsey Beck. The emergency overflow at one of these assets is currently unmonitored meaning neither United Utilities nor the EA know how often untreated sewage is flowing into Cunsey Beck[9].

Concerningly, there is no limit on phosphorous input into Cunsey Beck from Near Sawrey WwTW (Near Sawrey Environmental Permit issued in 2018).

On the 21st June 2022, there was a mass fish kill on the river following a pollution incident.

WildFish and Save Windermere have since worked closely to shine a spotlight on the EA's reaction and subsequent handling of the incident. The EA investigation into the Category 1 incident attributed the fish kill to an algal bloom. A subsequent WildFish (Environmental Information Regulation 2004) request uncovered a series of errors and inadequacies in the EA's handling of the investigation. These findings have since been exposed nationally in BBC Panorama's episode 'The water pollution cover-up'.



Photo: Riverbed covered in algae from excess nutrients, which can come from sewage discharges.

76% decline in riverfly abundance* below Near Sawrey WwTW compared with directly above

*riverfly abundance for sites averaged between spring and autumn

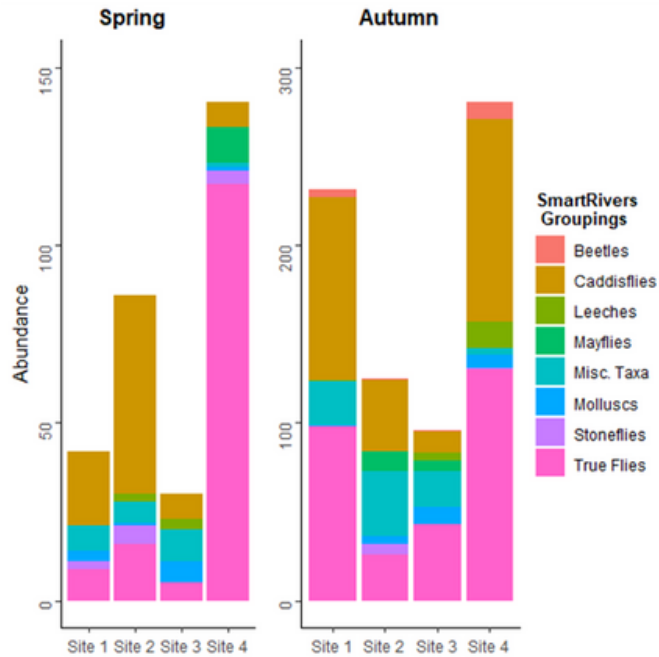


Fig 5. Proportions of invertebrate groups at the Cunsey Beck SmartRivers sites in spring and autumn 2023.

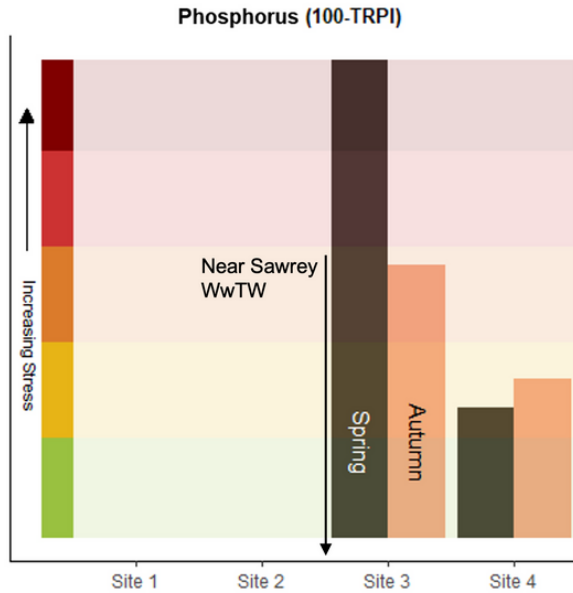


Fig 6. Phosphorus stress exhibited by the invertebrate communities at the Cunsey Beck SmartRivers sites in spring and autumn 2023.

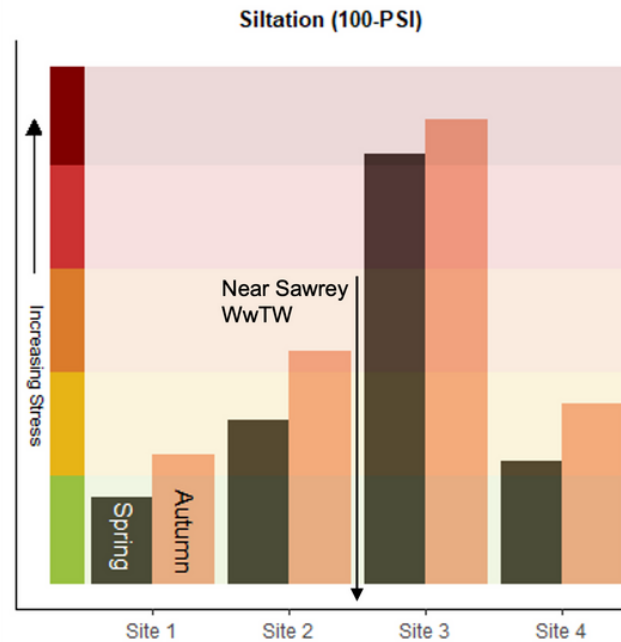


Fig 7. Sediment stress exhibited by the invertebrate communities at the Cunsey Beck SmartRivers sites in spring and autumn 2023.

What is the data telling us?

For all sites, invertebrate numbers were low (Fig.5). In both spring and autumn, site 3 (the site located directly below Near Sawrey WwTW) had the lowest numbers of pollution sensitive riverfly species and the lowest total number of invertebrates (Fig.5).

There was substantial siltation pressure, across both sample seasons, at site 3 (Fig.7). Sediment build-up alters the composition of the river's substrate making it uninhabitable for invertebrates, by destroying refugia and impacting on their ability to forage or find shelter. Increased siltation can also cause physical damage through abrasion and gill clogging. Siltation pressure significantly declines by site 4, which is reflected in the increased presence of siltation sensitive caddisfly species at the site (Fig.5&7).

In addition to sediment stress, SmartRivers data indicated a variety of increasing pressures, including a strong signal of phosphate impact at site 3 and a gradual build-up of organic enrichment as you move downstream (Fig.6). It is likely due to these pressures we are seeing unfavourable impacts on the invertebrate communities. For example, 84% of the invertebrates at site 4 in the spring survey were pollution tolerant blackfly (true flies).

Near Sawrey WwTW is having a negative impact on Cunsey Beck's ecology with an average 76% decline in riverfly abundance directly below the works compared with directly above. Both SmartRivers and EA monitoring have found the river to be in poor ecological health[10]. We fear without urgent intervention from the EA and United Utilities, the condition of this SSSI will further deteriorate.

Wilfin Beck

An archetypal Lake District beck which remains mostly hidden from sight but is nonetheless impacted by Windermere's seasonal tourist population.

Below the local treatment works, Far Sawrey WwTW, Save Windermere has documented an ongoing presence of sewage fungus.[1].

The permit for Far Sawrey WwTW was issued over 30 years ago and contains no numerical limits. Instead, it includes worded restrictions that ensure the works is operated (as far as is reasonably practicable) to prevent treated effluent from having any adverse environmental impacts (Far Sawrey Environmental Permit issued in 1989).



61% less invertebrate species were found below Far Sawrey WwTW compared with above in autumn 2022



Photo: Sewage fungus in the river, a sign of sewage pollution.

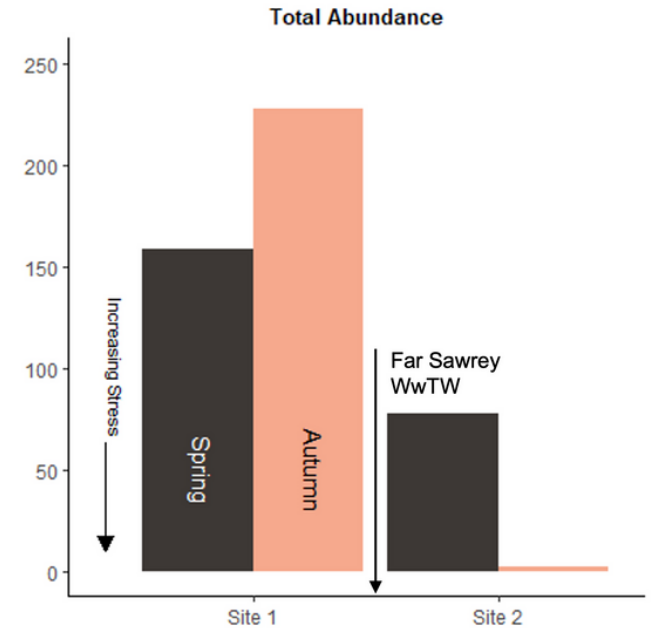
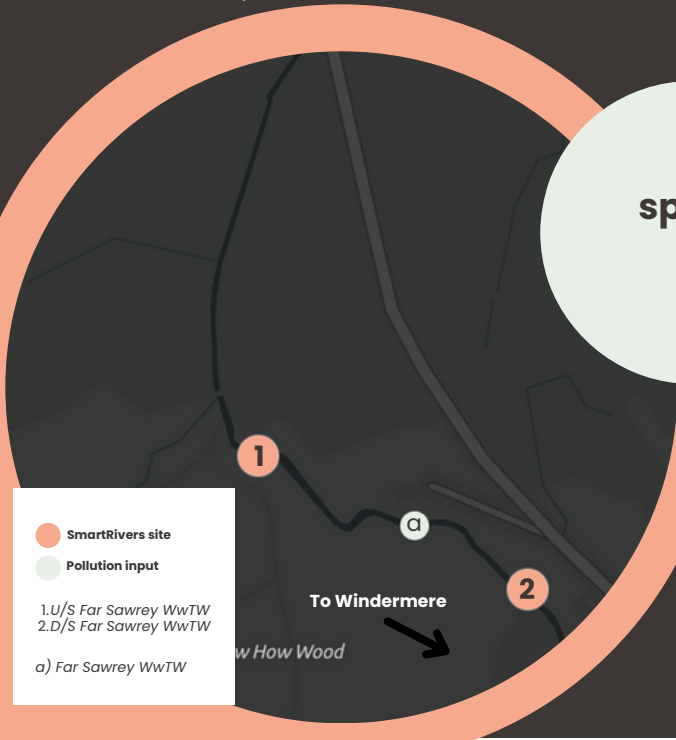


Fig 8. Invertebrate abundance at the Wilfin Beck SmartRivers sites, upstream and downstream of Far Sawrey WwTW, in spring and autumn 2023.

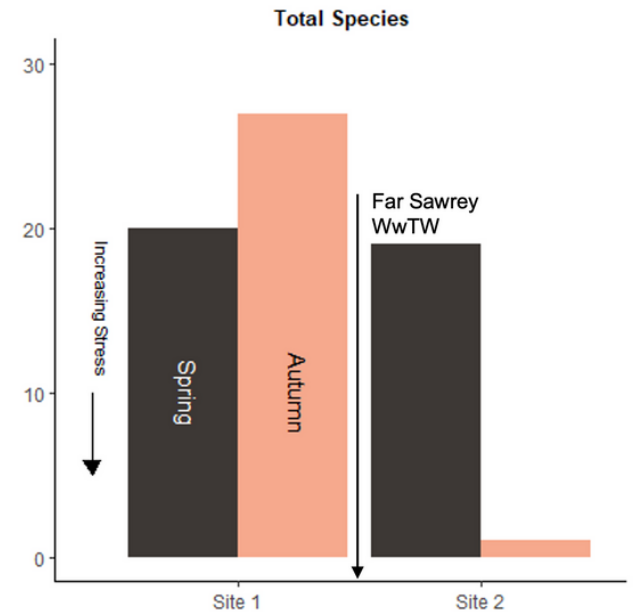


Fig 9. Invertebrate species diversity at the Wilfin Beck SmartRivers sites, upstream and downstream of Far Sawrey WwTW, in spring and autumn 2023.

What is the data telling us?

SmartRivers data on Wilfin Beck continues to concern both WildFish and Save Windermere. In autumn 2022, a 61% reduction in invertebrate species was found below Far Sawrey WwTW compared with above. This stark reduction prompted WildFish to write to the EA requesting that the EA review the existing licence which was issued in 1989 and investigate whether the works was in breach.

Autumn 2023 results indicate that the condition of the beck, downstream of Far Sawrey, has worsened with only two leeches of the same species found downstream of the works. When compared with the 27 species (228 individuals) found at the upstream site, this raises serious concerns (Fig.8&9).

SmartRivers data will again be shared with the EA as there is mounting evidence that Far Sawrey WwTW is having an adverse environmental impact on Wilfin Beck.

Table 1 & 2. Comparison between EA data and SmartRivers data taken from similar sample sites above and below Far Sawrey WwTW in 2023.

EA Data					
SmartRivers Group	Level	Taxon	Upstream Site	Downstream Site	% Change
Beetles	NA	NA	0	0	-
Caddisflies	Family	Odontoceridae	2	2	-
Caddisflies	Family	Philopotamidae	50	15	-42%
Caddisflies	Family	Hydropsychidae	10	20	-
Caddisflies	Family	Limnephilidae	3	1	-
Leeches	NA	NA	0	0	-
Mayflies	Family	Erbopdelidae	5	8	-
Mayflies	Species	Rhithrogena semicolorata	5	3	-23%
Mayflies	Genus	Ecdyonurus	10	10	-
Mayflies	Family	Baetidae	40	25	-
Misc. Taxa	Family	Gammaridae	20	25	-
Misc. Taxa	Family	Planariidae	8	7	-
Misc. Taxa	Family	Asellidae	1	1	0%
Misc. Taxa	Suborder	Zygoptera	0	1	-
Molluscs	Subfamily	Ancylidae	15	10	-33%
Stoneflies	Family	Taeniopterygidae	2	5	-
Stoneflies	Genus	Leuctra	15	22	+93%
Stoneflies	Family	Perlodidae	10	26	-
Stoneflies	Genus	Protonemura	2	3	-
True flies	Family	Tipulidae	1	0	-23%
True flies	Family	Simuliidae	12	10	-
Riverfly Abundance			154	140	-9%
Total Invertebrate Abundance			211	194	-8%

SmartRivers Data					
SmartRivers Group	Level	Taxon	Upstream Site	Downstream Site	% Change
Beetles	Genus	Hydraena	4	5	+29%
Beetles	Species	Limnius volckmari	3	3	-
Caddisflies	Species	Agapetus delicatulus	3	1	-
Caddisflies	Species	Halesus radiatus	12	0	-
Caddisflies	Species	Hydropsyche siltalai	23	27	-
Caddisflies	Species	Philopotamus montanus	22	0	-52%
Caddisflies	Species	Plectrocnemia conspersa	1	0	-
Caddisflies	Species	Potamophylax cingulatus	2	0	-
Caddisflies	Species	Rhyacophila dorsalis	0	2	-
Leeches	Species	Erbopdella octoculata	0	1	+100%
Mayflies	Species	Baetis muticus	9	2	-
Mayflies	Species	Baetis rhodani/atlancticus	17	5	-82%
Mayflies	Genus	Rhithrogena	19	1	-
Misc. Taxa	Species	Asellus aquaticus	1	0	-
Misc. Taxa	Species	Gammarus pulex/fossarum	19	0	-95%
Misc. Taxa	Species	Haploutaxis gordioides	0	1	-
Misc. Taxa	Group	Hydracarina	1	0	-
Molluscs	Species	Ancylus fluviatilis	0	1	+100%
Stoneflies	Species	Amphinemura sulcipectus	0	2	-
Stoneflies	Species	Leuctra inermis	10	0	-
Stoneflies	Species	Isoperla grammatica	0	4	+100%
Stoneflies	Species	Siphonoperla torrentium	1	17	-
True Flies	Genus	Hemerodromia	2	1	-
True Flies	Genus	Lispe	0	1	-
True Flies	Subfamily	Orthocladinae	8	1	-50%
True Flies	Genus	Simulium	1	1	-
True Flies	Subfamily	Tanytopodinae	1	2	-
Riverfly Abundance			119	61	-49%
Total Invertebrate Abundance			159	78	-51%

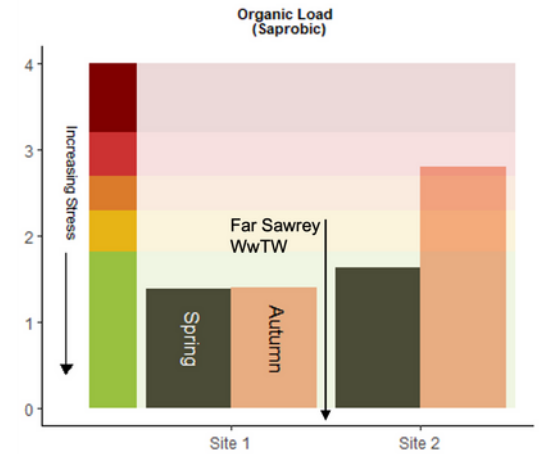


Fig 10. Organic stress exhibited by the invertebrate communities at the SmartRivers sites upstream and downstream of Far Sawrey WwTW in spring and autumn 2023.

Tables 1 and 2 show a comparison between EA data and SmartRivers data taken from similar sample sites above and below Far Sawrey WwTW in 2023.

Both sets of data identified a reduction in species abundance downstream of the works. That said, the EA did not consider the variance significant enough to open an investigation into the works[12].

By failing to identify to species level, the EA is unable to capture the detail required to accurately assess the health of the beck.

For example, the EA have identified one group of mayflies down to family level (Baetidae). In this family *B. rhodani* is more tolerant of organic pollution than *B. muticus* (both identified in the SmartRivers survey) (Fig.10). As our autumn data indicates strong organic loading at the downstream site, the EA bankside sampling (resulting in primarily family level data) could be missing key information as to the impacts of this on invertebrate communities.

River Brathay

United Utilities has two assets in the River Brathay sample area. Furthest upstream is Elterwater Pumping Station which discharges into Great Langdale Beck which then flows into Elterwater SSSI. Downstream of Elterwater SSSI is Langdale WwTW which discharges into the River Brathay. There are no inputs above the assets, nor in between, other than arable farming.

The pumping station has spilled untreated sewage for over 1,600 hours since 2020 and is less than 1km away from the Elterwater SSSI.[15]

The impact of this spilling on the condition of the SSSI has not been assessed, but the water quality in the SSSI is unfavourable. Two out of the lake's three basins are in a declining state, this includes the basin that first receives the untreated wastewater. [13],[14].

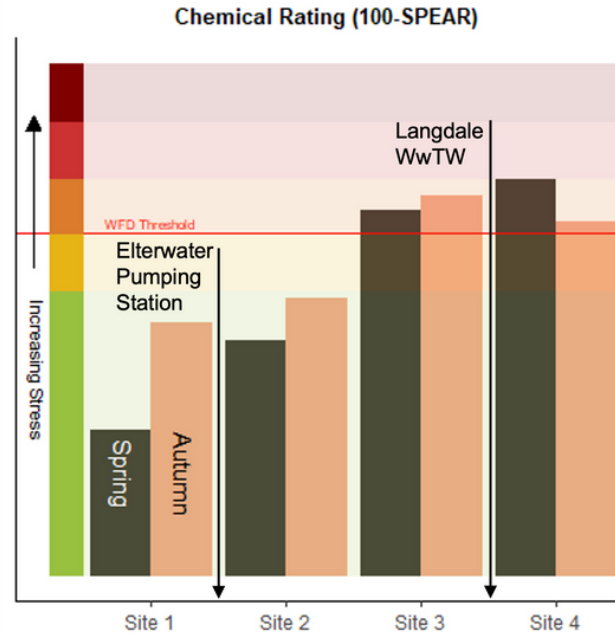


Fig 11. Chemical stress exhibited by the invertebrate communities at the River Brathay SmartRivers sites in spring and autumn 2023.

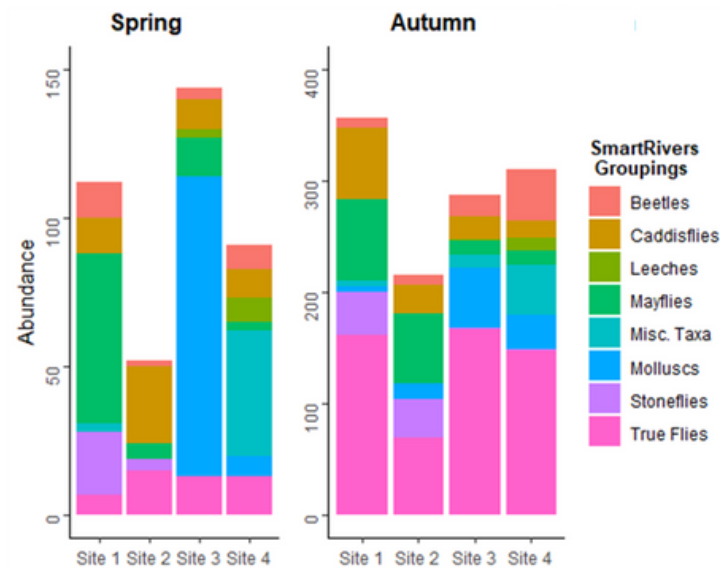


Fig 12. Proportions of invertebrate groups at the River Brathay SmartRivers sites in spring and autumn 2023.

What is the data telling us?

On the River Brathay, there was an 88% reduction, as an average over the two seasons, in the abundance of pollution sensitive riverfly species between sites 1 and 4.

There was also a clear increase in chemical pressure at the furthest downstream sites (Fig.11).

SmartRivers data suggests that United Utilities' two assets are having a negative impact on the health of the Brathay. Langdale WwTW is permitted to discharge 1.1 million litres of sewage per day.

In spring, higher proportions of pollution tolerant species were found. At site 3, nearly 60% of the sample was sediment tolerant fingernail clams. At site 4, at least 71% of the invertebrates were considered pollution tolerant, including species of true flies, mites and worms (the latter two are in the miscellaneous group)(Fig.12).

In autumn, the data was less clear. There was still the reduction in pollution sensitive species discussed above, but higher numbers of true flies (primarily blackfly and non-biting midges) across the sites. This may be linked to lower summer flows concentrating pollutants in these areas (Fig.12).

Ford Wood Beck

Outgate WwTW discharges into Ford Wood Beck which then flows into Blelham Tarn SSSI. The EA's permit for Outgate WwTW is new but sets a phosphorous limit of 2mg/l, which is eight times higher than at Windermere WwTW.

This is concerning given Blelham Tarn SSSI is in a declining state due to phosphorus pollution.[16].

Additionally, no ammoniacal limit (AN) limit has been included in the permit. Long-term exposure to AN has been linked to adverse effects on aquatic life.[17].

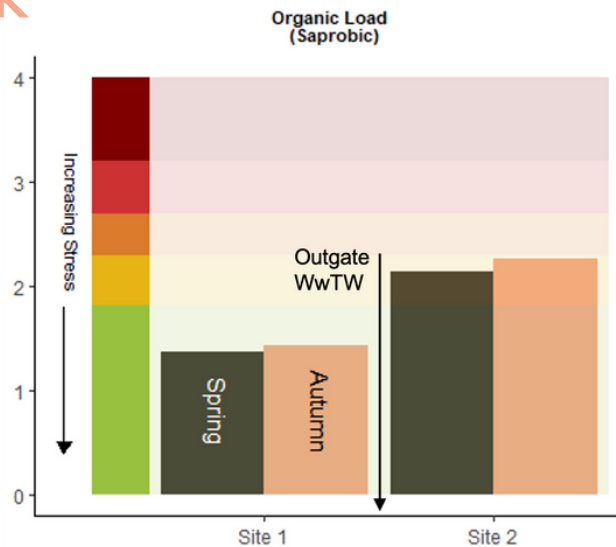


Fig 13. Organic stress exhibited by the invertebrate communities at the SmartRivers sites upstream and downstream of Outgate WwTW in spring and autumn 2023.

Next steps

This report has highlighted the need for continued high quality, independent data collection on rivers in the Windermere catchment.

The next round of SmartRivers sampling will commence in Spring 2024. The hub's objective in 2024 is to build on the existing dataset and discuss and share the findings with local stakeholders, including the Environment Agency.



What is the data telling us?

On Ford Wood Beck, there was a significant increase in saprobic stress at the site downstream of Outgate WwTW compared with the upstream site (Fig.13).

These findings support Save Windermere's eye-witness accounts of sewage fungus building-up in the beck below Outgate.

SmartRivers data is all open access

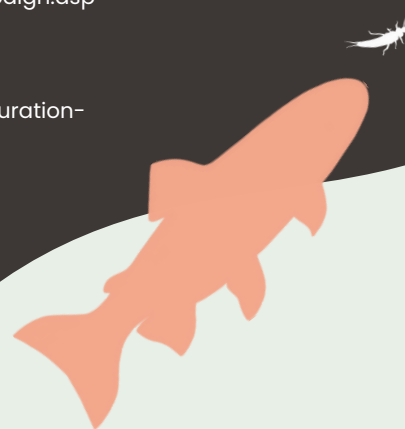
For access to the SmartRivers database and all the data used in this report please contact:

smartrivers@wildfish.org

Photo: Visual evidence of sewage pollution in the water column.

References

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- [2] ibid
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- [17] Zhang, L. et al. (2018) 'Ecological risks posed by ammonia nitrogen (AN) and un-ionized ammonia (NH₃) in seven major river systems of China', Chemosphere, 202, pp. 136–144.



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