Viking Wind Farm

Freshwater diatom survey, February 2025

Report to SSE

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Introduction

This report evaluates the results of diatom sampling in February 2025. Data for the three control lochs contributes to our understanding of the scale of natural variation which will, in turn, assist data interpretation in the future.

Materials and methods

All methods are identical to those used in the baseline report (Kelly 2020). A list of samples included in this survey is given in Table 1 and a guide to trends in diatom metrics is given in Table 2.

Table 1. List of samples analysed during this study. "Type" divides the samples into calcareous, soft or very soft water and sub-divides these into "target" (i.e. likely to be influenced by construction) and "control" lochs.

Sample	Loch	Location	Code	Date	Type (1)	Type (2)
125019	Smerla Water	near northern outflow	SM1L	2/2/2025	Very soft water	Control
125020	Smerla Water	near southern outflow	SM2L	2/2/2025	Very soft water	Control
125007	Gossa Water	SW corner	GO1L	2/2/2025	Soft water	Impact
125008	Gossa Water	near outflow	GO2L	2/2/2025	Soft water	Impact
125009	Lamba Water	potential impact zone	LB1L	2/2/2025	Very soft water	Impact
125010	Lamba Water	near outflow	LB2L	2/2/2025	Very soft water	Impact
125011	Maa Water	near SE inflow	MAA1L	2/2/2025	Very soft water	Impact
125012	Maa Water	near outflow	MAA2L	2/2/2025	Very soft water	Impact
125013	Truggle Water	inflow on E side	TR1L	2/2/2025	Very soft water	Impact
125014	Truggle Water	near outflow	TR2L	2/2/2025	Very soft water	Impact
125021	Laxo Water	inflow area	LA1L	2/2/2025	Soft water	Control
125022	Laxo Water	near outflow	LA2L	2/2/2025	Soft water	Control
125015	Sand Water	west side	SA1L	2/2/2025	Calcareous	Impact
125016	Sand Water	near inflow	SA2L	2/2/2025	Calcareous	Impact
125017	Sand Water	east side	SA3L	2/2/2025	Calcareous	Impact
125018	Sand Water	near outflow	SA5L	2/2/2025	Calcareous	Impact
125023	Petta Water	north end	PE1L	2/2/2025	Calcareous	Impact
125024	Petta Water	near outflow	PE2L	2/2/2025	Calcareous	Impact
125025	Loch of Skellister	NW shore	SK1L	2/2/2025	Soft water	Impact
125026	Loch of Skellister	near outflow	SK2L	2/2/2025	Soft water	Impact
125027	Loch of Benston	south side	BE1L	2/2/2025	Calcareous	Control
125028	Loch of Benston	near outflow	BE2L	2/2/2025	Calcareous	Control

Table 2. Interpretation of trends in diatom metrics

Fig.	Explanation	Comment
a.	LTDI2 – indicates impact of nutrients on biota.	High values = bad
b.	DAM – indicates impact of acidification.	Low values = bad.
c.	Ntaxa = number of taxa.	A very basic measure of diversity. Values could drop due to loss of species but could, conceivably, increase if there were localised changes allowing different species to thrive. Although nominally "two-tailed", in practice, reductions in diversity are more likely to indicate a problem than increases
d.	Motile	Percent of diatom valves which belong to motile taxa – these would have a competitive advantage in situations where light or other resources are limiting, because they can adjust their position within the biofilm.
e.	EpiRho (only for calcareous lochs)	Proportion of diatoms capable of nitrogen fixation (members of the genera *Epithemia* and *Rhopalodia*). Indicates increased N stress (which could occur in response to P enrichment as well as to absence of sufficient N). These genera would disappear if N supply increased so this is a two-tailed test. Lower limit defined as 0.

Results

General comments

Lochs are reported separately. Values of each parameter are plotted along with "warning" and "action" limits where the former are the 25th and 75th percentiles of data collected during the scoping and baseline studies, and in the period before work in each catchment started, whilst the latter are the minimum and maximum values. Neither of these limits is ideal but it does allow deviations from pre-construction conditions to be followed.

Calcareous lochs

Sand Water

None of the metrics show concerning trends. As in October 2024, DAM remains low, again due to abundant *Tabellaria flocculosa* and *Stauroforma exiguiformis* but strong indicators of acid conditions (e.g. *Eunotia* spp) were not abundant.

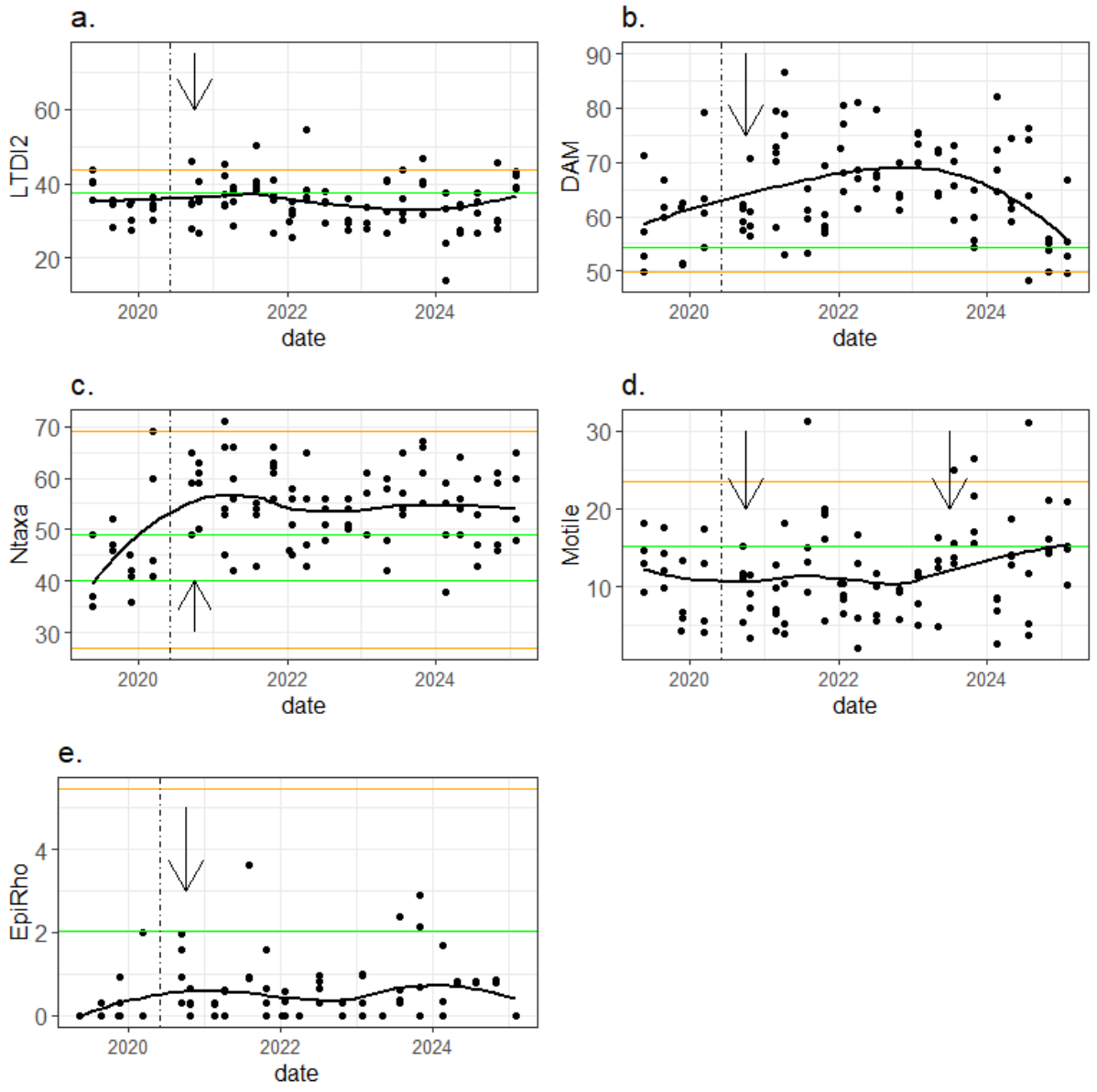

Fig. 1. Variation in diatom metrics over time in Sand Water. Vertical line indicates the approximate start of the construction phase, and the arrows indicates the approximate date of the 2020 incidents and also, for Motile, the date of the incident in July 2023. Green lines indicate warning limits and orange lines indicate action limits.

Petta Water

The two samples from Petta Water showed contrasting trends: PE2L was dominated by *Psammothidium abundans*, leading to higher values of LTDI2 than at PE1L, where *Achnanthidium sieminskae* was the most abundant diatom. *P. abundans* was more prolific in this sample (42.5%) than in any other sample collected during this study (average relative abundance of 326 samples from throughout UK and Ireland: 1.6%, but this is unlikely to reflect changes in nutrient or acidification status of the loch (the elevated TON recorded in February 2025 is unlikely to drive this change as the loch is assumed to be phosphorus limited). The very high value of DAM at PE1L is due to the abundance of *A. sieminskae*, which has a preference for circumneutral conditions. The upward trend in motile valves mentioned in the previous report was not sustained in the present samples. Values of Total Suspended Solids and Turbidity were above baseline in the most recent samples, and could have an effect on diatom assemblages if sustained.

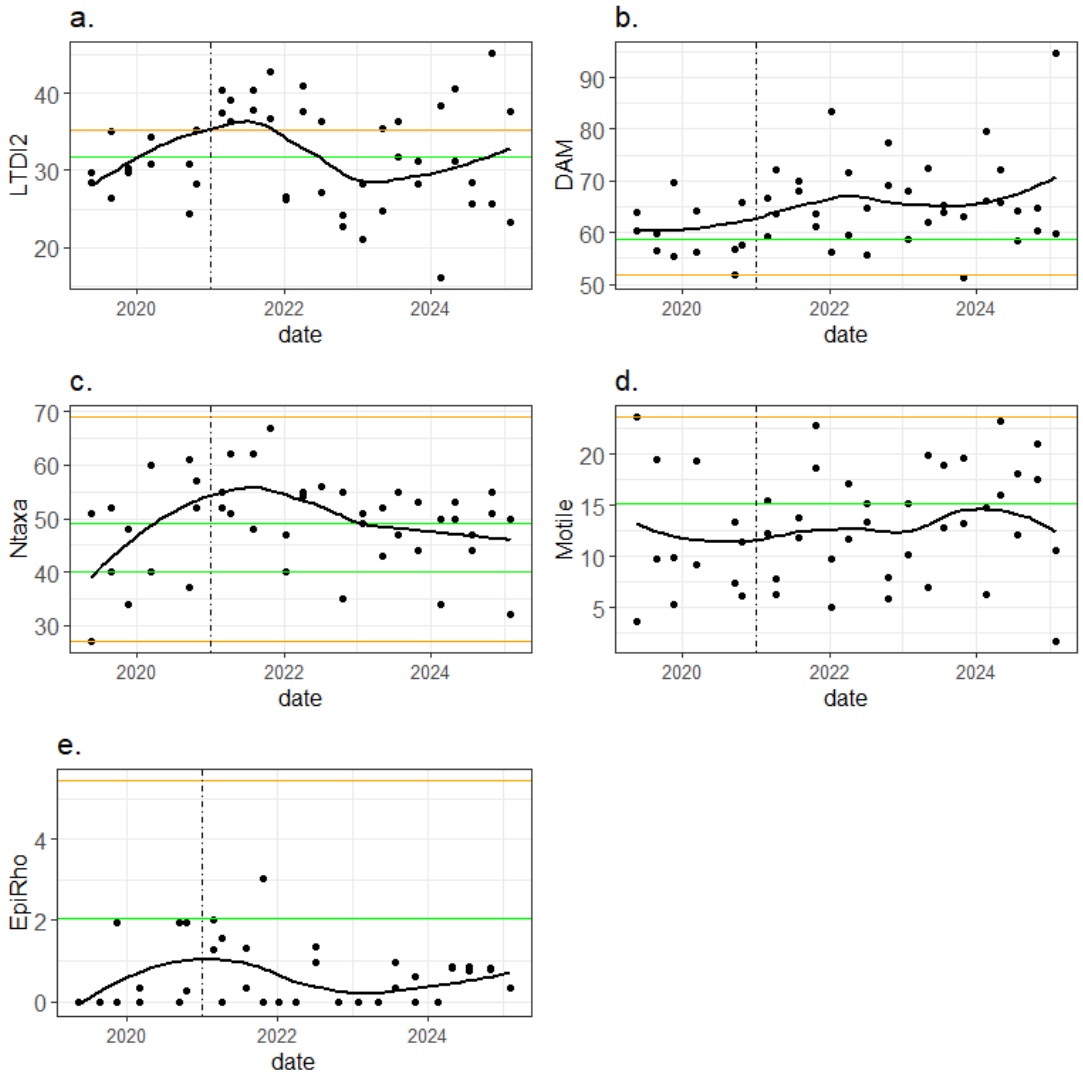

Fig. 2. Variation in diatom metrics over time in Petta Water. Green lines indicate warning limits and orange lines indicate action limits.

Loch of Benston

This is the control loch of the calcareous group although it is different in character to Sand Water and Petta Water, with greater influence of both agricultural runoff and septic tanks generating higher LTDI2 values. Results do not have any direct implications for construction work but will help to disentangle the effect of local (i.e. construction) versus regional drivers if Petta Water or Sand Water show any unexpected changes. The dominance of *Achnanthidium* cf *lineare* (26% of the total) resulted in relatively low diversity (for this site) and low values of motile taxa.

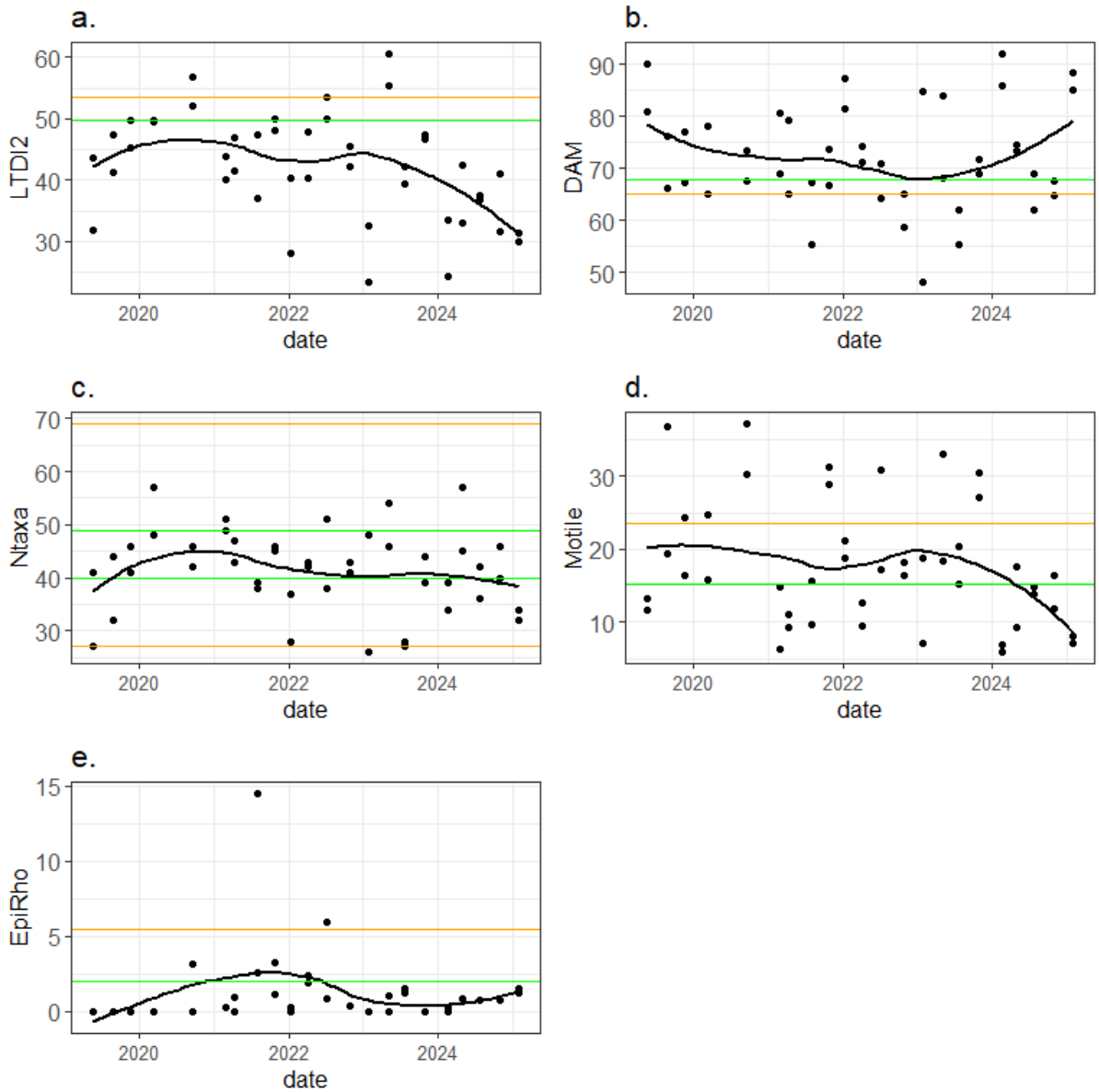

Fig. 3. Variation in diatom metrics over time in Loch of Benston. Green lines indicate warning limits and orange lines indicate action limits.

Very soft water lochs

Lamba Water

LTDI2 and DAM were both within their respective warning limits. One sample (LA2L) had more taxa than is typically observed at this location but, in the absence of signals from the pressure metrics, this is unlikely to signify a change in the condition of the loch.

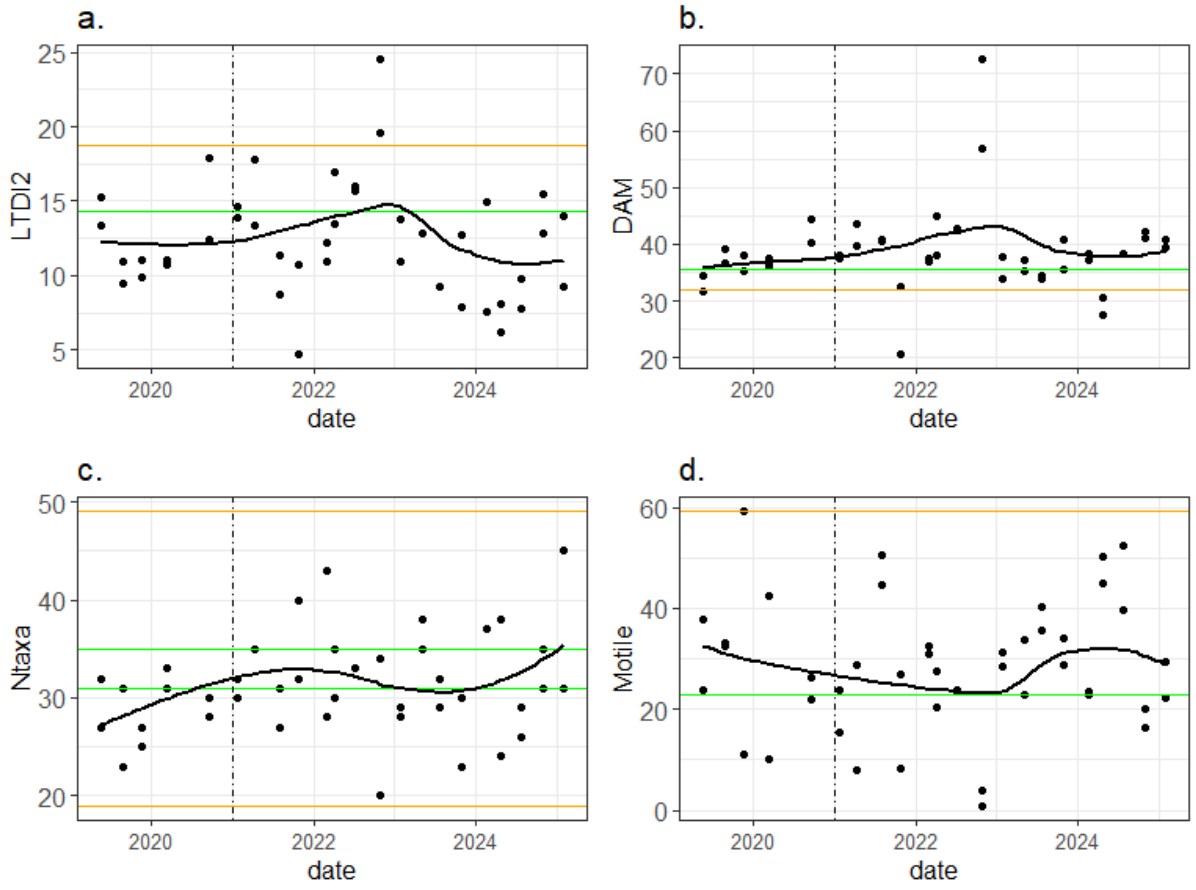

Fig. 5. Variation in diatom metrics over time in Lamba Water. Green lines indicate warning limits and orange lines indicate action limits.

Maa Water

No metrics show concerning trends. LTDI2 shows a consistent decline over the past three years, but always within the warning limits. There is a significant correlation between LTDI2 and DAM ($r = 0.52$; $p < 0.001$) suggesting that causes are linked but it is not clear without further analyses which taxa are driving these trends. The important message, from the point of view of operations is that both trends are in the "right" direction.

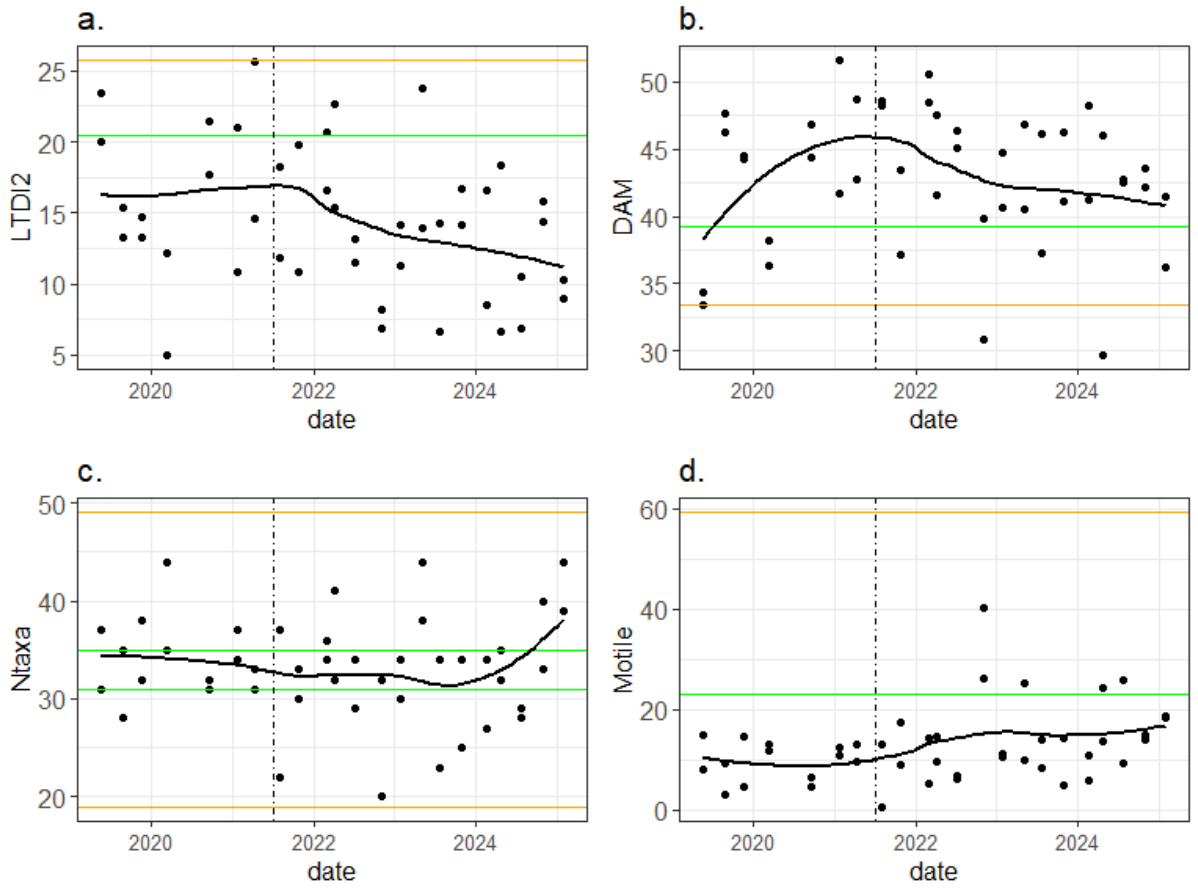

Fig. 6. Variation in diatom metrics over time in Maa Water. Green lines indicate warning limits and orange lines indicate action limits.

Truggles Water

None of the trendlines show any cause for concern.

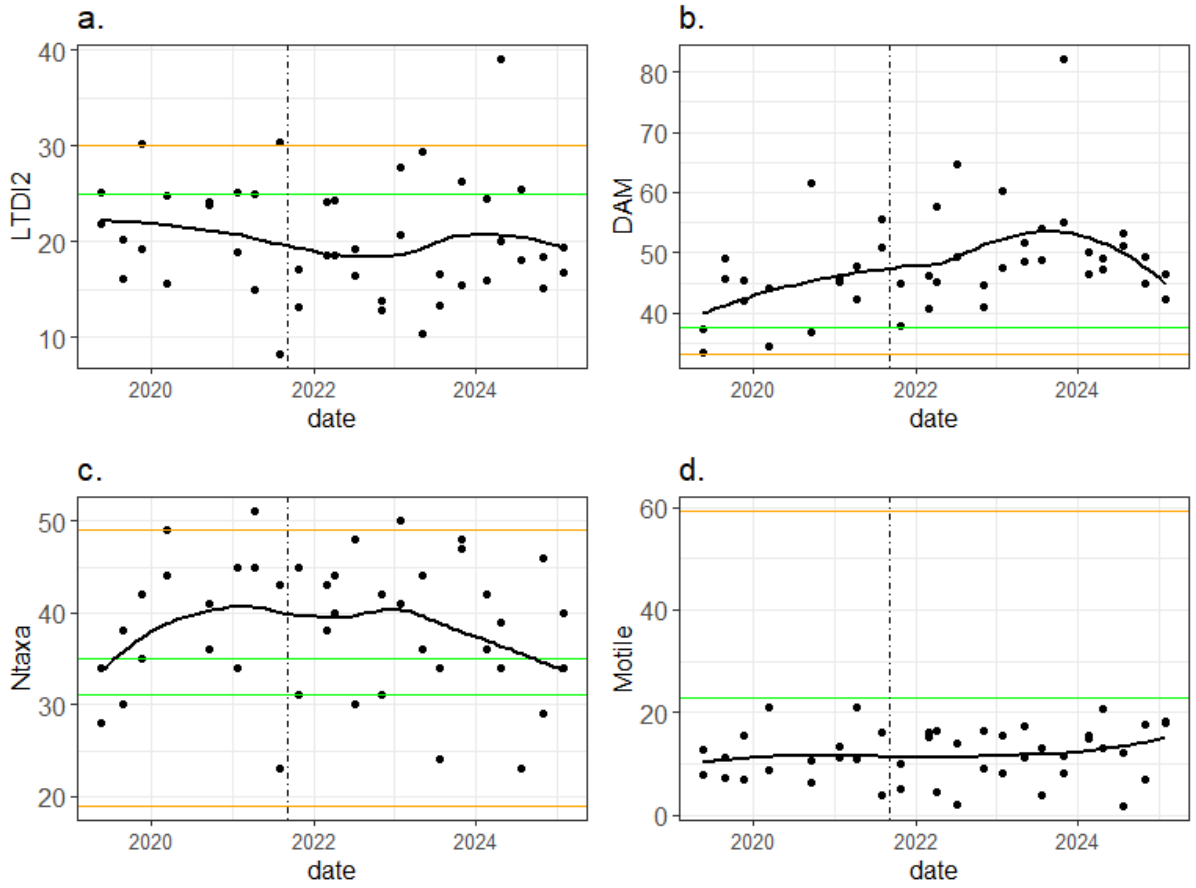

Fig. 7. Variation in diatom metrics over time in Truggles Water. Green lines indicate warning limits and orange lines indicate action limits.

Smerla Water

As Smerla Water is a control loch, warning or action limits have been plotted simply to enable comparisons with the other lochs as construction activities proceed. This loch, well away from any construction activity, shows the scale of variation in metrics that can be expected with minimal human activity in the catchment.

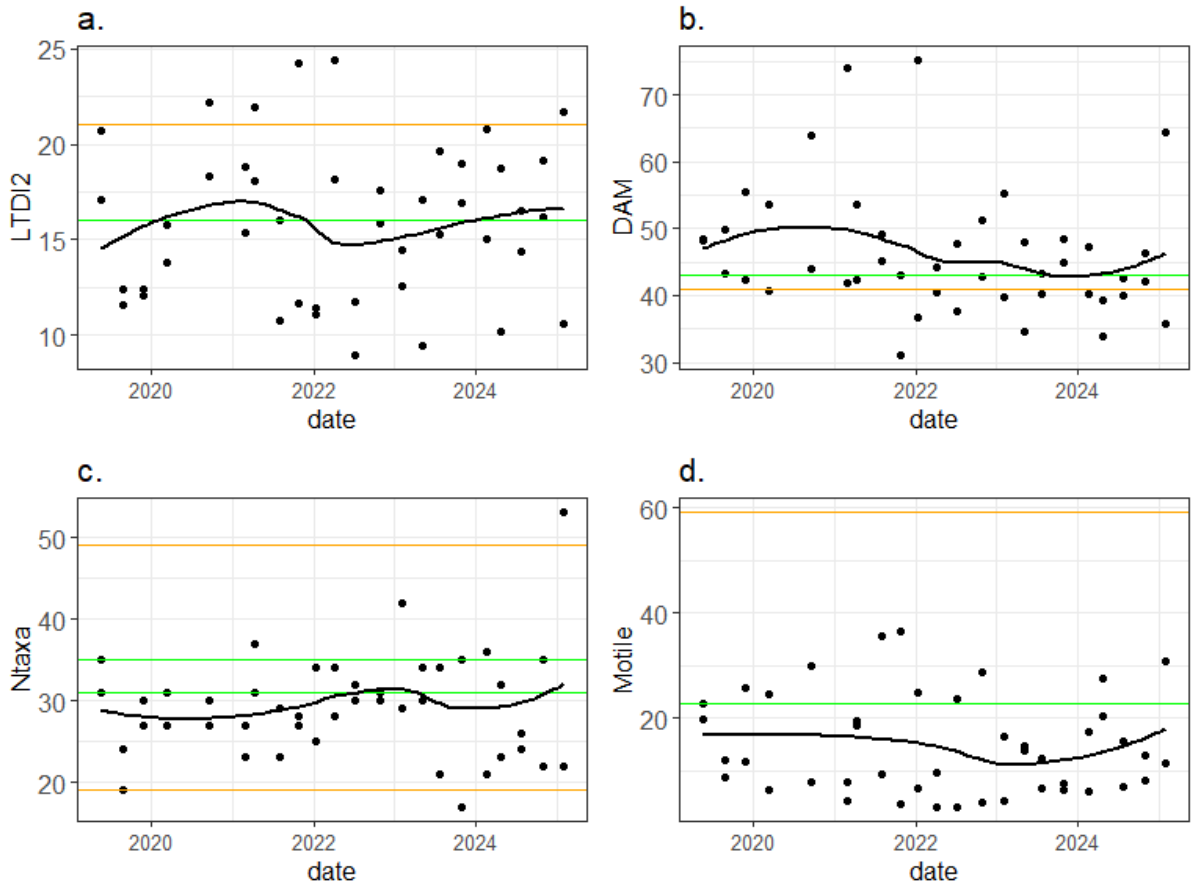

Fig. 8. Variation in diatom metrics over time in Smerla Water. Green lines indicate warning limits and orange lines indicate action limits.

Soft water lochs

Loch of Skellister

Trendlines for all pressure metrics (LTDI2, DAM, motile) along with Ntaxa lie within the warning limits. As at Maa Water, LTDI2 has been declining for the past three years but it is not clear without further analyses which taxa are driving these trends. None of the most recent chemical results suggest a possible causal agent. Again, the important message, from the point of view of operations is that this trend is in the "right" direction.

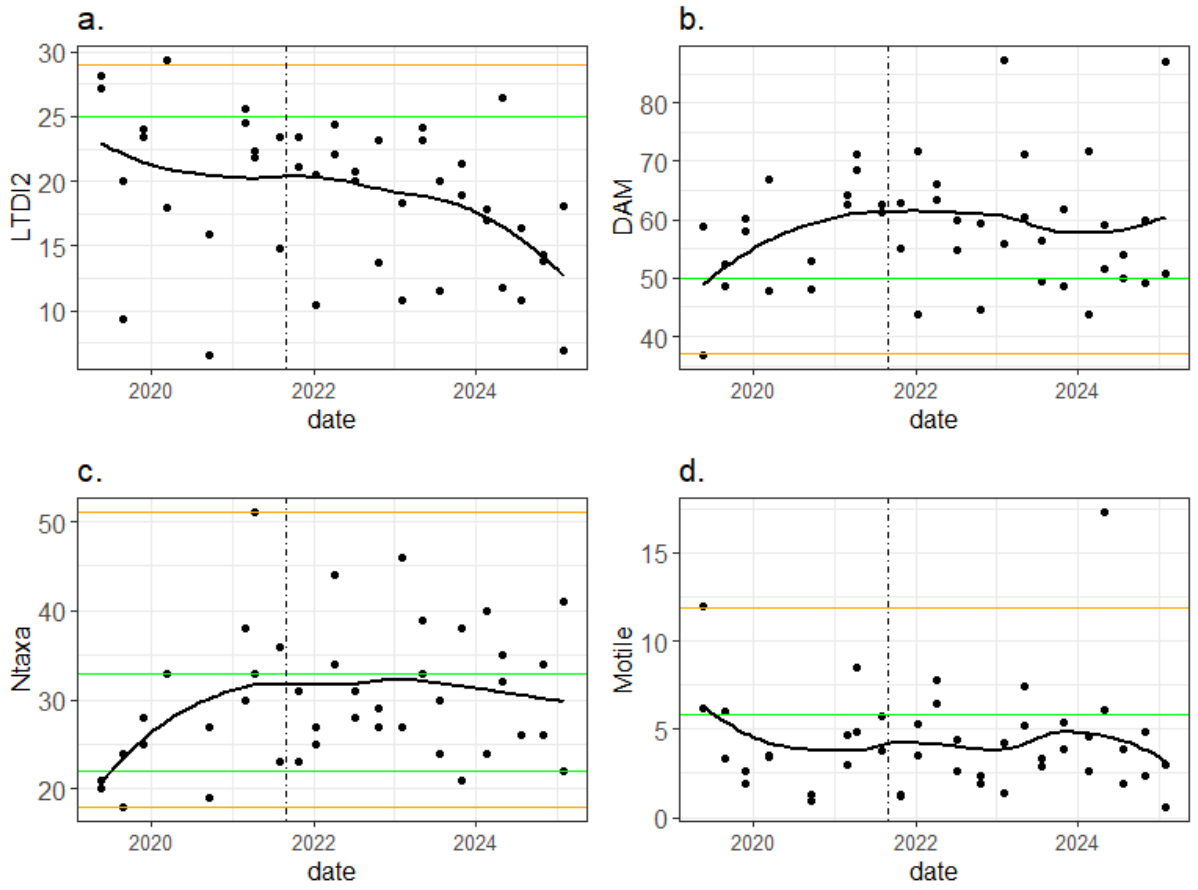

Fig. 10. Variation in diatom metrics over time in Loch of Skellister. Green lines indicate warning limits and orange lines indicate action limits.

Gossa Water

Trendlines for LTDI2, DAM and motile lie within the warning limits although the same trend as observed at Maa Water and Loch of Skellister is apparent here, with a gradually decreasing LTDI2. A single high value of motile was recorded, mostly due to the presence of *Sellaphora verkhovii*. This was at the outflow site, furthest from the zone of any potential impact, so is not likely to be the result of operations.

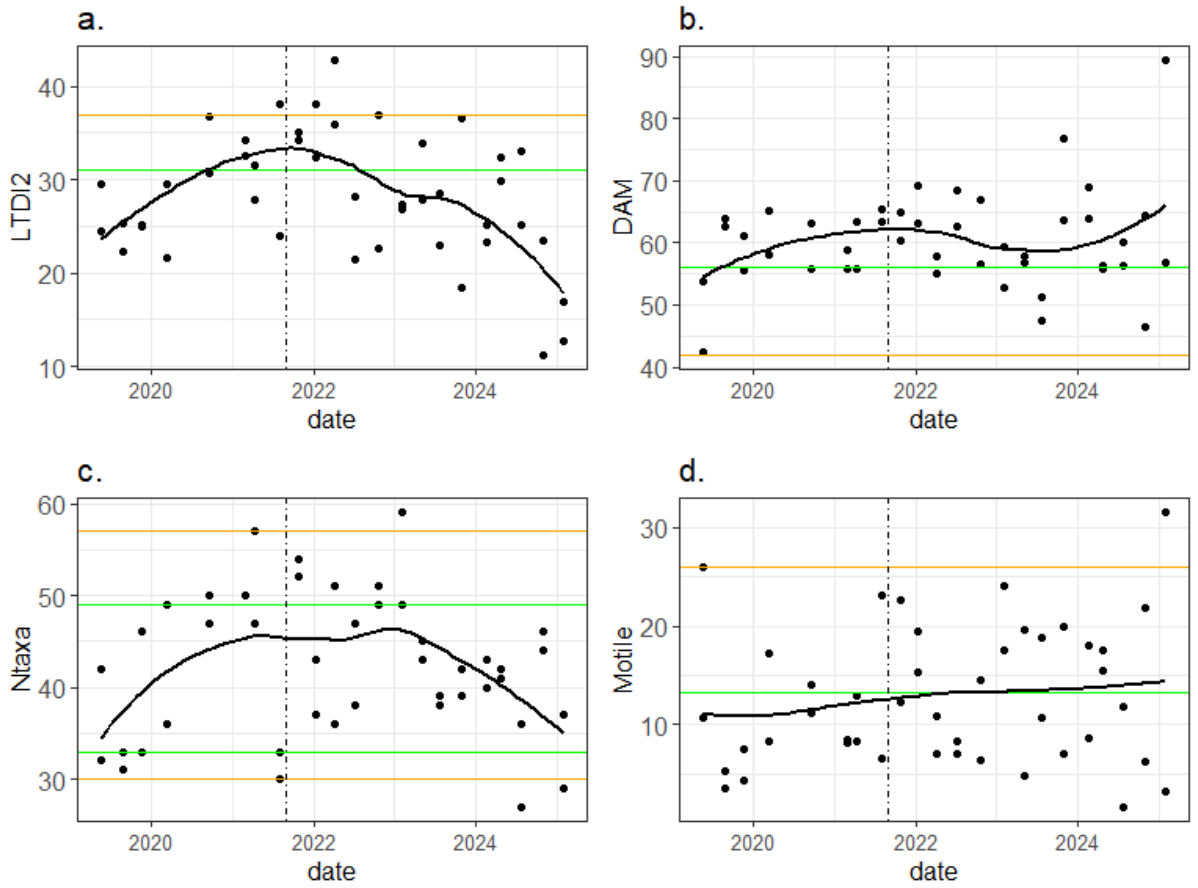

Fig. 11. Variation in diatom metrics over time in Gossa Water. Green lines indicate warning limits and orange lines indicate action limits.

Laxo Water

As is the case for Loch of Benston and Smerla Water, Laxo Water is a control loch and shows the scale of variation in metrics that can be expected with minimal human activity in the catchment. The generally declining values for LTDI2 highlighted in other lochs is also observed here adding, as this is a control loch, more evidence to the theory that this is not connected with operations.

Fig. 12. Variation in diatom metrics over time in Laxo Water. Green lines indicate warning limits and orange lines indicate action limits.

Conclusions and recommendations

No further action is required, based on these data.

References

Kelly, M.G. (2020). Viking wind farm: freshwater diatom baseline survey. Report to SSE, September 2020. Bowburn Consultancy, Durham.