VIKING ENERGY WIND FARM

FRESHWATER INVERTEBRATE MONITORING SPRING 2025

July 2025

Aquaterra Ecology

Waterside Ecology

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Viking Energy Wind Farm:
Freshwater invertebrate monitoring, spring 2025

Contractors: Aquaterra Ecology & Waterside Ecology

Summary

Background

This study was commissioned to assess the water quality and invertebrate communities of a suite of monitoring sites in streams draining the Viking Energy Wind Farm. The key objectives of the monitoring were to:

- Characterise the invertebrate communities of the watercourses;
- Assess of the water quality of the watercourses using a range of biotic indices;
- Compare data at potentially impacted and control sites with pre-construction baselines to determine whether there was any evidence of negative impacts on water quality.

Macro-invertebrate communities were sampled using standard kick sampling methods. Major groups were identified to species level to establish presence of any rarities and to provide data for production of biological indices: BMWP, ASPT, WFD WHPT class, Water Chemistry Status and PSI. Physical environmental variables including bed width, depth, flows and substrate profile were recorded at each site.

Two-season (spring and autumn) baseline data were collected at most sites in 2019. The current report covers sampling conducted across the full wind farm site during spring 2025. Twenty-nine were sampled within or downslope of the wind farm along with six controls. By spring 2025 the site was operational and works were largely limited to cabling along with some remedial work to tracks and compounds.

Main Findings

- Impacts on the streambed and invertebrate fauna remain detectable in Burn of Lunklet (LU1 and LU2). The observed changes are consistent with known changes to water quality. Streambed condition at WE3 in Burn of Weisdale appear to have improved since the 2024 survey and this has been accompanied by some improvements in invertebrate communities.
- Habitats at most other sites were unchanged and without substantial visible siltation or proliferation of filamentous algae.
- There has been a near-ubiquitous decline in invertebrate density compared with the 2019 baseline, but this was seen at all control sites indicating it is a regional phenomenon unrelated to construction or operation of the wind farm.
- Diversity as measured by taxon richness was generally low, consistent with baseline data. The lowest diversities (six taxa present) were at LU2 where Chironomidae (pollution tolerant, non-biting midges) were the dominant taxa and GR1 where the mayfly *Baetis rhodani* made up a high proportion of the sample.
- The mean proportion of EPT at the impact monitoring sites was 64.7%, ranging from 1.8% at LU1 to 87.9% at GI1. Five impact sites (FL1, QU1, LM1, LU1, LU2 and WE3) failed to reach 50% EPT but all routine monitoring sites outside Burn of Lunklet scored >25%. There was no overall decline in EPT compared with baseline.
- Mean ASPT at impact monitoring sites was 5.2 (range 4.0 to 5.69) with lowest score at LU2 and the highest at WE1 in Burn of Weisdale. At control sites the mean ASPT was 5.0 (range 4.50 to 5.46). There was no statistically significant difference ASPT between impact monitoring and control sites and no overall decline compared with baseline.
- There was a slight but statistically significant decline in BMWP scores at impact monitoring sites with classifications at 12 sites declining by a single class. This included several sites where few changes to water quality have been identified, suggesting the change may be unrelated to construction. BMWP also declined at five of the six control sites, supporting this conclusion. Particularly low BMWP scores were recorded at LU1, LU2 in Burn of Lunklet and at GR1 and GR2 in Burn of Grunnafirth.

- Water Chemistry Status was Class 1 or 2 at almost all sites indicating circumneutral or not significantly acidified water chemistry. However, LU2 scored 3 (potentially acidified), consistent with known impacts on water quality in this watercourse.
- Ecological status for WHPT ASPT at 24 impact monitoring sites was classified High and the remining five as good.
- The WHPT NTAXA classifications were H (High) at 25 impact monitoring sites. Three sites were classified as Moderate (LU1, LU2 and GR2) and one (GR1) as Bad. No hydrochemical changes have been recorded that would explain the low invertebrate diversity at GR1.
- Mean PSI at impact monitoring sites was 64.7 (range 42.9.to 83.3). The lowest PSI was at LU2 in Burn of Lunklet, where the index suggested moderately sedimented conditions. No site declined by two classes, the proposed threshold for impact detection at individual sites and there was no statistically significant overall decline compared to baseline.

The data suggest that most watercourses in the wind farm site continue to provide good, well oxygenated conditions with healthy populations of invertebrates. The main exception is Burn of Lunklet. Although there are some signs of improved water quality here, conditions remain poor and the invertebrate fauna remains depleted, lacking in diversity and dominated by pollution tolerant species.

1. Introduction

1.1. Background

As part of the Viking Energy Wind Farm development by SSE on Mainland Shetland, Scotland a series of water quality monitoring programmes have been put in place. The identified sensitive ecological receptors within the streams draining the sites are the fish (reported separately) and aquatic invertebrates. Aquatic invertebrates are to be sampled annually in spring throughout the construction and post construction phases of the development. Stream hydrochemistry is monitored monthly and aids interpretation of the biological data as well as providing direct measures of water quality. The monitoring programme and sampling locations were agreed by statutory consultees during early 2019, as part of the overall Water Quality Monitoring Plan for the site (Viking Energy 2019).

Spring and autumn baseline data on freshwater invertebrate populations were collected at 31 sites, including six control sites, prior to construction (Aquaterra Ecology 2020). The baseline data showed the invertebrate communities to be dominated mainly by Ephemeroptera, Plecoptera and Trichoptera species indicating that the water quality was good. The abundance and diversity of macroinvertebrates as measured by taxon richness was generally low to moderate, reflecting the isolation of the Shetland Isles. There were no signs of significant pollution or substantial enrichment. A range of biotic indices for water quality were calculated and thresholds were set for detection of potential negative impacts during construction or operation at the site.

Construction across the whole of the Viking Energy Wind Farm was started in August 2020, at which point the full Water Quality Monitoring Plan (WQMP) was initiated. This report presents the results of freshwater invertebrate monitoring during spring 2025. The site became operational in autumn 2024 and by the time spring sampling took place any works were limited to remedial tasks around tracks, cable routes and site compounds.

1.2. Aims and objectives

The aim of the monitoring programme is to provide data on invertebrate communities and indices of water quality to identify any significant impacts from wind farm construction. The freshwater invertebrate monitoring programme provides:

i) A description of the macro-invertebrate community including species level identification in most major groups (Malacostraca, Ephemeroptera, Trichoptera, Plecoptera, Mollusca [excepting Sphaeriidae], Odonata and adult Coleoptera);

ii) BMWP and ASPT scores as an assessment of water quality;

iii) Water Chemistry Status as an index of acidity

iv) An index of sedimentation: PSI;

v) WFD ecological status class for the WHPT ASPT and WHPT NTAXA parameters;

vi) Semi-quantitative assessments of invertebrate abundance;

vii) A description of the environmental variables at each monitoring site including depth, width, flow, substrate profile and estimates of in-stream vegetation.

The resulting data are compared with those collected during the 2019 baseline (Aquaterra Ecology 2020) and with hydrochemical monitoring data to identify whether any observed changes in the invertebrate fauna can be attributed to impacts from construction or operation of the Viking Energy Wind Farm.

2. Methods

2.1. Field and laboratory methods

Sampling took place at 29 monitoring sites that had potentially been subject to construction and at 6 control sites (Table 1). Sampling was conducted between 10th and 16th May 2025. Sampling conditions were good with low water levels at all sites. Site WE5 was not sampled in spring 2025 as no suitable habitat was present in the reach. This site always consisted of several small pockets of gravel and pebble in a reach dominated be soft sediments.

Sample collection was based on standard kick sampling methodologies employed by Scottish Environment Protection Agency (SEPA 2001, UKTAG 2008). A 25 cm wide kick sample net with a 1 mm mesh was used at all sites. Sampling was conducted in riffle-type habitat when available. Riffles are one of the most productive habitats in rivers and streams and are the standard habitat for water quality bio-monitoring (SEPA 2001). In small burns with limited size of suitable riffles multiple riffles may be used to produce a composite sample.

The sampling procedure involved a total of three minutes of kick sampling at each site followed by a further one minute period of hand sampling for attached invertebrates such as molluscs and cased caddis. This is slightly different to the latest SEPA method as the one minute is not divided into a 30 second surface sweep and 30 second stone search (SEPA 2019). It is not likely to be a significant difference as surface dwelling invertebrates are not normally present in riffles. The method is consistent with that employed during the baseline study. Samples from kicking and hand collecting were preserved together in 70% Industrial Methylated Spirits (IMS) in sealed plastic containers.

Kick samples are produced by timed effort sampling and are therefore semi-quantitative. The area kicked in the surveys was estimated as the approximate distance travelled during kicking in metres multiplied by the width of the net. Although this is an approximation, it does facilitate comparison between sites within a watercourse and between watercourses if undertaken in a consistent manner.

2.1.1. Variables recorded in field

The standard suite of physical and other environmental variables (see Aquaterra Ecology 2020) was measured in the field. Physical variables included stream width, depth, current speed and substrate profiles. Macrophyte cover was estimated for the area kicked. Width, depth and current speed were measured; substrate proportions and macrophyte cover were estimated by eye.

2.1.2. Invertebrate identification

Invertebrates were examined using a Wild binocular microscope at 6-50X magnification and a Brunel compound microscope at 100X. Specimens from kick samples were identified to species level to provide data for a range of biotic indices. Further details are provided by Aquaterra Ecology (2020). Species were checked for rarities using the JNCC Taxon Designations spreadsheet (JNCC 2011). This includes all major conservation designations, for example ‘Habitats Directive’, ‘Red Lists’, UKBAP and the Scottish Biodiversity List.

2.2. Indices

2.2.1. BMWP and ASPT

These scores were primarily developed for identifying organic pollution, but they are widely used as indicators of general stream health. The scoring system is based on the pollution sensitivity of a range of invertebrate families (see Appendix 8.1). Background to BMWP and ASPT and details of the calculations are provided by Aquaterra Ecology (ibid.). In short, the BMWP index is the sum of the group scores for the sample while ASPT (Average Score Per Taxon) is the average score for the groups present in the sample. Low scores for the BMWP or ASPT indices indicate possible pollution; high scores indicate good water quality. ASPT is viewed as a more stable and reliable index of pollution. The indices are used to provide a classification of the watercourses, as described in Table i below.

Table i Simplified Scottish River Classification Scheme as used by SEPA.

Class	Description	BMWP	ASPT	Comments
A1	Excellent	≥85	≥6.0	Sustainable* salmonid population
A2	Good	70-84	5.0-5.9	Sustainable* salmonid population
B	Fair	50-69	4.2-4.9	Salmonids may be present
C	Poor	15-49	3.0-4.1	Fish may be present
D	Seriously Polluted	<15	<3.0	Fish absent or seriously restricted

* If other environmental variables are suitable

2.2.2. Water Chemistry Status

Water chemistry status (Patterson and Morrison 1993) is an index of acidity based on the presence of sensitive invertebrate indicator groups (Appendix 8.2). Group 1 taxa normally tolerate a minimum pH of 6.0 while typical group 2 tolerance is pH 5.5. Based on the groups present three water chemistry classes are defined (Table ii). Care is required interpreting these data for the Viking EWF site since some indicator species e.g. *Gammarus pulex* are absent from the Shetland Isles (Sutcliffe 1991).

Table ii. Water Chemistry Classes

Class	Description	Comment
Class 1	Circumneutral	Group 1 taxa present. Water chemistry is suitable for the great majority of plants and animals. Alkalinity should be sufficient to buffer against most acid spate waters and the mean pH is ≥6.0 and unlikely to drop below 5.6. Salmonid fish not stressed by the water chemistry.
Class 2	Not significantly acidified	Group 1 absent, group 2 present. The water chemistry is suitable for all except the most sensitive taxa. The mean pH is likely to be 5.6 or above. Where heavy metal and aluminium levels are low and/or organic content is high mean pH could be as low as 5.3. The water chemistry is likely to be suitable for salmonid fish but such streams may be vulnerable to future acidification.
Class 3	May be acidified	Groups 1 and 2 absent. Water chemistry may be acid to the point where wildlife is significantly affected including reduction of invertebrate diversity and reduction of salmonid fish populations, especially salmon. Further survey and chemical analysis is recommended to improve the diagnosis.

2.2.3. PSI (Proportion of Sediment-sensitive Invertebrates) Index

The PSI index (Extence *et al.* 2011) uses the varying sensitivity of macroinvertebrates to fine sediment levels as a proxy for measuring the extent to which watercourse beds are composed of, or covered by fine sediment. Some invertebrates, for example oligochaetes are adapted to living in soft sediments whilst other groups, for example Plecoptera with gills vulnerable to clogging, may be absent or scarce in such habitats. In order to calculate PSI, invertebrate species and families are classified into four sensitivity ratings and are scored according to their abundance in three minute kick samples (Table iii).

Table iii Sensitivity Ratings and Abundance Weighted Scores.

Group	Fine Sediment Sensitivity Rating FSSR	Abundance			
		1-9	10-99	100-999	1000+
A	Highly sensitive	2	3	4	5
B	Moderately sensitive	1	2	3	4
C	Moderately insensitive	1	2	3	4
D	Highly insensitive	2	3	4	5

The PSI metric is then calculated as below:-

$$PSI = \frac{\sum \text{scores for sensitivity groups A \& B}}{\sum \text{scores for sensitivity groups A-D}} \times 100$$

The initial interpretation of this score given by Extence (ibid.) is in Table iv.

Table iv. PSI score and river bed conditions

PSI Range	River Bed Condition
81-100	Minimally sedimented/unsedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

2.2.4. Ecological Quality Index (EQI) and Water Framework Directive (WFD) Class

The Water Framework Directive requires the assessment of the ecological status of water bodies, including a biological element. Parts of the assessment of the benthic invertebrate quality element are the ASPT and NTAXA indices, based on the WHPT (Whalley Hawkes Paisley Tribbs) metrics for groups sensitive to organic enrichment, toxic pollution and habitat degradation (UKTAG 2014).

Using a standard set of environmental variables for sampling sites the observed invertebrates and resultant indices can be compared to predicted (expected) indices produced by RIVPACS. The resulting EQI values are the ratio of the observed to expected values (O/E) and this standardises biotic indices so that a particular value of EQI ratio implies the same ecological quality for that index, no matter what type of river or stream. The EQI values are used to produce the Ecological Quality Ratio (EQR) and WFD class of the water body.

For the WHPT ASPT and WHPT NTAXA parameters the following class boundaries are assigned from EQR values for spring/autumn combined (UKTAG 2014):

Table v. WHPT ASPT and NTAXA status class boundaries

Status Boundary	WHPT ASPT EQR	WHPT NTAXA EQR
High/Good H/G	0.97	0.80
Good/Moderate G/M	0.87	0.68
Moderate/Poor M/P	0.72	0.56
Poor/Bad P/B	0.53	0.47

3. Results

3.1. Sites and environmental variables

Sites are listed in Table 1, which also provides brief notes of any substantial changes to water quality over the preceding year when compared with baseline. The notes on water quality and other impacts briefly summarise data on temporal trends provided in recent hydrochemical monitoring reports for the site (Headley 2024, 2025).

Physical environmental variables are listed in Table 2. Comparisons with baseline suggest few changes to overall substrate composition, reflecting the stable nature of most sites. Ochre-coloured deposits were again present at LU1 and LU2. The ochreous deposition at these sites were heavy and thick. Some light ochre deposition was noted at WE3 and WE4 during 2023 and 2024 (Emes & Watt, 2023 & 2024). During the current round of sampling WE3 was clear of ochre and deposition at WE4 was minimal.

Filamentous algae were present at many sites, including four of the six controls (Table 2). Mean algal coverage at impact sites was 12.6% (σ = 18.4). Where filamentous algae were present, coverage ranged from 5% to 80% of the visible streambed, with the highest coverage at LU1 on Burn of Lunklet. Coverage met or exceeded 25% at WF2, PW2, LU2 and WE2. At control sites the highest coverage was 15%, at SE1 and SA1. It was noted that dense algal cover was again present through many of the lower reaches of Seggie Burn.

High algal densities of up to 50% were observed at some sites during the baseline period and algal presence may well be a natural phenomenon. There is no clear relationship between sites with abundant algae and elevated levels of nutrient as listed in Table 1. Some species of algae are very responsive to changes in light levels, temperature and flow, and are therefore subject to natural inter-annual variation particularly in the broader, shallower stream reaches.

3.2. Invertebrate communities

The proportional abundances of major invertebrate groups are shown in Figure 1 (expressed as percentages of the total population). The numbers of each species found in the samples are recorded in Appendix 8.3. The categories in Figure 1 represent the groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddis flies), Diptera (two-winged flies) and

‘Other’. The first three groups are generally intolerant of organic pollution and they dominate many of the invertebrate communities of upland streams in Britain (Ormerod *et al*. 1993). Diptera contains the chironomids, a group very tolerant of organic pollution or enrichment. The ‘Other’ Category contains a range of groups including the vermiforms (Oligochaeta and Hirudinea) which are tolerant of organic pollution, other Insecta and a small number of Mollusca and Crustacea species moderately tolerant of organic pollution. As the majority of species of Ephemeroptera, Plecoptera and Trichoptera (EPT) are pollution sensitive, a combined proportion of these taxa as a percentage of invertebrates present, is a useful general indication of water quality. If EPT is >50% then water quality is likely to be good, 25-50% indicating moderate quality.

In spring 2025 the mean proportion of EPT at the impact monitoring sites was 64.7%, ranging from 10.3% at LU1 to 87.9% at GI1 (Table 3). Five impact sites (FL1, QU1, LM1, LU1, LU2 and WE3) failed to reach the 50% threshold. The lowest EPT values were in Burn of Lunklet where scores were 10.3% and 1.8% at LU1 and LU2 respectively. The invertebrate fauna at both of these sites was dominated by Diptera species (Figure 1), in particular chironomids, which are known to be tolerant of metal pollution. No routine monitoring sites outside Burn of Lunklet scored less than 25% EPT.

The mean EPT value at control sites was 73.8% (range 63.8% to 85.1), with the lowest value at LB2 on Burn of Laxobigging and the highest at SA2 on Burn of Sandgarth. The difference in mean EPT at impact and control sites was not statistically significant (pooled variance T = 0.99, df = 33, p = 0.33).

3.3. Invertebrate Abundance and Diversity

Invertebrate abundance is shown numerically in Table 3 (total invertebrates per site) and invertebrate densities in spring 2025 are shown against baseline in Figure 2, omitting any sites lacking spring baseline data (i.e. WF2, CR2, CR3, LU2 and WE5).

Mean invertebrate densities at impact monitoring and control sites in spring 2025 were 134.3 (σ = 73.3) and 99.1 (σ = 43.2) per m^2 respectively and there was no significant difference between the two suites of sites (T = 1.13, df = 33, p = 0.27). The highest invertebrate densities were at WF1a and WF2 in Wester Filla Burn, where invertebrate densities were 348.8 and 243.0 per m^2 respectively. In both cases the densities were in large part due to the abundance of *Baetis rhodani*, a mayfly species, in the samples (Appendix 8.3).

Mean taxon richness (numbers of taxa present) at impact monitoring sites was 10.2 (range 6 to 17) while at control sites it was 10.7 (range 9 to 18). The lowest numbers of taxa was at LU2 in Burn of Lunklet and GR1 in Burn of Grunnafirth.

Invertebrate density and taxon richness were mainly low by national standards, as has been the case during previous monitoring periods including the pre-construction baseline.

3.4. BMWP and ASPT scores

BMWP and ASPT scores are summarised in Table 3 and classifications are given in Table 4. Mean ASPT at impact monitoring sites was 5.2 (range 4.0 to 5.69) with lowest score at LU2 and the highest at WE1 in Burn of Weisdale. At control sites the mean ASPT was 5.0 (range 4.50 to 5.46). There was no statistically significant difference ASPT between impact monitoring and control sites (pooled variance T = 0.96, df = 33, p = 0.34).

ASPT at 22 of the impact monitoring sites was classified as A2 (Good) and six as B (fair). LU2 was classified as C (Poor). Four control sites were classified as Good and two, SE2 in Seggie Burn and LB2 in Burn of Laxobigging, as Fair.

Mean BMWP at impact monitoring sites was 44.1 (range 20 to 74). The highest value was at WE1 in Burn of Weisdale and the lowest at LU2. Based on the scores in Table 3, BMWP was classified as C (Poor) at 20 of 29 impact monitoring sites. Seven sites were classified as B (Fair) and only one (WE1) as A2 (Good). Classifications at five of six control sites were C while one (SE2 on Burn of Sandgarth) was A2. There was no statistically significant difference in mean BMWP between impact monitoring and control sites (T = 0.35, df = 33, p = 0.73).

3.5. Water Chemistry Status

The classifications are shown in Table 3. Six of the 30 impact monitoring sites were classified as 1 (circumneutral) while 22 of the remaining 23 were classified as 2 (not significantly acidified). LU2 and L2 were classified as 3 (potentially acidified). All control sites were classified as 2.

Appendix 8.3 provides a full list of indicator species present and their number in each sample. The Group 2 indicator species *Baetis rhodani* was present at all impact monitoring and control sites with the exception LU2 on Burn of Lunklet. This is a very common species and where present its mean abundance was 92.8 individuals per site. It is worth noting that only two were present at LU1 and seven at LM1 in Burn of Lambawater. Periods of low pH do occur in Burn of Lambawater and Burn of Lunklet has suffered acidification due to runoff from Scallafield Scord.

Group 1 taxa, the most acid-sensitive, were represented by the caddis fly *Agapetus fuscipes*, which was present only at PW1 in Burn of Pettawater. Limestone in present in this stream, resulting in a high pH. The crustacean *Gammarus duebeni* was present in Burn of Crookadale (CR1) and in two of its tributaries, namely Gill Burn (GI1) and Burn of Flamister (FL1). The Group 1 mollusc, *Radix balthica*, was present at two impact monitoring and sites, LA1 in Laxo Burn and WE4 in Burn of Weisdale. The presence of any of these Group 1 species in a watercourse suggests relatively high alkalinity and good buffering against acidity.

3.6. PSI (Proportion of Sediment-sensitive Invertebrates) Index

PSI status scores are given in Table 3. Mean PSI at impact monitoring sites was 64.7 (range 42.9.to 83.3). The lowest PSI was at LU2 in Burn of Lunklet, where the index suggested moderately sedimented conditions, while the highest was at PW2. A total of 18 impact sites were classified as slightly sedimented, nine as moderately sedimented and two as minimally sedimented (Table 4).

Mean PSI at control sites was 68.3 (range 52.9 to 83.3). Four were classified as slightly sedimented, one as moderately sedimented and one as minimally sedimented (Table 4). PSI scores did not differ significantly between impact monitoring and control sites (T = 0.79, df = 33, p = 0.44).

3.7. Ecological Status Class for WHPT ASPT and WHPT NTAXA.

The WHPT ASPT scores are given in Table 3 with associated classifications in Table 4. Tables 5 and 6 provide the EQR values, classification probabilities and suitability codes for each site. The abundance weighted scores for taxa at each site are in Appendix 8.7.

The mean value for WHPT ASPT parameter at impact monitoring sites was 6.10 (range 5.08 to 6.88). The lowest and highest were at FL1 in Burn of Flamister and WF1a in Wester Filla Burn respectively. Of 29 impact monitoring sites, 24 were classified as H (High) for this index and the remainder as G (Good). Four control sites were also classified as H and two as G. There was no statistically significant difference in WHPT ASPT between impact monitoring and control sites (T = 1.34, df = 33, p = 0.19).

WHPT NTAXA at impact sites ranged from 5 at GR1 to 13 at WE1 (Table 3). Mean WHPT NTAXA at impact monitoring sites was 9.3. The mean WHPT NTAXA at control sites was 8.8, ranging from seven at LB1 in Burn of Laxobigging to 14 at SA2 in Burn of Sandgarth. The WHPT NTAXA classifications were H (High) at all but four impact monitoring sites: GR1, GR2, LU1 and LU2. The low diversity at GR1 resulted in a classification of B (Bad) while GR2 was classified as M (Moderate). Confidence in B classification at GR1 was low (28% probability compared with a 25% probability of M). Few changes in water quality have been observed in this watercourse and none seem likely to explain the low diversity found in the current survey. Both sites in Burn of Lunklet were classified as M.

There was no statistically significant difference in mean WHPT NTAXA between impact monitoring and control sites (T = 0.52, df = 33, p = 0.61).

4. Discussion

4.1. Data quality

Conditions for kick sampling were good at all sites with low water levels, so capture efficiency is likely to have been relatively good.

The issue of a potentially depauperate island fauna was noted by Aquaterra Ecology (2020) and is likely to have resulted in conservative values for a number of indices when compared to mainland UK sites. In particular, the absence of a number of normally common acid sensitive indicator taxa from Shetland is likely to have resulted in scores of 2 (not significantly acidified) for Water Chemistry Status at some sites when hydrochemical data (Headley 2020) would suggest that scores of 1 (circumneutral) might be expected. BMWP and ASPT scores may also be naturally depressed compared to mainland sites due to the absence of high scoring taxa such as Perlidae, Perlodidae and Heptageneidae from Shetland streams. These caveats do not affect comparisons with baseline or between potentially impacted and control sites.

The suitability codes listed in Table 5 rate the availability of suitable reference sites and data in the RICT database. The suitability code for all sites in the current study was 1 with the exceptions of CO1 in Corgill Burn, which was rated as 4. A score of 1 indicates that high reliance can be placed on the RICT classifications for the WHPT ASPT and NTAXA indices. Site CO1 had a suitability code of 2 during the baseline survey and no change has taken place in the physical environment that would change the change of code. It seems likely that later versions of RICT may use a slightly different algorithm for assessing site suitability to RICT2[1], but this is conjecture. Nevertheless, the RICT classifications for CO1 for WHPT ASPT and WHPT NTAXA are consistent with the other indices e.g. ASPT and numbers of BMWP scoring taxa, so seem likely to be realistic.

4.2. Assessments

4.2.1. Invertebrate communities

As in 2024 there was a general decline in the abundance (density) of invertebrates at most impact monitoring sites when compared with baseline (Table 7, Figure 2). Mean baseline density was 222.2 invertebrates per m^2 and this fell to 132 at the same sites in 2025, a statistically significant change (paired T-test, $T = 5.97$ df = 24, $p < 0.001$). This decline was also evident at all six control sites and this change was also significant (Table 7). The similar trends at impact at control sites suggest that the observed change is most likely to reflect wider environmental conditions rather than any impact from construction. This view is reinforced by the fact that declines in invertebrate numbers were observed at a many impact monitoring sites e.g. KI1, PW1, PW2, GR2, WE1 where there have been few or no concerning changes in water quality.

While it seems improbable that widespread change in invertebrate density is attributable to construction effects, it is probable that some of the changes at individual sites do in fact reflect known impacts. In particular, the loss of much of the invertebrate fauna from parts of Burn of Lunklet has been previously been reported (Watt & Emes 2022, 2023 & 2024) and can be attributed to construction impacts on water quality and the resulting contamination of sediments (Headley 2023a).

In spring of 2023 a substantial decline in invertebrate density and diversity was recorded at WE4 on Burn of Weisdale (Emes & Watt 2023). Deterioration in water quality was observed at this site and substantial ochre deposition was present. Ochre deposition was less evident in 2024 and density and diversity of invertebrates improved. These improvements were sustained in the current round of sampling.

Mean EPT at impact monitoring sites increased compared with the spring baseline (Table 7), but the change was non-significant (paired T-test, $T = 0.98$, df = 24, $p = 0.34$). Aquaterra Ecology (2020) did not suggest any threshold for detection of impact based on EPT proportion, as this is not a formal index. Unsurprisingly the biggest changes in EPT between the spring baseline and the current study were at sites where potentially damaging changes to water and habitat quality have been observed, in particular LU1.

A very substantial decline in EPT was to 11.7% was recorded at WE3 during 2024 (Emes and Watt 2024). Visible streambed impacts were observed at this site and the substrate was silted with some ochre deposition. This was thought likely to have been a result of track and cabling works a short distance upstream. A substantial decline in salmonid fish numbers around WE3 recorded in the

[1]RICT2 no longer works reliably and has been replaced by RICT3.

same year (Waterside Ecology 2023). During the current survey it was noted that the streambed at WE3 appeared relatively clean and EPT increased to 48.8%, a substantial improvement although still 10% lower than baseline (Table 7).

Although some known localised impacts on water or habitat quality have been reflected in reduced EPT, as described above, the majority of sites exceeded the 50% threshold suggestive of good water quality.

4.2.2. BMWP and ASPT scores

It was pointed out in the baseline survey (Aquaterra Ecology 2020) that there are few taxa present on Shetland that score 10 on the BMWP scale. Several families that are very common and widespread in mainland Scotland such as Perlodidae and Heptageniidae are absent from Shetland making ASPT scores of ≥ 6.0 improbable. As a result, ASPT scores from Shetland watercourses are likely to be approximately a class below the level in Table i when compared to mainland sites with similar water quality.

There was very little change in mean ASPT at those impact monitoring sites that were sampled during the baseline and 2025 (Table 7) and the change was non-significant (paired T-test, $T = 0.85$, $df = 25$, $p = 0.41$). Five individual sites declined by a single class from A2 to B, while another four shifted from B to A2. Shifts of a single class are very common due to natural variation in species distribution/abundance and the vagaries of sampling. No baseline data are available for LU2 on Burn of Lunklet, the only site classified as C (Poor). Nevertheless, it is highly likely that this classification reflects the contamination identified by hydrochemical sampling and the consequent impacts on the streambed.

There was a slight but statistically significant decline BMWP scores at impact monitoring sites (Table 7) and classification at 12 sites declined by a single class (Table 4). The sites showing this decline included several (LA1, GO1, WF1a and PW1) where few changes to water quality have been identified during hydrochemical monitoring, suggesting a slight downward trend in this index across the construction site. BMWP also declined at five of the six control sites, suggesting that the widespread change is unlikely to have been related to construction effects.

While the general downward trend is probably unrelated to construction, it is reasonable to suppose that construction has played a part in reducing BMWP in those watercourses where more serious pollution has occurred, such as in Burn of Lunklet. Low scores for this and other indices are consistent with known impacts in this watercourse. The very low BMWP scores at GR1 and GR2 in Burn of Grunnafirth are more puzzling however, as very few changes in hydrochemistry have occurred during construction and none in the past year that would significantly impact on invertebrate populations. Fish populations in this watercourse will be sampled in the summer. If the results are poor it may be worth considering re-sampling Burn of Grunnafirth for invertebrates in the autumn.

4.2.3. Water chemistry status

The data in Table 4 show that four impact sites shifted between class 1 and class 2 and five moved from 2 to 1. Such changes are expected as the presence of a single animal can result in a change of classification. Overall, the data indicate moderate alkalinities and adequate buffering against acidity in most streams.

Unsurprisingly given the known changes to pH (summarised by Headley 2024b) LU2 was classified as acidified. This can reliably be attributed construction impacts related largely to runoff from the borrow pit on Scallafield Scord. LU1 achieved a classification of 2 due to the presence of two specimens of *Baetis rhodani*, which used to be relatively common at this site (Aquaterra Ecology 2020). This is an improvement on spring 2024, when it was class 3, and is consistent with recent improvements in pH following mitigation measures in the headwaters of Red Burn. It is however worth noting that *B. rhodani* is highly mobile and prone to downstream drift so could enter the watercourses from uncontaminated tributaries. Its absence from LU2 clearly indicates that recovery of Burn of Lunklet still has some way to go.

4.2.4. PSI Index

The proposed threshold for site-specific impact detection is a decline to a PSI class of sedimented or heavily sedimented i.e. PSI < 41 (Aquaterra Ecology 2020). None of the sites met this threshold and there was no general trend either of decline or increase in the PSI scores between the baseline and current monitoring period (Table 7, T = 1.07, df = 24, p = 0.30). Low PSI scores at LU1 and LU2 (45.5 and 42.9 respectively) reflect impact of ochre deposition on the streambed in this watercourse.

4.2.5. Ecological Status Class for WHPT ASPT and WHPT NTAXA.

The WHPT NTAXA score declined between baseline and 2024 at 16 of the 25 impact monitoring sites (Table 7) and a paired T-test showed the decline was statistically significant (T = 3.89, df = 24, p = 0.001). Despite this, there were very few changes in the WHPT NTAXA classifications between the baseline and current study (Table 4) and most sites continue to be classified as H (High). The downward trend in NTAXA was also observed at control sites, with declines at five of six sites. This is suggestive of a regional trend, particularly as reduced numbers of scoring taxa were noted in many watercourses where there have been no potentially damaging changes to hydrochemistry.

For individual sites, Aquaterra Ecology (2020) suggested a downward shift of two WHPT NTAXA classes at any site without a similar change at control sites should be regarded as potentially impacted. Three sites GR1, GR2 and LU1 met this threshold. Impacts of construction on Burn of Lunklet are clear but, as noted above, there is no clear explanation for declines in diversity and abundance of invertebrates in Burn of Grunnafirth.

The WHPT ASPT scores during the baseline and current sampling periods are provided in Table 7. The mean WHPT ASPT score at impact monitoring sites showed a slight, but statistically significant decline between 2019 and 2024. No significant change was apparent between baseline and the current survey (Table 7, T = 1.54, df =24, P = 0.13).

Changes of one class for WHPT ASPT occurred at six impact sites, three moving from H to G and three from G to H (table 4). Shifts of one class are to be expected and a similar shift from H to G was observed at control site SE2.

4.3. Burn of Lunklet

Time series data for Burn of Lunklet are provided in Table 8. These show that while some classifications at LU1 during the current survey fail to meet the proposed threshold for impact detection (i.e. two classes), all monitoring scores remain substantially below baseline or other surveys prior to pollution from Scallafield Scord. In particular, the invertebrate fauna is now sparse, lacking in diversity and dominated by pollution tolerant species such as chironomids. This is also true of LU2, for which there are no baseline data.

It is clearly too early to determine whether slight improvements in some scores and indices in Burn of Lunklet since 2023 and 2024 will be maintained. Hydrochemical data show that there have been some improvements in water quality and pH has risen since implementation of mitigation. This may allow some species to recolonise. However, streambed impacts remain and recent work (Headley 2025) shows that the current mitigation measures may not be sufficiently effective at removing particulate metals. This may result in ongoing damage to stream habitats through deposition of metal rich ‘ochres’.

4.4. Conclusions

Assessment of the 2025 spring data set suggests that:

- Most watercourses in the wind farm site continue to provide good, well oxygenated conditions with healthy populations of invertebrates.
- There has been a near-ubiquitous decline in invertebrate density compared with the 2019 baseline, but this was seen at all control sites indicating it is a regional phenomenon unrelated to construction or operation of the wind farm.
- There have been few changes at individual sites that meet the criteria set for detection of impact i.e. a change of two classes with no corresponding change at control sites. Exceptions were:
    - PSI and WHPT NTAXA at GR1.
    - WHPT NTAXA at LU1.
- No changes in water quality have been observed that would explain the observed changes at GR1.

- A number of water quality indices show slight improvements at LU1 and LU2 compared with spring 2024. However, the data indicate that the invertebrate fauna remains depleted, lacking in diversity and dominated by pollution tolerant species.

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6. Tables

Table 1 Sampling sites, spring 2025

Main Catchment	Sub-catchment	Site	Sq.	E	N	Notes including hydrochemistry or potential pollution incidents
Impact monitoring sites						
Laxo	Laxo Burn	LA1	HU	43842	62899	Original site now unsuitable (natural change). Sampled nearest riffle 2024 and 2025
	Burn of Gossawater	GO1	HU	43734	62543	Few exceedances. No significant differences from baseline in the last 12 months
	Corgill Burn	CO1	HU	43528	60222	Not sampled for chemistry
	Easter Filla Burn	EF1	HU	42419	62334	Elevated TON winter 2021-22. Suspended solids/turbidity late winter 2022-23.
Manse Burn	Wester Filla Burn	WF1a	HU	41560	62077	Elevated TON and iron 2023-24. Exceedance of dissolved cadmium 2025. Total suspended exceedance April 2025.
	Wester Filla Burn	WF2	HU	41537	61123	Not sampled for chemistry
Grunnafirth	Burn of Grunnafirth	GR1	HU	45707	58838	Few exceedances. No significant differences from baseline in the last 12 months
	Burn of Grunnafirth	GR2	HU	45248	58108	Few exceedances. No significant differences from baseline in the last 12 months
Crookadale	Burn of Crookadale	CR1	HU	43329	53964	Prolonged nitrate impact 2020 and 2021 but returned to baseline thereafter
	Burn of Crookadale	CR2	HU	43329	53964	Prolonged nitrate impact 2020 and 2021 but returned to baseline thereafter
	Burn of Crookadale	CR3	HU	42522	54435	Upstream control for CR1 & CR2
	Gill Burn	GI1	HU	43591	54698	Elevated TON now returned to baseline.
	Burn of Flamister	FL1	HU	43799	55052	Periods of elevated TON. Last exceedance was December 2023.
Quoys	Burn of Quoys	QU1	HU	44731	55359	Periods of elevated iron and TON but no significant differences in the last 12 months
Kirkhouse	Burn of Kirkhouse	KI1	HU	39790	61810	Few exceedances. Brief Mn exceedance autumn 2022.
Stromfirth	Burn of Pettawater	PW1	HU	41584	55539	Few identified exceedances, none threatening to biota.
	Burn of Pettawater	PW2	HU	41634	56963	Few identified exceedances, none threatening to biota.
Burrafirth	S. Burn of Burrafirth	BF1	HU	36686	57507	Impacted by waters from Scallafield Scord. Metals, reduced DOC, pH and ANC
	S. Burn of Burrafirth	BF2	HU	36702	56890	Prolonged elevated TON
	S. Burn of Burrafirth	BF3	HU	36478	55015	Not sampled for chemistry
	Burn of Lamba Water	LM1	HU	37449	57088	Periodic low pH
	Burn of Lunklet	LU1	HU	37437	57039	High TON, low pH, elevated metals incl. Al, Zn, Ni, Mn. Heavy ochre deposition.
	Burn of Lunklet	LU2	HU	37724	57519	As LU1 above.
	Burn of Marrofield Water	MA1	HU	37337	57310	Periods of elevated Al and Zn since 2022/23. Low pH. Cadmium November 2024.
Weisdale	Burn of Weisdale	WE1	HU	40114	54297	Occasional TON exceedances but no exceedances last 12 months.
	Burn of Weisdale	WE2	HU	40222	55270	Occasional TON exceedances but no exceedances last 12 months.
	Burn of Weisdale	WE3	HU	40511	56722	Impacted by runoff from Scallafield Scord. Changes to metals, ANC and DOC.
	Burn of Weisdale	WE4	HU	40525	57790	Impacted by runoff from Scallafield Scord. Changes to metals, ANC and DOC.
	Burn of Droswall*	DR1	HU	39956	54988	Periods of elevated TON. Silt. Elevated bioavailable manganese Sept. 2024.
Control sites						
Laxo	Seggie Burn	SE1	HU	43952	63779	
	Seggie Burn	SE2	HU	43609	64718	
Laxobigging	Burn of Laxobigging/Voxter	LB1	HU	41719	72710	
	Burn of Laxobigging/Voxter	LB2	HU	41416	72398	
Sandgarth	Burn of Sandgarth	SA1	HU	40789	68062	Potential agricultural impacts and manure storage could affect data
	Burn of Sandgarth	SA2	HU	40841	67585	

*correct name is Burn of Scallafield but Droswall is consistent with baseline and other reports

Table 2 Environmental variables, May 2025

Site	Wet width (m)	Bed width (m)	Depth 1/4 (cm)	Depth 1/2 (cm)	Depth 3/4 (cm)	Substrate (% of total)								Flow types	Current Speed (ms⁻¹)	Vegetation cover (%)	
						HO	SI	SA	GR	PE	CO	BO	BE			Total	Algae
Impact monitoring sites																	
LA1	3.4	4.8	10	10	10	0	0	5	5	45	40	5	0	run/glide	0.5	30	5
GO1	2.1	2.1	10	15	10	0	0	0	5	25	55	15	0	riffle/run	5.0	25	5
CO1	0.9	1.1	10	7	10	0	0	0	5	40	50	5	0	run/riffle/glide	0.5	5	0
EF1	1.5	2.2	5	5	10	0	0	3	7	25	55	10	0	riffle/run	0.6	25	5
WF1a	1.5	1.5	5	5	10	0	0	5	10	55	30	0	0	riffle/run	0.8	0	0
WF2	1.4	2.2	7	7	10	0	0	10	15	35	40	0	0	run/riffle	0.6	45	45
GR1	2.4	3.0	15	15	10	0	0	1	2	15	57	20	0	run/riffle	0.8	0	0
GR2	2.4	2.5	15	10	10	0	0	2	5	15	58	20	0	riffle/run	0.7	0	0
CR1	1.8	1.8	12	10	7	0	0	2	3	15	70	10	0	run/riffle	0.7	20	20
CR2	1.2	1.2	10	10	12	5	0	2	3	30	60	0	0	run/riffle	0.6	0	0
CR3	0.9	0.9	10	10	7	0	0	3	5	25	57	10	0	run/riffle	0.7	5	0
GI1	0.9	0.9	7	5	10	0	5	2	3	30	60	0	0	riffle/run	0.7	0	0
FL1	1.0	1.2	10	10	10	0	0	2	3	30	55	10	0	riffle/run	0.6	10	5
QU1	1.8	3.0	7	10	12	0	2	0	5	35	48	5	0	run/riffle	0.6	0	0
KI1	3.0	4.0	15	10	10	0	0	0	5	20	65	10	0	run/riffle	0.7	10	10
PW1	2.0	2.0	15	15	15	0	0	8	12	20	45	15	0	run/riffle	0.7	35	0
PW2	2.0	2.5	7	10	12	0	0	5	10	20	40	15	0	run/riffle	0.7	55	50
BF1	5.3	6.2	15	15	15	0	0	0	0	15	65	20	0	run/riffle	0.6	0	0
BF2	3.5	5.0	15	10	15	0	0	2	5	15	58	20	0	run/riffle	0.7	15	10
BF3	3.3	3.5	10	10	10	0	0	2	3	15	65	15	0	riffle/run	0.7	10	10
LM1	1.5	1.9	15	10	10	0	0	2	3	30	55	5	0	run/riffle	0.7	25	10
LU1	1.8	2.4	10	10	10	0	ochre	0	5	20	50	15	0	run/riffle	0.6	80	80
LU2	1.5	2.1	10	15	15	5	ochre	0	5	10	75	10	0	run/riffle	0.7	25	25
MA1	1.2	1.8	15	10	10	0	0	0	2	15	63	20	0	riffle/run	0.7	25	15
WE1	4.3	4.4	20	10	15	0	0	5	10	10	55	20	0	run/glide	0.8	35	25
WE2	2.6	3.0	10	10	10	0	0	3	3	20	54	20	0	run/riffle	0.7	35	25
WE3	2.5	3.5	15	10	10	0	0	3	7	35	55	0	0	run/riffle	0.5	20	15
WE4	1.6	1.6	5	10	10	0	3	5	32	35	25	0	0	run/glide	0.6	0	0
DR1	1.7	1.8	20	15	15	0	3	2	5	20	50	20	0	run/riffle	0.7	15	10
Control sites																	
SE1	4	4.8	20	15	10	0	0	2	3	15	60	20	0	run/riffle	0.8	45	15
SE2	1.9	2.1	15	15	10	0	0	5	10	30	40	15	0	run/riffle	0.7	40	5
LB1	4	4.8	10	10	15	0	0	2	3	20	50	20	0	run/riffle	0.6	5	30
LB2	3.6	4.6	15	10	10	0	0	2	3	10	60	25	0	run/riffle	0.7	0	0
SA1	1	1	10	10	10	0	1	5	10	30	49	5	0	run/riffle	0.6	20	15
SA2	1	1	10	5	7	0	2	5	15	48	30	0	0	run/riffle	0.6	0	0

HO = High Organic (peat) SI = silt SA = sand GR = Gravel PE = Pebble CO = Cobble BO = Boulder BE = Bedrock

Table 3 Biological monitoring scores and classifications spring 2025

Site	Total Invertebrates (n)	Number of Taxa (n)	EPT (%)	BMWP score	Scoring taxa (n)	ASPT score	WHPT BMWP score	WHPT scoring taxa (NTAXA)	WHPT ASPT	PSI	Water Chemistry status
Impact monitoring sites											
LA1	145	12	86.2	45	10	4.50	65.6	10	6.56	52.2	1
GO1	136	9	89.0	42	9	4.67	55.2	9	6.13	76.5	2
CO1	120	12	59.2	48	9	5.33	64.4	10	6.44	63.2	2
EF1	278	17	79.1	68	12	5.67	91.1	14	6.51	72.0	2
WF1a	375	11	93.9	49	9	5.44	61.9	9	6.88	72.7	2
WF2	328	13	75.9	49	9	5.44	64.4	10	6.44	70.0	2
GR1	85	6	68.2	24	5	4.80	29.0	5	5.80	58.3	2
GR2	120	8	82.5	29	6	4.83	37.4	6	6.23	61.5	2
CR1	91	8	81.3	37	7	5.29	47.3	8	5.91	81.8	1
CR2	87	8	55.2	31	6	5.17	42.5	7	6.07	61.5	2
CR3	194	12	90.2	54	10	5.40	66.8	10	6.68	72.0	2
GI1	122	12	66.4	60	11	5.45	65.0	11	5.91	66.7	1
FL1	243	11	37.0	47	9	5.22	45.7	9	5.08	63.2	1
QU1	49	11	49.0	41	8	5.13	59.2	10	5.92	60.0	2
KI1	121	11	66.1	44	8	5.50	63.3	10	6.33	76.5	2
PW1	151	10	68.2	32	7	4.57	51.4	9	5.71	56.3	1
PW2	142	11	73.2	50	9	5.56	65.1	10	6.51	83.3	2
BF1	74	9	52.7	35	7	5.00	48.7	8	6.09	60.0	2
BF2	63	8	74.6	32	6	5.33	44.3	7	6.33	69.2	2
BF3	152	11	56.6	47	9	5.22	61.0	10	6.10	65.0	2
LM1	250	14	38.4	56	10	5.60	69.7	11	6.34	64.0	2
LU1	39	8	10.3	24	5	4.80	33.0	6	5.50	45.5	2
LU2	112	6	1.8	20	5	4.00	30.7	6	5.12	42.9	3
MA1	108	11	77.8	49	9	5.44	64.1	10	6.41	70.0	2
WE1	245	13	77.6	74	13	5.69	87.9	13	6.76	79.2	2
WE2	133	12	68.4	55	11	5.00	71.7	12	5.98	63.2	2
WE3	285	11	48.8	36	7	5.14	49.6	9	5.51	53.3	2
WE4	445	14	79.6	55	10	5.50	70.0	12	5.83	60.9	1
DR1	102	11	69.6	45	9	5.00	53.9	10	5.39	55.6	2
Control sites											
SE1	113	9	77.9	41	8	5.13	51.6	8	6.45	75.0	2
SE2	160	10	77.5	36	8	4.50	42.0	8	5.25	52.9	2
LB1	53	9	66.0	37	7	5.29	42.7	7	6.10	64.7	2
LB2	47	9	63.8	32	7	4.57	47.9	8	5.99	83.3	2
SA1	144	9	72.2	35	7	5.00	42.5	8	5.31	63.6	2
SA2	228	18	85.1	71	13	5.46	87.3	14	6.24	70.0	2

Table 4 Biomonitoring Classifications summary spring 2019 (baseline) and spring 2025

Site	ASPT Class		BMWP Class		Water Chemistry Class		PSI sedimentation		WFD WHPT Ecological Status Class			
									ASPT		NTAXA	
	Baseline	2025	Baseline	2025	Baseline	2025	Baseline	2025	Baseline	2025	Baseline	2025
Impact monitoring sites												
LA1	B	B	B	C	2	1	Slight	Moderate	G	H	H	H
GO1	A2	B	B	C	2	2	Slight	Slight	H	H	H	H
CO1	A2	A2	B	C	2	2	Slight	Slight	H	H	H	H
EF1	A2	A2	B	B	2	2	Slight	Slight	H	H	H	H
WF1a	A2	A2	B	C	1	2	Slight	Slight	H	H	H	H
WF2	N/A	A2	N/A	C	N/A	2	N/A	Slight	N/A	H	N/A	H
GR1	A2	B	B	C	2	2	Minimal	Moderate	H	H	H	B
GR2	A2	B	B	C	2	2	Slight	Slight	H	H	H	M
CR1	A2	A2	C	C	2	1	Slight	Minimal	H	H	H	H
CR2	N/A	A2	N/A	C	N/A	2	N/A	Slight	N/A	H	N/A	H
CR3	N/A	A2	N/A	B	N/A	2	N/A	Slight	N/A	H	N/A	H
GI1	A2	A2	A2	B	2	1	Slight	Slight	H	H	H	H
FL1	A2	A2	B	B	2	1	Slight	Slight	H	G	H	H
QU1	A2	A2	C	C	2	2	Slight	Moderate	H	H	H	H
KI1	B	A2	C	C	2	2	Slight	Slight	G	H	H	H
PW1	A2	B	B	C	1	1	Slight	Moderate	H	H	H	H
PW2	A2	A2	B	B	2	2	Slight	Minimal	H	H	H	H
BF1	B	A2	C	C	2	2	Slight	Moderate	G	H	H	H
BF2	A2	A2	C	C	2	2	Slight	Slight	H	H	H	H
BF3	A2	A2	B	C	2	2	Slight	Slight	H	H	H	H
LM1	A2	A2	C	B	2	2	Slight	Slight	H	H	H	H
LU1	A2	B	B	C	2	2	Slight	Moderate	H	G	H	M
LU2	N/A	C	N/A	C	N/A	3	N/A	Moderate	N/A	G	N/A	M
MA1	A2	A2	C	C	2	2	Slight	Slight	H	H	H	H
WE1	A2	A2	B	A2	1	2	Slight	Slight	H	H	H	H
WE2	A2	A2	B	B	1	2	Slight	Slight	H	H	H	H
WE3	A2	A2	B	C	1	2	Slight	Moderate	H	G	H	H
WE4	B	A2	B	B	2	1	Slight	Slight	H	H	H	H
DR1	B	A2	B	C	2	2	Slight	Moderate	G	G	H	H
Control sites												
SE1	A2	A2	C	C	2	2	Slight	Slight	H	H	H	H
SE2	A2	B	C	C	2	2	Slight	Moderate	H	G	H	H
LB1	A2	A2	B	C	2	2	Slight	Slight	H	H	H	H
LB2	A2	B	B	C	2	2	Slight	Minimal	H	H	H	H
SA1	B	A2	C	C	1	2	Moderate	Slight	G	G	H	H
SA2	A2	A2	C	A2	2	2	Moderate	Slight	H	H	H	H

Table 5 Ecological Quality Index and Water Framework Directive Ecological Status Class for WHPT ASPT spring 2025

Site	Observed WHPT ASPT	Predicted WHPT ASPT	WHPT ASPT EQR	Most Probable Class	Probability of class %					Suitability Code
					H	G	M	P	B	
Impact monitoring sites										
LA1	6.56	5.89	1.095	H	95.7	4.2	0.1	0.0	0.0	1
GO1	6.13	5.89	1.030	H	79.2	19.5	1.3	0.0	0.0	1
CO1	6.44	5.89	1.076	H	92.4	7.4	0.2	0.0	0.0	4
EF1	6.51	5.90	1.088	H	95.5	4.4	0.1	0.0	0.0	1
WF1/1a	6.88	5.91	1.139	H	98.5	1.5	0.0	0.0	0.0	1
WF2	6.44	5.93	1.071	H	91.5	8.3	0.2	0.0	0.0	1
GR1	5.80	5.89	0.982	H	54.7	36.0	8.9	0.5	0.0	1
GR2	6.23	5.89	1.044	H	80.7	17.4	1.9	0.1	0.0	1
CR1	5.91	5.89	0.996	H	62.8	33.2	4.0	0.0	0.0	1
CR2	6.07	5.89	1.020	H	73.3	24.0	2.6	0.0	0.0	1
CR3	6.68	5.89	1.113	H	97.3	2.6	0.0	0.0	0.0	1
GI1	5.91	5.89	0.995	H	63.5	33.6	2.8	0.0	0.0	1
FL1	5.08	5.89	0.869	G	9.2	44.9	43.5	2.4	0.0	1
QU1	5.92	5.89	0.997	H	64.3	32.9	2.9	0.0	0.0	1
KI1	6.33	5.90	1.059	H	88.4	11.1	0.5	0.0	0.0	1
PW1	5.71	5.89	0.966	H	47.2	45.1	7.7	0.1	0.0	1
PW2	6.51	5.89	1.087	H	94.2	5.8	0.1	0.0	0.0	1
BF1	6.09	5.89	1.024	H	75.9	22.3	1.8	0.0	0.0	1
BF2	6.33	5.89	1.059	H	86.9	12.5	0.7	0.0	0.0	1
BF3	6.10	5.89	1.024	H	76.6	22.2	1.3	0.0	0.0	1
LM1	6.34	5.89	1.061	H	89.8	10.0	0.3	0.0	0.0	1
LU1	5.50	5.89	0.938	G	34.8	47.1	17.4	0.7	0.0	1
LU2	5.12	5.89	0.881	G	15.4	43.6	37.8	3.1	0.0	1
MA1	6.41	5.89	1.072	H	91.6	8.2	0.1	0.0	0.0	1
WE1	6.76	5.89	1.128	H	98.4	1.6	0.0	0.0	0.0	1
WE2	5.98	5.89	1.005	H	69.3	28.7	1.9	0.0	0.0	1
WE3	5.51	5.89	0.938	G	33.1	51.6	15.1	0.2	0.0	1
WE4	5.83	5.89	0.984	H	57.7	38.2	4.1	0.0	0.0	1
DR1	5.39	5.89	0.916	G	23.2	54.5	22.0	0.3	0.0	1
Control sites										
SE1	6.45	5.90	1.075	H	91.0	8.6	0.4	0.0	0.0	1
SE2	5.25	5.90	0.897	G	17.5	50.3	31.2	1.1	0.0	1
LB1	6.10	5.89	1.024	H	74.0	23.9	2.1	0.1	0.0	1
LB2	5.99	5.89	1.008	H	69.5	27.6	2.9	0.0	0.0	1
SA1	5.31	5.89	0.906	G	20.0	52.2	27.1	0.7	0.0	1
SA2	6.24	5.90	1.047	H	87.0	12.7	0.3	0.0	0.0	1

Table 6 Ecological Quality Index and Water Framework Directive Ecological Status Class for WHPT NTAXA, spring 2025

Site	Observed WHPT NTAXA	Predicted WHPT NTAXA	WHPT NTAXA EQR	Most Probable Class	Probability of class %				
					H	G	M	P	B
Impact monitoring sites									
LA1	10	11.67	1.001	H	82.8	11.6	4.7	0.8	0.2
GO1	9	11.67	0.916	H	70.6	17.5	9.0	2.3	0.6
CO1	10	11.67	1.002	H	82.7	12.4	4.0	0.8	0.1
EF1	14	11.74	1.334	H	99.3	0.7	0.0	0.0	0.0
WF1/1a	9	11.82	0.906	H	68.7	18.9	9.5	2.4	0.7
WF2*	10	11.99	0.974	H	79.8	13.9	5.2	0.9	0.2
GR1	5	11.67	0.575	B	9.6	15.8	25.2	20.8	28.6
GR2	6	11.67	0.662	M	21.3	22.1	26.9	16.2	13.6
CR1	8	11.67	0.833	H	54.4	23.4	15.5	5.0	1.8
CR2*	7	11.67	0.744	H	35.6	26.5	22.1	9.9	5.9
CR3*	10	11.68	1.001	H	82.8	11.8	4.4	0.8	0.2
GI1	11	11.67	1.090	H	91.1	6.7	1.8	0.3	0.1
FL1	9	11.67	0.916	H	70.4	18.0	8.9	2.2	0.6
QU1	10	11.67	1.002	H	83.1	11.7	4.4	0.7	0.2
KI1	10	11.73	0.996	H	82.6	12.1	4.3	0.9	0.1
PW1	9	11.68	0.915	H	69.5	18.7	9.0	2.3	0.6
PW2	10	11.67	1.004	H	82.7	12.0	4.5	0.7	0.1
BF1	8	11.67	0.835	H	55.3	22.8	14.9	5.1	1.9
BF2	7	11.67	0.745	H	36.1	25.0	22.8	10.6	5.6
BF3	10	11.67	1.005	H	83.7	11.1	4.2	0.8	0.2
LM1	11	11.67	1.085	H	91.4	6.2	2.1	0.3	0.0
LU1	6	11.67	0.664	M	20.8	23.5	26.2	16.5	13.1
LU2	6	11.68	0.660	M	20.6	22.1	26.9	17.0	13.3
MA1	10	11.67	1.002	H	82.9	12.1	4.1	0.8	0.2
WE1	13	11.68	1.258	H	98.4	1.4	0.3	0.0	0.0
WE2	12	11.68	1.174	H	96.3	3.1	0.6	0.1	0.0
WE3	9	11.68	0.916	H	69.9	18.4	8.9	2.3	0.6
WE4	12	11.68	1.175	H	96.1	3.2	0.7	0.1	0.0
DR1	10	11.69	0.999	H	82.6	12.2	4.1	0.9	0.2
Control sites									
SE1	8	11.76	0.826	H	52.6	24.4	15.7	5.2	2.1
SE2	8	11.79	0.823	H	52.3	24.0	16.2	5.7	1.9
LB1	7	11.67	0.744	H	35.9	25.2	22.2	10.9	5.9
LB2	8	11.67	0.830	H	54.1	22.8	16.0	5.3	1.9
SA1	8	11.69	0.829	H	53.6	23.2	16.0	5.1	2.1
SA2	14	11.71	1.340	H	99.3	0.6	0.1	0.0	0.0

Table 7 Water quality indices at sites sampled during 2019 baseline and spring 2025

Site	**Density** (invertebrates.m^{-2})		**EPT** (%)		**BMWP Scoring taxa** (n)		**BMWP**		**ASPT**		**WHPT NTAXA** (n)		**WHPT BMWP**		**WHPT ASPT**		**PSI** (%)	
	2019	2025	2019	2025	2019	2025	2019	2025	2019	2025	2019	2025	2019	2025	2019	2025	2019	2025
Impact monitoring sites																		
LA1	180.4	111.5	85.2	86.2	8	10	39	45	4.9	4.5	8	10	50.0	65.6	6.25	6.56	64.7	52.2
GO1	303.8	132.7	87.1	89.0	10	9	52	42	5.2	4.7	11	9	73.4	55.2	6.67	6.13	60.7	76.5
CO1	236.8	73.8	80.4	59.2	13	9	69	48	5.3	5.3	15	10	93.6	64.4	6.24	6.44	60.7	63.2
EF1	248.0	222.4	66.1	79.1	10	12	56	68	5.6	5.7	11	14	74.4	91.1	6.76	6.51	68.2	72.0
WF1/1a	353.7	348.8	92.1	93.9	13	9	67	49	5.2	5.4	16	9	100	61.9	6.25	6.88	64.3	72.7
GR1	119.2	69.4	78.5	68.2	10	5	54	24	5.4	4.8	12	5	78.1	29	6.51	5.80	88.2	58.3
GR2	157.2	100.0	87.7	82.5	10	6	54	29	5.4	4.8	11	6	72.6	37.4	6.6	6.23	76.2	61.5
CR1	191.2	93.3	72.4	81.3	8	7	45	37	5.6	5.3	11	8	67.2	47.3	6.11	5.91	61.9	81.8
GI1	176.3	103.8	87.9	66.4	14	11	76	60	5.4	5.5	16	11	104.5	65.0	6.53	5.91	71.0	66.7
FL1	229.7	211.3	67.1	37.0	12	9	67	47	5.6	5.2	15	9	94.6	45.7	6.31	5.08	63.3	63.2
QU1	66.7	40.0	36.0	49.0	7	8	36	41	5.1	5.1	9	10	54.2	59.2	6.02	5.92	62.5	60.0
KI1	153.6	96.8	43.2	66.1	6	8	29	44	4.8	5.5	8	10	46.7	63.3	5.84	6.33	71.4	76.5
PW1	425.4	120.8	56.4	68.2	12	7	60	32	5.0	4.6	16	9	95	51.4	5.94	5.71	63.0	56.3
PW2	299.2	132.1	80.7	73.2	9	9	51	50	5.7	5.6	11	10	72.5	65.1	6.59	6.51	69.6	83.3
BF1	288.0	68.8	43.1	52.7	7	7	34	35	4.9	5.0	8	8	49.1	48.7	6.14	6.09	76.5	60.0
BF2	177.6	63.0	11.7	74.6	7	6	39	32	5.6	5.3	8	7	50.2	44.3	6.28	6.33	64.7	69.2
BF3	176.2	124.1	24.5	56.6	11	9	57	47	5.2	5.2	11	10	62.7	61.0	5.7	6.10	71.4	65.0
LM1	216.7	204.1	26.2	38.4	8	10	42	56	5.3	5.6	11	11	69.6	69.7	6.33	6.34	76.5	64.0
LU1	205.6	31.2	47.5	10.3	12	5	66	24	5.5	4.8	13	6	83.0	33.0	6.38	5.50	69.6	45.5
MA1	166.5	105.4	76.0	77.8	9	9	49	49	5.4	5.4	10	10	66.3	64.1	6.63	6.41	63.6	70.0
WE1	177.0	200.0	49.4	77.6	11	13	55	74	5.0	5.7	18	13	100.6	87.9	5.59	6.76	65.2	79.2
WE2	227.6	108.6	63.9	68.4	12	11	61	55	5.1	5.0	14	12	86.5	71.7	6.18	5.98	66.7	63.2
WE3	267.5	215.1	58.9	48.8	10	7	54	36	5.4	5.1	11	9	69.3	49.6	6.3	5.51	68.4	53.3
WE4	338.3	237.3	85.1	79.6	12	10	58	55	4.8	5.5	11	12	71.5	70.0	6.5	5.83	66.7	60.9
DR1	173.6	86.8	41.3	69.6	14	9	69	45	4.9	5.0	16	10	90	53.9	5.63	5.39	61.5	55.6
Mean	222.2	132.0	61.9	66.1	10.2	8.6	53.56	44.96	5.25	5.2	12.0	9.5	75.0	58.2	6.25	6.09	67.86	65.19
T	*5.97*		*0.98*		*3.02*		*2.74*		*0.85*		*3.89*		*3.93*		*1.57*		*1.07*	
P	***<0.001***		*0.335*		***0.006***		***0.011***		*0.406*		***0.001***		***0.001***		*0.13*		*0.297*	
Control sites																		
SE1	114.4	176.4	50.3	77.9	8	8	45	41	5.6	5.1	9	8	59.6	51.6	6.62	6.45	75.0	75.0
SE2	216.0	196.9	78.6	77.5	9	8	49	36	5.4	4.5	11	8	67.3	42.0	6.12	5.25	76.2	52.9
LB1	187.8	77.6	64.8	66.0	10	7	54	37	5.4	5.3	11	7	75.5	42.7	6.86	6.10	80.0	64.7
LB2	144.6	62.6	40.4	63.8	10	7	56	32	5.6	4.6	13	8	82.0	47.9	6.31	5.99	79.0	83.3
SA1	189.2	158.0	72.0	72.2	9	7	42	35	4.7	5.0	11	8	59.7	42.5	5.43	5.31	55.0	63.6
SA2	244.7	88.0	86.1	85.1	8	13	40	71	5.0	5.5	10	14	58.0	87.3	5.8	6.24	60.0	70.0
Mean	182.8	126.6	65.4	73.8	9.0	8.3	47.7	42.0	5.3	5.0	10.8	8.8	67.0	52.3	6.2	5.9	70.9	68.3
T	*4.35*		*1.54*		*0.54*		*0.72*		*1.11*		*1.52*		*1.52*		*1.54*		*0.47*	
P	***0.007***		*0.185*		*0.611*		*0.505*		*0.315*		*0.189*		*0.189*		*0.183*		*0.658*	

T and *P* values are results of paired T-tests comparing 2019 and 2024 spring data. Significant changes are highlighted by bold P values.

Table 8 Spring biomonitoring classifications in Burn of Lunklet and the TWE tributary, 2019 to 2025 (shaded cells are scores prior to contamination)

Site and year	Total Invertebrates (n)	Number of Taxa (n)	BMWP score	Scoring taxa (n)	ASPT score	WHPT score	WHPT scoring taxa (n)	WHPT ASPT	PSI	Water Chemistry status	%EPT
LU1											
2019	257	14	66	12	5.50	83.0	13	6.38	69.6	2	47.5
2021	322	12	52	9	5.78	74.5	11	6.77	68.4	2	64.9
2022	93	11	34	6	4.50	44.1	8	5.51	30.0	2	5.4
2023	11	5	7	3	2.33	7.2	2	3.60	25.0	2	9.3
2024	61	8	20	5	4.00	31.5	7	4.50	57.1	3	6.6
2025	39	8	24	5	4.80	33.0	6	5.50	45.5	2	10.3
LU2											
2023	54	7	25	6	4.17	30.4	5	6.08	30.0	3	11.1
2024	16	2	3	2	1.50	4.8	2	2.40	33.3	3	0.0
2025	112	6	20	5	4.00	30.7	6	5.12	42.9	3	1.8

7. Figures

Figure 1 Proportions of major invertebrate groups: percentages of sample by number spring 2025

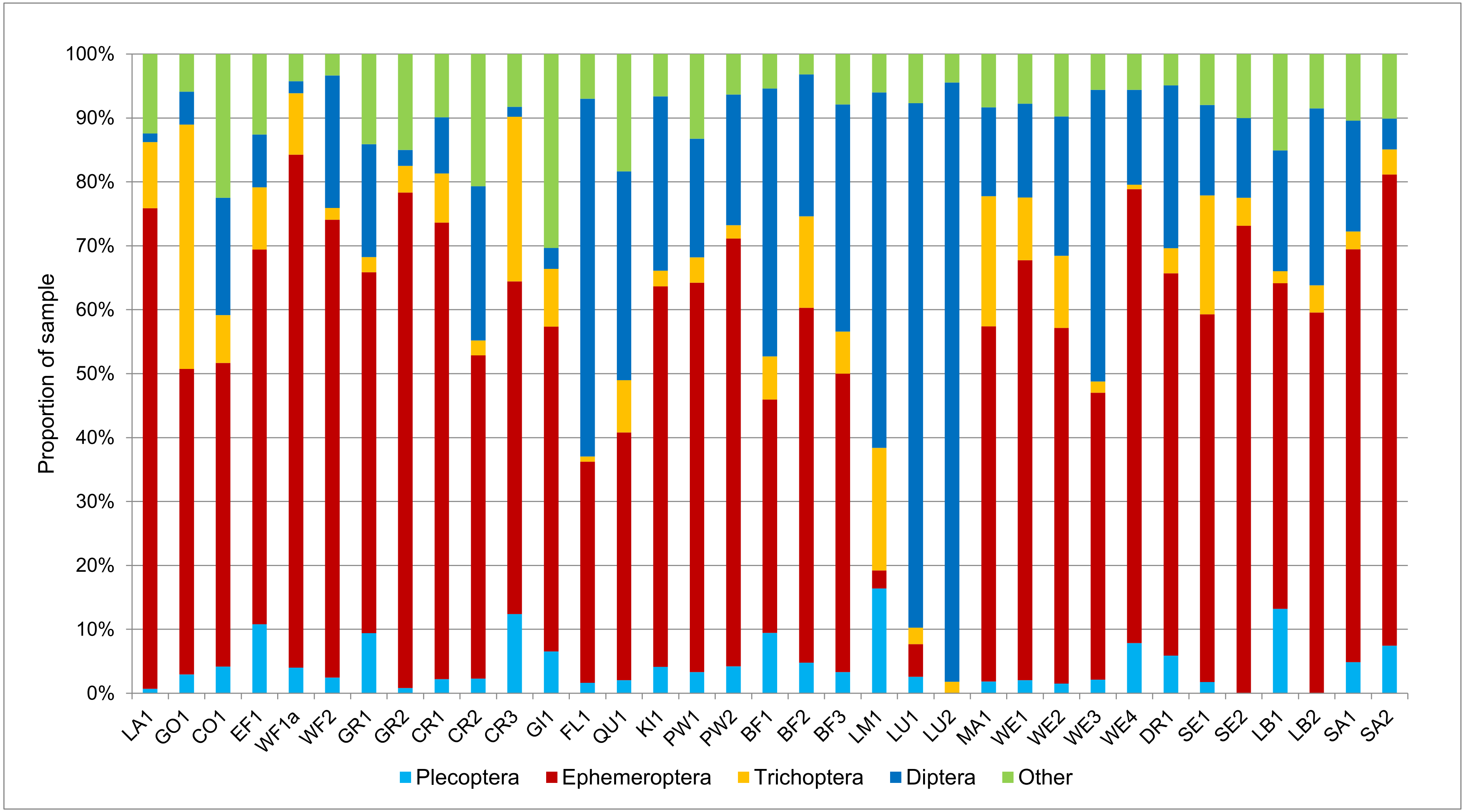
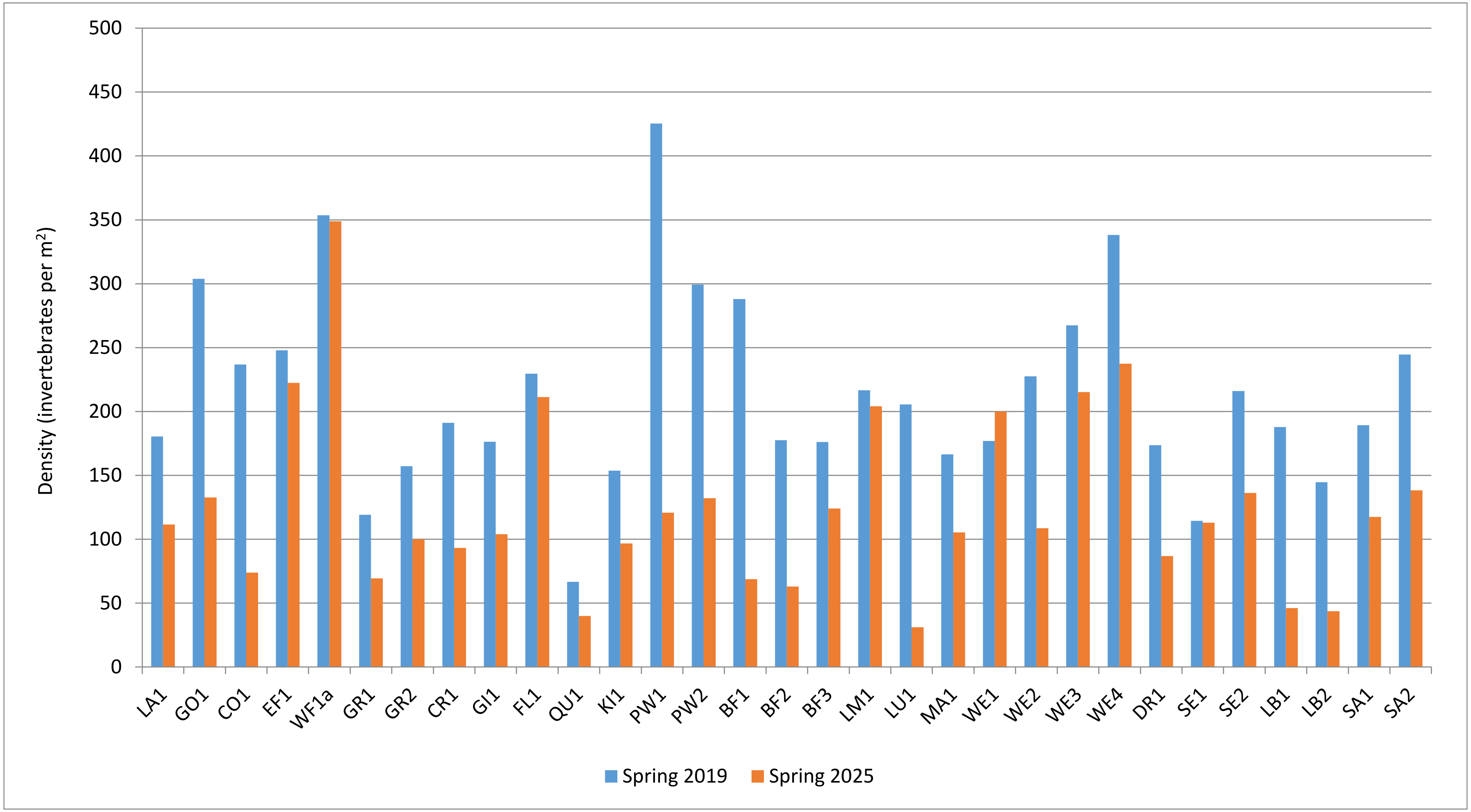


Figure 2 Density (number/m² kicked) of invertebrates in kick samples, spring baseline (2019) and spring 2025



Sites without 2019 baseline data not shown

8. Appendices

8.1. Pressure sensitivity (BMWP) Scores for Individual Taxa

Common Name	Family	BMWP score
Flatworms	Planariidae	5
	Dendrocoelidae	5
Snails	Neritidae	6
	Viviparidae	6
	Valvatidae	3
	Hydrobiidae	3
	Lymnaeidae	3
	Physidae	3
	Planorbidae	3
Limpets and	Ancylidae	6
Mussels	Unionidae	6
	Sphaeriidae	3
Worms	Oligochaeta	1
Leeches	Piscicolidae	4
	Glossiphoniidae	3
	Hirudididae	3
	Erpobdellidae	3
Crustaceans	Asellidae	3
	Corophiidae	6
	Gammaridae	6
	Astacidae	8
Mayflies	Siphlonuridae	10
	Baetidae	4
	Heptageniidae	10
	Leptophlebiidae	10
	Ephemerellidae	10
	Potamanthidae	10
	Ephemeridae	10
	Caenidae	7
Stoneflies	Taeniopterygidae	10
	Nemouridae	7
	Leuctridae	10
	Capniidae	10
	Perlodidae	10
	Perlidae	10
	Chloroperlidae	10
Damselflies	Platycnemidae	6
	Coenagriidae	6
	Lestidae	8
	Calopterygidae	8
Dragonflies	Gomphidae	8
	Cordulegasteridae	8
	Aeshnidae	8
	Corduliidae	8
	Libellulidae	8

Common Name	Family	BMWP Score
Bugs	Mesoveliidae	5
	Hydrometridae	5
	Gerridae	5
	Nepidae	5
	Naucoridae	5
	Aphelocheiridae	10
	Notonectidae	5
	Pleidae	5
	Corixidae	5
Beetles	Haliplidae	5
	Hygrobiidae	5
	Dytiscidae	5
	Gyrinidae	5
	Hydrophilidae	5
	Clambidae	5
	Scirtidae	5
	Dryopidae	5
	Elmidae	5
	Chrysomelidae	5
	Curculionidae	5
Alderflies	Sialidae	4
Caddisflies	Rhyacophilidae	7
	Philopotamidae	8
	Polycentropidae	7
	Psychomyiidae	8
	Hydropsychidae	5
	Hydroptilidae	6
	Phryganeidae	10
	Limnephilidae	7
	Molannidae	10
	Beraeidae	10
	Odontoceridae	10
	Leptoceridae	10
	Goeridae	10
	Lepidostomatidae	10
	Brachycentridae	10
	Sericostomatidae	10
True flies	Tipulidae* (Tipuloidea)	5
	Chironomidae	2
	Simuliidae	5

* includes Limoniidae and Pediciidae

8.2. *Acid intolerant indicators: Water Chemistry Status Groups*

Species	Normal minimum pH
Group 1	
Gammarus pulex	≥ 6.0
Glossosoma & Agapetus spp.	6.0
Ancylus fluviatilis	6.0
Radix balthica	6.0
Asellus aquaticus	6.0
Group 2	
Hydropsyche sp.	5.5 - 6.0
Baetis sp.	5.5 Occasionally 5.2
Heptageniidae	5.5 Occasionally 5.2

8.3. Invertebrate numbers present in kick samples, spring 2025

Taxon	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Plecoptera																																			
Chloroperlidae																																			
Chloroperla torrentium	1	4	5	27	4	6	8	1	2	2	11	3		1	1	5	1	6	1	3	20			1	4	2	1	1		2		6		7	7
Leuctridae																																			
Leuctra inermis				3	11	2					13	5	4		4		5	1	2	2	21	1		1	1		5	34	6			1			10
Ephemeroptera																																			
Baetidae																																			
Baetis rhodani	109	65	57	163	301	235	48	93	65	44	101	62	84	19	72	92	95	27	35	71	7	2		60	161	74	128	316	61	65	117	27	28	93	168
Trichoptera																																			
Glossosomatidae																																			
Agapetus fuscipes																5																			
Hydropsychidae																																			
Hydropsyche siltalai	11	35	2	10	30						43	4			1			5	9	5	29			11	11	13			2	9		1			
Hydroptilidae																																			
Hydroptila sp.																	1								8	1	5	1						3	
Limnephilidae																																			
Early instars	1									1			1																	1	1				
Halesus radiatus			1	2										1																					1
Potamophylax cingulatus				1					3							1					1				2			1	1						1
Philopotamidae																																			
Philopotamus montanus																													1						
Wormaldhia occipitalis																																	1		
Polycentropidae																																			
Plectronemia conspersa																	1				5	1	2												2
Polycentropus flavomaculatus			4	5							2						1				1			1							1				
Rhyacophilidae																																			
Rhyacophila dorsalis	3	17	2	9	6	6	2	5	4	1	5	7	1	3	2					5	12			10	3	1		1		11	5		1	1	5
Diptera																																			
Ceratopogonidae														1	1												3	1	2					2	2
Chironomidae	2	4	21	15	3	61	15	2	6	11	1	2	131	9	30	24	24	30	13	48	137	28	91	13	33	28	113	61	24	16	17	8	9	22	3
Empididae			1	6		1			2	10				5	1	3	4	1	1	3	2	4	13	2		1	14	2					1		
Limoniidae				1							1			1			1																		
Muscidae																																			

Taxon	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Limnophora sp.				1																															
Pediciidae						1		1																									1		
Dicranota sp.		3			4	4					1	2	4			1															3			1	1
Pedicia sp.																																	1		1
Simulidae						1							1		1					3			1		3			2				2	1		4
Coleoptera																																			
Dytiscidae														1									1												
Agabus sp.				1								1																	1						
Agabus guttatus				3																															
Hydraenidae																																			
Hydraena gracilis			1	1	3			1																	5					1					1
Scirtidae																																			
Elodes sp.		1				1						1					2								3	1									2
Hemiptera																																			
Corixidae female																										1									
Crustacea																																			
Gammaridae																																			
Gammarus duebeni									1			1	2																						
Mollusca																																			
Hydrobiidae																																			
Potamopyrgus antipodarum																																			6
Lymnaeidae																																			
Radix balthica	2																											1							
Sphaeriidae																																			
Pisidium sp.		1									3					1		1		1	2			1					1						
Hirudinea																																			
Erpobdellidae																																			
Helobdella stagnalis	1																									1	1				1				
Glossiphoniidae																																			
Glossiphonia complanata	1																																		
Oligochaeta																																			
Enchytraeidae	2		9	1	3	1	2	2	8	8	1	1	1	1	2	3		1	1	1	2	1	4		1	2	6	3	1	1	3	6	4	7	2
Lumbricidae	10	6	14	29	9	8	10	15		10	12	33	11	7	6	16	7	2	1	10	10	1		7	10	8	8	13	2	7	10	1		8	11
Lumbriculidae	2		3		1	1							3								1	1		1			1	8			2	1			1

8.4. BMWP, ASPT indicator groups present in kick samples with score, spring 2025

Taxon	LA1	GO1	CO1	EF1	WF1	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Plecoptera																																			
Chloroperlidae	10	10	10	10	10	10	10	10	10	10	10	10		10	10	10	10	10	10	10	10			10	10	10	10	10		10		10		10	10
Leuctridae				10	10	10					10	10	10		10		10	10	10	10	10	10		10	10		10	10	10			10			10
Ephemeroptera																																			
Baetidae	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		4	4	4	4	4	4	4	4	4	4	4	4
Trichoptera																																			
Hydropsychidae	5	5	5	5	5						5	5			5			5	5	5	5			5	5	5			5	5		5			
Hydroptilidae																	6								6	6	6	6						6	
Limnephilidae	7		7	7					7	7			7	7		7					7				7			7	7	7	7				7
Philopotamidae																													8				8		
Polycentropodidae			7	7							7						7				7	7	7	7	7	7					7				7
Rhyacophilidae	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7					7	7			7	7	7		7		7	7		7	7	7
Diptera																																			
Chironomidae	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Simulidae						5							5		5					5			5		5			5				5	5		5
Tipuloidea		5		5	5	5					5	5	5	5		5	5														5		5	5	5
Coleoptera																																			
Dytiscidae				5								5		5									5						5						
Hydraenidae			5	5	5			5																	5					5					5
Scirtidae		5				5						5					5								5	5									5
Hemiptera																																			
Corixidae																										5									
Crustacea																																			
Gammaridae									6			6	6																						
Mollusca																																			
Hydrobiidae																																			3
Lymnaeidae	3																											3							
Sphaeriidae		3									3					3		3		3	3			3					3						
Hirudinea																																			
Erpobdellidae	3																									3	3				3				
Glossiphoniidae	3																																		
Oligochaeta	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

8.5. Water Chemistry Status indicator groups and species present in kick samples

Taxon	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Group 1																																			
Agapetus sp.																✓																			
Gammarus duebeni									✓			✓	✓																						
Radix balthica	✓																											✓							
Group 2																																			
Baetis rhodani	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hydropsychidae	✓	✓	✓	✓	✓						✓	✓			✓			✓	✓	✓	✓			✓	✓	✓			✓	✓		✓			

8.6. PSI taxa groups present in kick samples and scores

Taxon	Group	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Chloroperlidae	A	2	2	2	3	2	2	2	2	2	2	3	2		2	2	2	2	2	2	2	3			2	2	2	2	2		2		2		2	2
Leuctridae	A				2	3	2					3	2	2		2		2	2	2	2	3	2		2	2		2	3	2			2			3
Baetidae	A	4	3	3	4	4	4	3	3	3	3	4	3	3	3	3	3	3	3	3	3	2	2		3	4	3	4	4	3	3	4	3	3	3	4
Glossosomatidae	A																2																			
Hydropsychidae	A	3	3	2	3	3						3	2			2			2	2	2	3			3	3	3			2	2		2			
Limnephilidae	B	1		1	1					1	1			1	1		1					1				1			1	1	1	1				1
Philopotamidae	A																													2				2		
Polycentropodidae	B			1	1							1						1				1	1	1	1	1	1					1				1
Rhyacophilidae	A	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2					2	3			3	2	2		2		3	2		2	1	5
Limoniidae	B				1							1			1			1																		
Pediciidae	B		1			1	1					1	1	1			1															1		1	1	1
Simulidae	A						2							2		2					2			2		2			2				2	2		2
Hydraenidae	B			1	1	1			1																	1					1					1
Scirtidae	B		1				1						1					1								1	1									1
Gammaridae	B									1			1	1																						
Dytiscidae	D				2								2		2									2						2						
Corixidae	D																										2									
Hydrobiidae	C																																			2
Lymnaeidae	D	2																											2							
Sphaeriidae	D		2									2					2		2		2	2			2					2						
Erpobdellidae	C	1																									1	1				1				
Glossiphoniidae	C	1																																		
Enchytraeidae	D	2		2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2
Lumbricidae	D	3	2	3	3	2	2	3	3		3	3	3	3	2	2	3	2	2	2	3	3	2		2	3	2	2	3	2	2	3	2		2	3
Lumbriculidae	D	2		2		2	2							2								2	2		2			2	2			2	2			2

8.7. WHPT BMWP and WHPT ASPT ABUND indicator groups present in kick samples with scores

Taxon	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Plecoptera																																			
Chloroperlidae	11.4	11.4	11.4	12.2	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	12.2	11.4		11.4	11.4	11.4		11.4	12.2			11.4	11.4	11.4		11.4	11.4	11.4		11.4	11.4	11.4	11.4
Leuctridae					9.3				9.3		9.3	9.3					9.3							9.3			9.3	10.6					9.3	9.3	9.3
Ephemeroptera																																			
Baetidae	5.9	5.9	7.2	7.2	7.2	7.2	5.9	7.2	5.9	7.2	7.2	7.2	5.9	5.9	5.9	7.2	5.9	5.9	5.9	5.9				3.6	7.2	7.2	5.9	7.2	5.9	7.2	7.2	5.9	5.9	7.2	5.9
Trichoptera																																			
Glossosomatidae																7.8																			
Hydropsychidae	5.8	7.2		5.8	7.2	5.8					7.2	7.2			5.8			5.8	7.2	5.8	7.2			7.2	7.2	7.2				7.2	5.8	5.8			
Hydroptilidae																										6.1									
Limnephilidae	5.9									5.9	5.9	5.9		5.9	5.9	5.9	5.9							5.9			5.9	5.9			5.9	5.9			5.9
Philopotamidae																																11.2	11.2		
Polycentropidae			8.2	8.1	8.2	8.2					8.2				8.2						8.2	8.2							8.2						
Rhyacophilidae	9.2	9.2	9.2	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1		8.1	8.1		8.1	8.1	9.2			8.1	8.1	8.1	8.1			9.2	9.2	8.1		8.1	8.1
Diptera																																			
Ceratopogonidae									5.4	5.4							5.4	1.3				1				5.4	5.4					5.4		5.4	
Chironomidae	1.2	1.3	1.3	1.3	1.2	1.2	1.3	1.3	1.3	1.3	1.2		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2
Empididae				7					7.6	7		7.0		7.0	7.6	7.0	7.0		7.0	7.0		7.0		7.0	7.0	7.0	7.6		7.0	7.0	7.0	7.0	7.0		
Tipuloidea		5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4		5.4	5.4					5.4				5.4	5.4		5.4		5.4	5.4			5.4
Muscidae				4												4																			
Simulidae	5.5		5.5	5.5			5.5	5.5		18	5.5	5.5			5.5	5.5	13			5.5					5.5				5.5	5.5		5.5	5.5	5.5	5.5
Coleoptera																																			
Dytiscidae				4.5		4.5							4.5									5.0													4.5
Elmidae																																			5.3
Hydraenidae		8.5			8.5							8.5													8.5										
Scirtidae											6.9					6.9	6.9								6.9	6.9				6.9		6.9	6.9	6.9	6.9
Hemiptera																																			
Corixidae					3.7																														
Crustacea																																			
Gammaridae									4.2				4.2																						
Mollusca																																			
Hydrobiidae																																			4.0
Lymnaeidae	3.6																									3.6									
Sphaeriidae			4.4			4.4		4.4			4.4	4.4			4.4		4.4							4.4	4.4										
Hirudinea																																			

Taxon	LA1	GO1	CO1	EF1	WF1a	WF2	GR1	GR2	CR1	CR2	CR3	GI1	FL1	QU1	KI1	PW1	PW2	BF1	BF2	BF3	LM1	LU1	LU2	MA1	WE1	WE2	WE3	WE4	DR1	SE1	SE2	LB1	LB2	SA1	SA2
Erpobdellidae	3.6													3.6		3.6										3.6			3.6						
Oligochaeta	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	3.6	2.3	2.3	3.6	2.3	2.3	3.6	2.3	2.3	2.3	3.6	2.3	2.3	3.6	3.6	3.6	2.3	3.6	3.6	2.3	2.3	3.6	2.3	2.3	3.6	3.6	2.3