

Loch Kemp Storage - EIA Report (Additional Information)

AI Appendix 12.1: Addendum to Loch Kemp Baseline Aquatic Surveys – Macroinvertebrates

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ash



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Storage**
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Introduction

Additional Information Requirements

Following the submission of the Section 36 application for the Loch Kemp Storage Scheme (the Proposed Development), it was brought to the attention of Gavia Environmental Ltd that some of the indices and the nomenclature of macroinvertebrate taxa used in the Volume 4, Appendix 12.1: Loch Kemp Baseline Aquatic Surveys of the EIA Report were now outdated. Additionally, whilst reviewing these indices it was discovered that certain taxa had been missed from the species lists in the initial Biological Monitoring Working Party (BMWP) score calculations in error, which may have affected the initial scores.

In response to the Section 36 application for the Proposed Development, one consultee requested that Walley, Hawkes, Paisley & Trigg (WHPT) scores should be provided, as this would help to identify more subtle differences in invertebrate communities and detect changes caused by pressures other than organic enrichment.

The raw species data sheets were externally reviewed by an accredited analyst, Riverwood Ecology, with scores recalculated and a fresh set of indices provided. A comprehensive suite of biotic indices now provides BMWP scores, Proportion of Sediment-sensitive Invertebrates (PSI) index, Community Conservation Index (CCI), Empirical Proportion of Sediment-sensitive Invertebrates (EPSI) index, WHPT metric and Lotic-invertebrate Index for Flow Evaluation (LIFE).

Methodology

Macroinvertebrate Surveys

Sampling

To collect aquatic macro-invertebrates, a combination of 'kick' sampling and 'sweep' sampling were deployed on watercourses identified which had the potential to be affected by the Proposed Development.

Kick sampling was conducted on riverine survey locations using the standard Scottish Environment Protection Agency (SEPA) / Environment Agency kick sample method. A three-minute kick sample was conducted in riffled areas, moving within the river to account for differences in substrate and habitat types. During each kick sample the net was held downstream of the surveyor, with its bottom edge in contact with the substrate. The surveyor kicked and dislodged the substrate, moving slowly backwards, and in an upstream direction. Invertebrates dislodged from the substrate were washed downstream and trapped in the net. This was followed by a one-minute manual search in which substrate too large to dislodge during the initial three-minute sample were over-turned and examined. To account for surface macroinvertebrate presence a further one-minute sweep was conducted in the shallow margins and across the surface of the river.

In lentic water systems such as Loch Kemp, Loch Ness, Loch Cluanie, Loch Pàiteag and Lochan a' Choin Uire, sweep sampling was the preferred method of sampling. This relied on a disturbance of the substrate and then a sweeping like motion in a figure of eight of the pond net through the water column to collect the sample (Chadd, 2010).

All macroinvertebrate samples were collected using a standard Freshwater Biological Association pond net (mesh diameter 1.0 x 1.0 mm); which was disinfected with Virkon S prior to and after use.

Invertebrates and substrate trapped in the pond net or collected during the manual search were stored in a labelled sample bucket (with a paper sample identification label also added to the sample container for security) for later extraction. The sample was fixed with bioethanol prior to analysis.

Analysis

Macroinvertebrate identification and indices compilation was conducted on several biotic score indexes.

Biological Monitoring Working Party (BMWP) measures the biological quality of rivers using invertebrates as indicators on five scores from: Very good; Good; Moderate; Poor and Very poor. The score related to the pollution tolerance of an invertebrate assemblage, and thus the biological quality of the river. Pollution sensitive families score higher than pollution tolerant families. The cumulative score of assigned values of species provides an indication of biological water quality.

Proportion of Sediment-sensitive Invertebrates (PSI) index measures the sedimentation impacts on watercourses based on the conditions fauna are adapted to. This is based on five categories: Heavily sedimented; Sedimented; Moderately sedimented; Slightly sedimented; and Minimally sedimented.

The Community Conservation Index (CCI) is an expression of conservation values and accounts for community richness and the relative rarity of macroinvertebrate species. Each species is assigned a conservation score of 1 – 10 based on a number of parameters ranging from 1 (Very common) to 10 (Red data book 1, Endangered). The sum of the conservation score is calculated and divided by the number of individuals contributing to mean CCI score. Scoring ranges from Low conservation value (conservation score of 0-5) to High conservation value (conservation score of >20).

Empirical Proportion of Sediment-sensitive Invertebrates (EPSI) index measures the sedimentation from fine sediments based on a scale from Dominated by fine sediment (0 score) to Minimal amounts of fine sediments (100 score).

Average Score Per Taxon (ASPT) is derived from the WHPT index and is calculated by dividing the total WHPT score by the Number of Scoring Taxa Present (NTAXA).

Lotic-invertebrate Index for Flow Evaluation (LIFE) assesses the flow conditions using macroinvertebrates, each assigned a LIFE score. The score for each taxa is added together and the total is divided by the number of scoring taxa/species

Results

In total, fourteen loch survey locations and thirteen riverine survey locations were investigated for the suitability of performing kick samples to collect aquatic invertebrates. Marginal areas on Loch Kemp, Lochan a' Choin Uire, Loch Cluanie, Loch Pàiteag and Loch Ness were examined for their suitability for performing sweep samples. Kick sampling was carried out at survey locations on the Allt a' Chinn Mhonaich, Allt an t-Sluichd, Allt Leachd Gowerie and Allt Paiteag.

Loch sampling was undertaken in July and September 2022 on all lochs within the site boundary, along the shoreline margins. Riverine samples were collected at strategic locations during September 2022. Macroinvertebrate samples were collected at locations likely to be affected by the Proposed Development and at 'control' locations either upstream of likely affected areas or outwith the site boundary. All samples were collected in areas which were suitable for safe access and had the ability to support aquatic invertebrates. Samples were sent off for professional analysis and identified to species level where practical to do so.

Updated biotic indices were calculated by Riverwood Ecology in 2024, following the submission of the Section 36 Application in November 2023. The sample from survey location K_L11 has been omitted from the results due to an issue with data loss, however there are three other survey locations within Lochan a' Choin Uire which give a comprehensive representation of the species present.

Results from Loch Aquatic Macroinvertebrate Samples are displayed in **Table 1** below. Results from Riverine Aquatic Macroinvertebrate Samples are displayed in **Table 2** below. Results and Survey Locations are also displayed in **Appendix A - Figure 5.0**.

A full taxa list (species) for loch and riverine species is provided in **Appendix B** and **Appendix C**.

Table 1. Loch Aquatic Macroinvertebrate Samples

Biotic Index	K_L1	K_L2	K_L3	K_L4	K_L5	K_L6	K_L7	K_L8	K_L9	K_L10	K_L12	K_L13	K_L14	K_L15
	Loch Kemp	Loch Kemp	Loch Kemp	Loch Kemp	Loch Pàiteag	Loch Pàiteag	Loch Pàiteag	Lochan a' Choin Uire	Lochan a' Choin Uire	Lochan a' Choin Uire	Loch Ness	Loch Ness	Loch Ness	Loch Cluanie
	NH 46775 16856	NH 47239 16272	NH 47232 16435	NH 46589 16342	NH 47494 15664	NH 47323 15582	NH 47428 15456	NH 46137 16459	NH 46048 16424	NH 45988 16415	NH 45665 16909	NH 45333 16555	NH 45200 16406	NH 47505 16392
	04/08/2022	04/08/2022	04/08/2022	23/09/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	29/07/2022	28/07/2022	28/07/2022	04/08/2022
BMWP (TL1)	76	72	78	75	54	85	91	77	46	95	50	56	91	61
NTAXA (TL1)	13	12	13	12	9	13	16	13	9	16	9	9	13	10
ASPT (TL1)	5.85	6.00	6.00	6.25	6.00	6.54	5.69	5.92	5.11	5.94	5.56	6.22	7.00	6.10
PSI (TL5)	25.00	58.33	75.00	66.67	18.18	46.67	15.38	21.43	10.00	50.00	62.50	100.00	84.21	50.00
PSI(FAM) (TL3)	33.33	50.00	57.89	66.67	20.00	33.33	16.00	20.00	10.00	50.00	62.50	81.82	82.35	25.00
E-PSI (TL5))	40.54	90.44	83.08	94.17	0.00	69.44	36.86	50.51	0.00	82.74	84.39	100.00	100.00	80.00
E-PSI (FAM)	53.10	100.00	91.21	89.26	0.00	55.86	26.61	30.94	0.00	71.12	89.24	100.00	100.00	36.53
CCI (TL5)	5.25	4.50	4.88	5.00	4.00	6.43	5.40	7.00	1.67	4.50	4.50	4.50	4.29	4.80
WHPT (TL2)	75.6	77.4	83.1	79.3	43.7	86.6	76.9	72	43.2	92.6	51.4	57.4	96.4	46
NTAXA (TL2)	13	13	14	13	10	14	17	13	10	17	9	9	14	10
ASPT (TL2)	5.82	5.95	5.94	6.10	4.37	6.19	4.52	5.54	4.32	5.45	5.71	6.38	6.89	4.60

Table 2. Riverine Aquatic Macroinvertebrate Samples

Biotic Index	K_R1	K_R2	K_R3	K_R4	K_R5	K_R6	K_R7	K_R8	K_R9	K_R10	K_R11	K_R12	K_R13
	Allt a' Chinn Mhonaich	Allt Paiteag	Allt Paiteag	Allt Paiteag	Allt Leachd Gowerie	Allt Leachd Gowerie	Allt Leachd Gowerie	Allt a' Chinn Mhonaich	Allt a' Chinn Mhonaich	Allt an t-Sluichd	Allt an t-Sluichd	Allt Paiteag	Allt Paiteag
	NH 45096 16197	NH 47244 16411	NH 47303 16408	NH 47413 16420	NH 46745 15710	NH 46774 15484	NH 46950 15046	NH 45929 15702	NH 45556 16050	NH 46779 16878	NH 46798 16923	NH 47848 16140	NH 47817 15696
	22/09/2022	22/09/2022	22/09/2022	22/09/2022	22/09/2022	22/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022
BMWP (TL1)	50	25	67	38	81	49	60	22	98	92	71	52	85
NTAXA (TL1)	8	5	11	6	13	10	9	5	15	15	12	10	14
ASPT (TL1)	6.25	5.00	6.09	6.33	6.23	4.90	6.67	4.40	6.53	6.13	5.92	5.20	6.07
LIFE (TL5)	8.83	8.50	9.25	8.50	8.29	7.57	8.60	7.33	8.53	8.29	7.82	8.22	7.80
LIFE(FAM) (TL2)	8.00	7.00	7.13	8.25	7.45	6.86	7.86	7.00	7.92	7.38	7.10	7.25	7.82
PSI (TL5)	100.00	75.00	91.67	100.00	90.48	65.00	100.00	66.67	83.72	82.93	74.29	80.00	77.78
PSI(FAM) (TL3)	81.82	60.00	82.35	100.00	82.35	38.46	100.00	50.00	77.78	83.33	59.09	70.59	81.82
E-PSI (TL5))	100.00	100.00	100.00	100.00	100.00	86.41	100.00	67.11	87.22	91.99	87.29	96.44	71.84
E-PSI (FAM)	87.88	99.00	100.00	100.00	96.54	93.30	100.00	64.44	83.71	94.49	91.27	96.14	93.57
CCI (TL5)	14.17	7.50	20.00	5.00	12.14	5.57	6.75	5.00	9.67	10.63	12.08	12.00	4.80
WHPT (TL2)	53.7	33.8	83.7	42.2	86.7	55.5	64.5	29.7	104.8	109.9	89.6	74	86.9
NTAXA (TL2)	8	6	12	7	13	10	9	6	15	16	14	12	14
ASPT (TL2)	6.71	5.63	6.98	6.03	6.67	5.55	7.17	4.95	6.99	6.87	6.40	6.17	6.21

Table 3. Glossary of Indices

Glossary:
NTaxa - Count of WHPT/BMWP family taxa in the sample
BMWP - Biological Monitoring Working Party score
ASPT - Average score per (BMWP/WHPT) taxon
WHPT - Whalley-Hawkes-Paisley-Trigg index
DEHLI - Drought Effect of Habitat Loss on Invertebrates
LIFE - Lotic-Invertebrate index for Flow Evaluation
PSI - Proportion of Sediment-sensitive Invertebrates
E-PSI - Empirically Weighted Proportion of Sediment-sensitive Invertebrates Index
CCI - Community Conservation Index (TL5 only)
TL1 - Taxonomic Level 1 - The 78 "BMWP family" level taxa in RIVPACS IV
TL2 - Taxonomic Level 2 - The 112 "WHPT family" level taxa in RIVPACS IV
TL3 - Taxonomic Level 3 - 'All Families'
TL5 - Taxonomic Level 5 - The 417 "WFD Species" level taxa in RIVPACS IV (including component members of species groups)

Table 4. Score Categories for BMWP, PSI and CCI

Key:		PSI/EPSI Score Category Interpretation		CCI Score Category Interpretation	
BMWP Score Category Interpretation					
0 – 10	Very poor	0 - 20	Heavily sedimented	0 - 5	Low conservation value
11 – 40	Poor	21 - 40	Sedimented	>5 - 10	Moderate conservation value
41 – 70	Moderate	41 - 60	Moderately sedimented	>10 - 15	Fairly high conservation value
71 – 100	Good	61 - 80	Slightly sedimented	>15 - 20	High conservation value
> 100	Very good	81 - 100	Unsedimented	>20	Very high conservation value

Discussion

Loch Sampling

In total, fourteen locations were sampled with surveys undertaken in Loch Kemp, Loch Pàiteag, Lochan a' Choin Uire, Loch Cluanie and the Loch Ness shoreline during July 2022.

Macroinvertebrate samples collected from Loch Kemp across four survey locations produced twenty-seven family groups. BMWP scoring was reflective of this deeming Loch Kemp "Good" across the four survey locations. WHPT scores ranged from 75.6 (K_R1) – 83.1 (K_L3). Community Conservation Index (CCI) scores for the Loch Kemp survey locations were deemed of *low conservation value* to *moderate conservation value*. The taxa collected were mainly generalists with the most abundant family groups across all four survey locations being that of *Oligochaeta* (aquatic and terrestrial worms), *Nemouridae* (Stoneflies) and *Corixidae* (Water boatman). In addition, the samples also contained a large number of the family group *Chironomidae* (non-biting midge).

Macroinvertebrate samples collected at Loch Pàiteag across three survey locations produced twenty-eight family groups. The loch was deemed "Moderate" to "Good" for BMWP score across the three survey locations. WHPT scores ranged from 43.7 (K_L5) – 86.6 (K_L6). Community Conservation Index (CCI) scores for the Loch Pàiteag survey locations ranged from low conservation value to *moderate conservation value*. The taxa collected were mainly generalists with the most abundant family group being that of *Chironomidae* (non-biting midge). In addition, the samples also contained an abundance of *Lymnaeidae* (common wandering snail), *Corixidae* (water boatman) and the family group *Daphniidae* (water fleas).

Macroinvertebrate samples collected from the Loch Ness shoreline across three survey locations produced twenty-one groups at the time of sampling. Survey locations K_L12 and K_L13 were deemed "Moderate" and K_L14 was deemed "Good" for BMWP score. WHPT scores ranged from 51.4 (K_L12) – 96.4 (K_L14). Community Conservation Index (CCI) scores for the Loch Ness survey locations were all deemed of *low conservation value*. The most abundant family group present was the *Chironomidae* (non-biting midge). The second largest group to be collected was *Leuctridae* (stoneflies), with the species *Leuctra hippopus* in abundance.

The samples collected from Lochan a' Choin Uire collected across three survey locations revealed twenty-seven family groups. Survey locations K_L8 and K_L10 were deemed "Good" and K_L9 was deemed "Moderate" for BMWP score. WHPT scores ranged from 43.2 (K_L9) – 92.6 (K_L10). Community Conservation Index (CCI) scores for the Lochan a' Choin Uire survey locations were deemed of *low conservation value* to *moderate conservation value*.

As with the results from Loch Kemp, Loch Pàiteag and Loch Ness Shoreline, the family of *Oligochaeta* were present in abundance. However, the most abundant family groups were found to be *Corixidae* (water boatmen) and *Gammaridae* (amphipod crustacean). Additionally, *Daphniidae* (water fleas) and *Lymnaeidae* (common wandering snail) were also found in large abundances. The large abundance of *Oligochaeta* is likely due to the high amount of organic matter / mud present with Lochan a' Choin Uire.

Loch Cluanie showed there being a low species abundance present during the time of the survey with only nine family groups present. The loch was deemed "Moderate" for BMWP score. Community Conservation Index (CCI) score for Loch Cluanie was deemed of *low conservation value*. The largest group collected were from the family *Gerridae* (Pond Skaters). Additionally, *Coenagrionidae* (narrow winged damselflies), were the second most abundant family group collected, with both *Coenagrion puella* and *Pyrrhosoma nymphula* present.

Of the species recorded, they were common and widespread taxa, typical of a range of habitat types. Within the samples collected, the species composition was that of marginal and lentic environments.

Chironomidae are responsible for most of the richness and abundance of aquatic communities, especially in naturally poor environments and are generally considered a pollution resistant group (Molineri *et al.*, 2020). In biomonitoring, a rather impoverished benthic community, dominated by this family, is generally attributed to bad water quality (Raunio *et al.*, 2007). This is reflected in biotic indices such as the WHPT (Walley Hawkes Paisley Trigg) biotic index which produces low scores and even negative scores based on their weighted abundance within a sample. However, this was not the case within the samples collected, which were generally more diverse. Larvae are often the dominant insects in the profundal and sublittoral zones of lochs.

Aquatic oligochaetes are benthic dwellers, occupying the sediments and decaying organic matter of most river and loch habitats, where they play a substantial eukaryotic role in decomposition. Most of these worms are

adapted to live in sediments ranging from sand to mud. They can be found in pockets of such sediments in stony habitats as well as in lowland rivers, lochs, and ponds where soft substrates are the norm. In biotic indices, this family scores relatively low when looking at weighted abundance and can produce negative scores if high abundances are contained within a sample, an indication that the family are also tolerant of pollution.

Species such as *Sericostoma personatum* are widespread throughout the UK and lake shores exposed to wave action with stony substrate (Elliot, 1969). The Small Silver Sedge (*Lepidostoma hirtum*) a species of caddisfly was recorded and is widespread in the north of the UK within habitats such as lakes with stony substrates. *Caenis luctuosa* is a species of small square-gilled mayfly which frequents margins of rivers and loch shores in the UK.

No red data book species (i.e. rare, vulnerable or endangered) were noted from the loch sampling conducted. Of the species recorded, they were predominantly common and widespread taxa, typical of a range of habitat types.

Riverine Sampling

In total 13 riverine survey locations were sampled which were undertaken in surrounding tributaries both in and outflowing to Loch Kemp (Allt Paiteag, Allt an t-sluichd and Allt Leachd Gowerie) and adjacent tributaries of Loch Ness which could be impacted by the Proposed Development (Allt a' Chinn Mhonaich). BMWP scores for riverine samples ranged from "Poor" (K_R2, K_R4, K_R8) to "Moderate" (K_R1, K_R3, K_R6, K_R7, K_R12) to "Good" (K_R5, K_R9, K_R10, K_R11, K_R13). This was reflected in the WHPT scores, which ranged from 29.7 (K_R8) to 109.9 (K_R10).

Community Conservation Index (CCI) scores for the riverine survey locations ranged from *low conservation value* (K_R13) to *moderate conservation value* (K_R2, K_R4, K_R6, K_R7, K_R8, K_R9) to *fairly high conservation value* (K_R1, K_R5, K_R10, K_R11, K_R12) to *high conservation value* (K_R3). High conservation value scores were in part due to the taxa list being so small, which skewed the CCI to a higher conservation value.

The most common and abundant family group present were *Oligochaeta* and *Chironomidae*. *Oligochaeta* can tolerate high silt concentrations and are tolerant of low dissolved oxygen levels which is a characteristic of deep silted environments. *Chironomidae* larvae require better oxygenated water, though they also exhibit a range of tolerances to pollution. They are more diverse in terms of substrate preference and can be found in a wider variety of aquatic environments. *Leuctridae* and *Nemouridae* (stoneflies) family groups were abundant across all riverine sample locations. These provide a dietary source for salmonid fish such as brown trout (*Salmo trutta*) which are present within watercourses across the Site. A diverse range of stonefly species was particularly prevalent at survey locations K_R10, K_R11 and K_R12 on the Allt an t-Sluichd and Allt Paiteag, where nine different taxa were recorded.

Samples collected were indicative of the species composition, which is typical of upland burns, with predatory caseless caddisfly species such as *Lepidostoma hirtum* noted along with stonefly families being common in small flowing and oxygen rich upland burns.

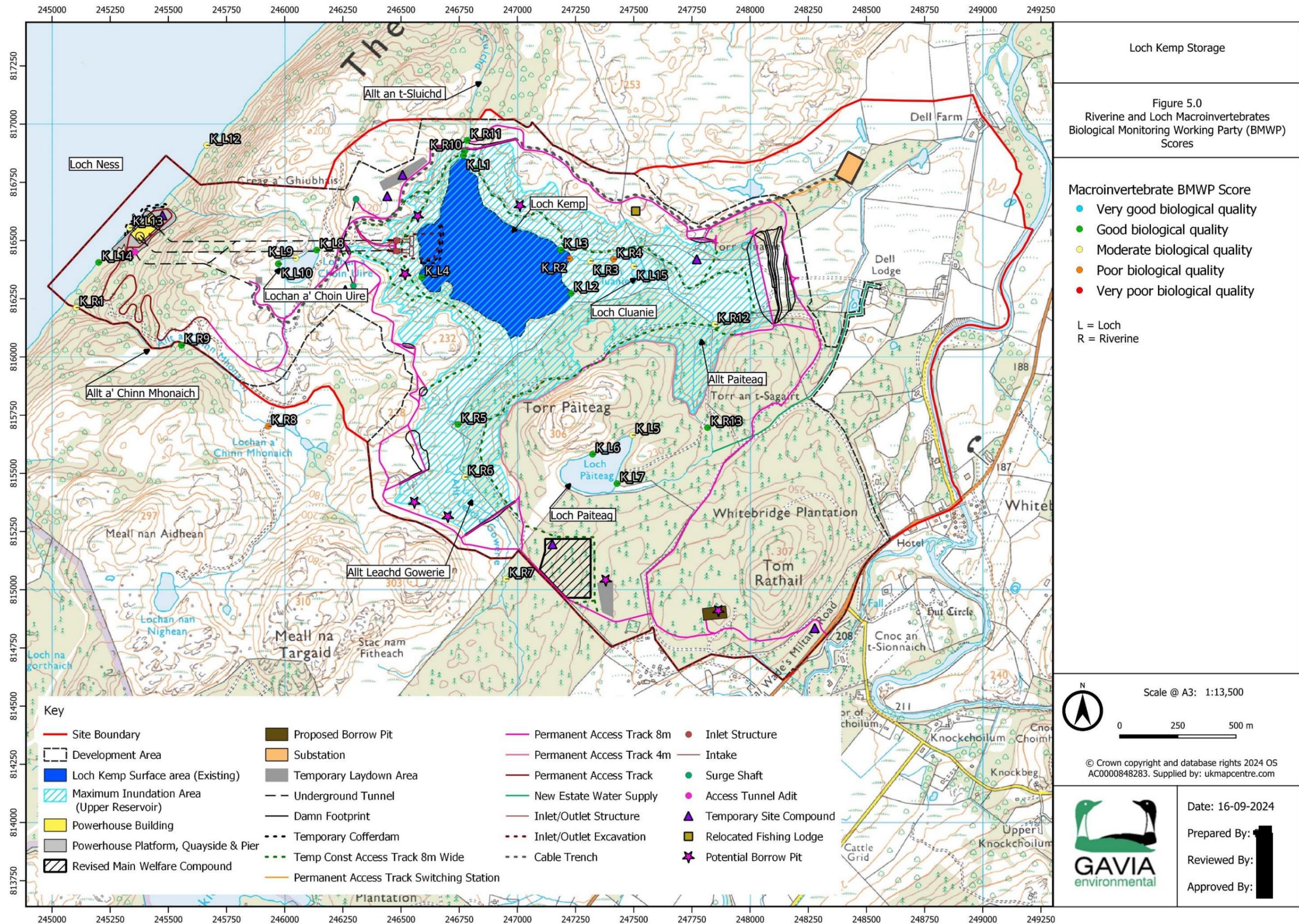
No red data book species (i.e. rare, vulnerable or endangered) were noted from the riverine sampling conducted. Of the species recorded, they were predominantly common and widespread taxa, typical of a range of habitat types.

Conclusion

Macroinvertebrate results from surveys conducted were fairly uniform throughout all survey locations. No red data book species were listed, (i.e. rare, vulnerable or endangered).

Both family groups *Oligochaeta* and *Chironomidae* were found in high abundance across the majority of sites. This large abundance of *Oligochaeta* is likely due to the high amount of organic silt present across the survey locations, especially within large areas of loch bed. Of the species recorded, they were common and widespread taxa, typical of a range of habitat types.

Appendix A – Riverine and Loch Macroinvertebrate Survey Locations & BMWP Scores



Appendix B

Loch Macroinvertebrate Taxa (Species) List

TAXA LIST			K_L1	K_L2	K_L3	K_L4	K_L5	K_L6	K_L7	K_L8	K_L9	K_L10	K_L12	K_L13	K_L14	K_L15	
			04/08/2022	04/08/2022	04/08/2022	23/09/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	05/08/2022	29/07/2022	28/07/2022	28/07/2022	04/08/2022
			Abundance														
AMPHIPODA	GAMMARIDAE	<i>Gammarus sp.</i>					1					39	1				
BIVALVIA	SPHAERIIDAE	<i>Sphaeriidae</i>							26	2		1					
COLEOPTERA	DRYOPIDAE	<i>Dryopidae</i>								2							
COLEOPTERA	DYTISCIDAE	<i>Dytiscus marginalis</i>														1	
COLEOPTERA	DYTISCIDAE	<i>Nebrioporus elegans</i>					1	1									
COLEOPTERA	ELMIDAE	<i>Elmis aenea</i>		2	2	2			1				2	1			
COLEOPTERA	ELMIDAE	<i>Esolus parallelepipedus</i>							1								
COLEOPTERA	ELMIDAE	<i>Limnius volckmari</i>			16									4	4		
COLEOPTERA	ELMIDAE	<i>Oulimnius sp.</i>		1					4			1					
COLEOPTERA	GYRINIDAE	<i>Gyrinidae</i>		1							1						
COLEOPTERA	HALIPLIDAE	<i>Brychius elevatus</i>			1			1									
COLEOPTERA	HYDROPHILIDAE	<i>Hydrophilidae</i>												1			
DIPLOSTRACA	DAPHNIIDAE	<i>Daphnia sp.</i>						31		34							
DIPTERA	CERATOPOGONIDAE	<i>Ceratopogonidae</i>				3		2							2		
DIPTERA	CHIRONOMIDAE	<i>Chironomidae</i>	21	1	2	8	31	29	11	3	3	23	15	2	42	2	
DIPTERA	MUSCIDAE	<i>Muscidae</i>										1					
DIPTERA	PEDICIIDAE	<i>Dicranota sp.</i>				1											
DIPTERA	PSYCHODIDAE	<i>Psychodidae</i>		1	2												
DIPTERA	TIPULIDAE	<i>Tipula sp.</i>			1												
EPHEMEROPTERA	CAENIDAE	<i>Caenis horaria</i>			2												
EPHEMEROPTERA	CAENIDAE	<i>Caenis luctuosa/macrura</i>	4					2	21			2					
EPHEMEROPTERA	EPHMERELLIDAE	<i>Serratella ignita</i>													15		
EPHEMEROPTERA	HEPTAGENIIDAE	<i>Ecdyonurus sp.</i>			8									16	7		
EPHEMEROPTERA	SIPHONURIDAE	<i>Siphonurus lacustris</i>						6		2							
GASTROPODA	LYMNAEIDAE	<i>Ampullaceana balthica</i>	3	13	7				34	12	14	3			1		
GORDIOIDA	N/A	<i>Nematomorpha</i>												1			
HEMIPTERA	CORIXIDAE	<i>Corixidae</i>	41				2	19	13	15	13	3				2	
HEMIPTERA	CORIXIDAE	<i>Sigara nigrolineata</i>							5	1	9						
HEMIPTERA	CORIXIDAE	<i>Sigara sp.</i>	9				1	1	9	1	4						
HEMIPTERA	GERRIDAE	<i>Gerridae</i>							1		1					4	
HEMIPTERA	GERRIDAE	<i>Gerris lacustris</i>														1	
HEMIPTERA	NOTONECTIDAE	<i>Notonecta sp.</i>														1	
HEMIPTERA	VELIIDAE	<i>Velia caprai</i>							12		2						
HEMIPTERA	VELIIDAE	<i>Velia sp.</i>					4	4			5						
HIRUDINEA	GLOSSIPONIIDAE	<i>Helobdella stagnalis</i>	4						1			8					
ISOPODA	ASELLIDAE	<i>Asellus aquaticus</i>					2		12				9				
MEGALOPTERA	SIALIDAE	<i>Sialis lutaria</i>	1						1								
ODONATA	AESHNIDAE	<i>Aeshnidae</i>								3						1	
ODONATA	COENAGRIONIDAE	<i>Coenagrionidae</i>	23				3	11		5							
ODONATA	COENAGRIONIDAE	<i>Coenagrion puella</i>	1	3			1	1	2	7		1				3	
ODONATA	COENAGRIONIDAE	<i>Coenagrion sp.</i>				3											
ODONATA	COENAGRIONIDAE	<i>Pyrrhosoma nymphula</i>														1	
ODONATA	CORDULEGASTRIDAE	<i>Cordulegaster boltonii</i>	1														
ODONATA	LIBELLULIDAE	<i>Libellulidae</i>							1		1					2	
OLIGOCHAETA	N/A	<i>Oligochaeta</i>	7	2	32	21		1		1	19	8	7	19	13		
PLECOPTERA	CHLOROPERLIDAE	<i>Chloroperlidae</i>	1														
PLECOPTERA	CHLOROPERLIDAE	<i>Siphonoperla torrentium</i>													1		

PLECOPTERA	LEUCTRIDAE	<i>Leuctra hippopus</i>	2	2	12			2	4	2		6	4	22	17	
PLECOPTERA	LEUCTRIDAE	<i>Leuctra sp.</i>			13			5						6	5	
PLECOPTERA	NEMOURIDAE	<i>Amphinemura sp.</i>				6										
PLECOPTERA	NEMOURIDAE	<i>Nemoura avicularis</i>				62										
PLECOPTERA	NEMOURIDAE	<i>Nemoura sp.</i>		7		19		9		1			4		1	
TRICHOPTERA	HYDROPSYCHIDAE	<i>Hydropsyche siltalai</i>				5										
TRICHOPTERA	HYDROPSYCHIDAE	<i>Hydropsyche sp.</i>				9										
TRICHOPTERA	HYDROPTILIDAE	<i>Hydroptila sp.</i>		1	13								1	3	34	
TRICHOPTERA	LEPIDOSTOMATIDAE	<i>Lepidostoma hirtum</i>		6		4		5			2		1			1
TRICHOPTERA	LEPTOCERIDAE	<i>Mystacides sp.</i>					2		1	1		1				
TRICHOPTERA	LEPTOCERIDAE	<i>Oecetis sp.</i>													1	
TRICHOPTERA	LEPTOCERIDAE	<i>Trienodes bicolor</i>								5						
TRICHOPTERA	LIMNPHILIDAE	<i>Halesus radiatus</i>	1									1				
TRICHOPTERA	LIMNPHILIDAE	<i>Limnephilidae</i>	1	2	1	4	5	2	9	2	8	1		1		1
TRICHOPTERA	LIMNPHILIDAE	<i>Potamophylax sp.</i>		1												
TRICHOPTERA	PHYRGANAEIDAE	<i>Agrypnia sp.</i>				1	6		7		3					
TRICHOPTERA	POLYCENTROPODIDAE	<i>Plectrocnemia conspersa</i>				3										
TRICHOPTERA	POLYCENTROPODIDAE	<i>Plectrocnemia sp.</i>				1										
TRICHOPTERA	POLYCENTROPODIDAE	<i>Polycentropodidae</i>				2										
TRICHOPTERA	POLYCENTROPODIDAE	<i>Polycentropus flavomaculatus</i>			1							1			1	
TRICHOPTERA	POLYCENTROPODIDAE	<i>Polycentropus sp.</i>										1				
TRICHOPTERA	SERICOSTOMATIDAE	<i>Sericostoma personatum</i>	9	4	4	8		2				3		3	19	
TROMBIDIFORMES	N/A	<i>Hydracarina</i>		3										2		
		Total No. of Taxa	16	16	16	18	12	18	22	18	13	19	10	12	15	12
		Total Abundance	129	50	117	162	59	130	180	99	83	106	48	77	163	20
		Sample Comments	N/A													

Appendix C

Riverine Macroinvertebrate Taxa (Species) List

TAXA LIST			K_R1	K_R2	K_R3	K_R4	K_R5	K_R6	K_R7	K_R8	K_R9	K_R10	K_R11	K_R12	K_R13
			22/09/2022	22/09/2022	22/09/2022	22/09/2022	22/09/2022	22/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022	23/09/2022
Order	Family	Taxa Name	Abundance												
AMPHIPODA	GAMMARIDAE	<i>Gammarus pulex/fossarum agg.</i>	12												16
COLEOPTERA	DRYOPIDAE	<i>Dryops sp.</i>		1											
COLEOPTERA	DYTISCIDAE	<i>Agabus/Ilybius sp.</i>					1						3	3	
COLEOPTERA	ELMIDAE	<i>Elmis aenea</i>				6					17	41	10	80	
COLEOPTERA	ELMIDAE	<i>Esolus parallelepipedus</i>									1	2			
COLEOPTERA	ELMIDAE	<i>Limnius volckmari</i>					6				16	59		51	
COLEOPTERA	ELMIDAE	<i>Oulimnius tuberculatus</i>												1	
COLEOPTERA	HELOPHORIDAE	<i>Helophorus minutus</i>						1					1		1
COLEOPTERA	HYDRAENIDAE	<i>Hydraena riparia</i>					1								
COLEOPTERA	HYDRAENIDAE	<i>Hydraena riparia group</i>			1										
COLEOPTERA	HYDROPHILIDAE	<i>Anacaena globulus</i>											1		
COLEOPTERA	SCIRTIDAE	<i>Elodes sp.</i>			4				3			26			
DIPTERA	CERATOPOGONIDAE	<i>Ceratopogonidae</i>		1	2	1				1			1	2	
DIPTERA	CHIRONOMIDAE	<i>Chironomidae</i>	4	16	66	2	32	56	3	2	17	103	51	23	51
DIPTERA	EMPIDIDAE	<i>Empididae</i>													1
DIPTERA	PEDICIIDAE	<i>Dicranota sp.</i>									2			5	
DIPTERA	SIMULIIDAE	<i>Simulium aureum group</i>			7									4	
DIPTERA	SIMULIIDAE	<i>Simulium sp.</i>			27		9					5	12		17
DIPTERA	TIPULIDAE	<i>Prionocera sp.</i>			2										
EPHMEROP-TERA	AMELETIDAE	<i>Ameletus inopinatus</i>											1		
EPHMEROP-TERA	BAETIDAE	<i>Baetis niger</i>					1								
EPHMEROP-TERA	BAETIDAE	<i>Baetis rhodani/atlanticus agg.</i>									10	21	9		3
EPHMEROP-TERA	CAENIDAE	<i>Caenis rivulorum</i>						1							
EPHMEROP-TERA	EPHEMERELLIDAE	<i>Serratella ignita</i>									19				
EPHMEROP-TERA	HEPTAGENIIDAE	<i>Ecdyonurus sp.</i>			1	1			1		5				
EPHMEROP-TERA	LEPTOPHLEBIIDAE	<i>Habrophlebia fusca</i>										2			10
EPHMEROP-TERA	LEPTOPHLEBIIDAE	<i>Paraleptophlebia sp.</i>					2					3			9
GASTROPODA	LYMNAEIDAE	<i>Stagnicola palustris/fuscus/corvus agg.</i>						2							
HEMIPTERA	VELIIDAE	<i>Velia caprai</i>										4	2		
HEMIPTERA	VELIIDAE	<i>Velia sp.</i>										2			
HIRUDINEA	GLOSSIPHONIIDAE	<i>Helobdella stagnalis</i>						9							
MEGALOPTERA	SIALIDAE	<i>Sialis fuliginosa</i>	7								1				
MEGALOPTERA	SIALIDAE	<i>Sialis lutaria</i>								11	14	4			6
ODONATA	COENAGRIONIDAE	<i>Coenagrion sp.</i>													
ODONATA	CORDULEGASTRIDAE	<i>Cordulegaster boltonii</i>									11				
OLIGOCHAETA	N/A	<i>Oligochaeta</i>	2	1	12	1	3	21	5	4	52	5	3	1	11
PLECOPTERA	LEUCTRIDAE	<i>Leuctra hippopus</i>	3	1	8	3	12	7		1	12	21	17	17	2
PLECOPTERA	LEUCTRIDAE	<i>Leuctra inermis</i>	2						1		9	2	2	4	5
PLECOPTERA	LEUCTRIDAE	<i>Leuctra sp.</i>	13	3	76	3	9	11		3	19	9	13	103	21
PLECOPTERA	NEMOURIDAE	<i>Amphinemura sp.</i>										3	27	24	
PLECOPTERA	NEMOURIDAE	<i>Amphinemura sulcicollis</i>										7	5	19	

PLECOPTERA	NEMOURIDAE	<i>Nemoura avicularis</i>									3	17	10		
PLECOPTERA	NEMOURIDAE	<i>Nemoura sp.</i>			17			8			15	58	70		
PLECOPTERA	NEMOURIDAE	<i>Protonemura meyeri</i>			31		3				22	8	5		
PLECOPTERA	NEMOURIDAE	<i>Protonemura sp.</i>			74		4				34	31	39		
PLECOPTERA	PERLODIDAE	<i>Dinocras cephalotes</i>	2						7						
PLECOPTERA	PERLODIDAE	<i>Isoperla grammatica</i>					1			1				1	
TRICHOPTERA	HYDROPTILIDAE	<i>Hydroptila sp.</i>						1						4	
TRICHOPTERA	HYDROPSYCHIDAE	<i>Diplectrona felix</i>						6							
TRICHOPTERA	HYDROPSYCHIDAE	<i>Hydropsyche pellucidula</i>							1	12					
TRICHOPTERA	HYDROPSYCHIDAE	<i>Hydropsyche siltalai</i>						4	1	9	2		2		
TRICHOPTERA	HYDROPSYCHIDAE	<i>Hydropsyche sp.</i>						3		8				1	
TRICHOPTERA	LEPIDOSTOMATIDAE	<i>Lepidostoma hirtum</i>					1				8				
TRICHOPTERA	LIMNAPHILIDAE	<i>Limnephilidae</i>	5		14		2		3	4	22	5	2		
TRICHOPTERA	LIMNAPHILIDAE	<i>Potamophylax cingulatus</i>								2	5				
TRICHOPTERA	LIMNAPHILIDAE	<i>Potamophylax sp.</i>						2		2	7	2			
TRICHOPTERA	ODONTOCERIDAE	<i>Odontocerum albicorne</i>	1		1			1			1				
TRICHOPTERA	PHRYGANEIDAE	<i>Agrypnia sp.</i>													
TRICHOPTERA	POLYCENTROPODI- DAE	<i>Plectrocnemia conspersa</i>		1										2	
TRICHOPTERA	POLYCENTROPODI- DAE	<i>Plectrocnemia sp.</i>		2						1					
TRICHOPTERA	POLYCENTROPODI- DAE	<i>Polycentropodidae</i>		3										7	
TRICHOPTERA	POLYCENTROPODI- DAE	<i>Polycentropus sp.</i>								1	1			2	
TRICHOPTERA	SERICOSTOMATIDAE	<i>Sericostoma personatum</i>				1		2		3		1		1	
		Total No. of Taxa	10	9	16	8	15	14	10	7	25	29	23	21	19
		Total Abundance	51	29	343	18	87	131	28	23	248	439	280	466	170
		Sample Comments	N/A												