



ABI ENVIRONMENTAL
SERVICES

April 25, 2024

Ms. Sarah MacDonald
Watershed Science Coordinator
Athabasca Watershed Council
5101- 50th Avenue, PO Box 1058
Athabasca, AB, T9S 2A8
Science@awc-wpac.ca

Dear Sarah,

Please find following, our report on the benthic macroinvertebrates from sites in the Athabasca watershed. In this report you will find the taxa and occurrence (total count) of macroinvertebrates per site, a list of the CABIN excluded taxa per site and quality control assurances. We have followed the CABIN protocol as outlined in the CABIN Laboratory Methods (2021) for subsampling, sorting, taxa identification and the auditing protocols. A digital copy in Excel is provided with the first tab containing the chain of custody form, the second the CABIN QA QC CL form, the third tab is clean data, followed by the tabulated data (included taxa) and finally the CABIN-ready data for upload. It is recommended that the CABIN-ready data be copied and pasted into CABIN Excel template (also supplied) for uploading.

We have identified 93% of the organisms present in this analysis to the genus-level. In a few cases, invertebrates were identified to the family level because they were too immature, no keys were available to the generic level or were too damaged to proceed to the genus level.

In terms of 'interesting' taxa from your material to be honest there was nothing that stands out as remarkable relative to what we have seen in the previous two years from your sites. At the same time though, each year both the number of families and genera collected have increased. Given the method of subsampling CABIN requires, it is probable that there are more distinct fauna to find at these sites. The invertebrates were mature, indicating sampling occurred at the optimal time at these sites.

If we can arrange a time, we would like to visit you do a bit of collecting with you, and if we can, give a talk. It has been our pleasure to work with you and the Athabasca Watershed Council. We hope that these data meet your expectations, and we would be delighted to work with you again. If you have any questions or require further information, please don't hesitate to contact us.

Yours sincerely,

Diane Edwards, PhD, P.Ag (#4277) & John Swann, PhD(Cand.), P.Biol (#6336)

3911 VARSITY DR. NW
CALGARY, AB, T3A 0Z3

OFFICE/FAX 403-247-6363
CONTACT@ABIENVIRONMENTAL.CA



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Report of Benthic Macroinvertebrates

Athabasca Watershed 2023

Taxonomy, Methods, and Quality Control

For

Athabasca Watershed Council

April 25, 2024

Prepared by:
Diane Edwards & John Swann
ABI Environmental Services LTD
Calgary, AB

3911 VARSITY DR. NW
CALGARY, AB, T3A 0Z3

OFFICE/FAX 403-247-6363
CONTACT@ABIENVIRONMENTAL.CA



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LAND ACKNOWLEDGEMENT

ABI Environmental Services is in the traditional territories of the Niitsitapi (Blackfoot) and the people of the Treaty 7 region in Southern Alberta, which includes the Siksika, the Piikuni, the Kainai, the Tsuut'ina, and the Iyârhe Nakoda. We are situated on land where the Bow River meets the Elbow River, and the traditional Blackfoot name of this place is "Mohkinstsis" which we now call the City of Calgary. The City of Calgary is also home to Metis Nation of Alberta, Region III.

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Sample Reception

Samples of benthic macroinvertebrates were collected from six sites by personal from the Athabasca Watershed Council using a kicknet (400um) and the CABIN method. The samples were received by ABI Environmental Services on October 06, 2023. All sample containers were found to be free from damage. The benthic invertebrates from each sampling site were collected in 500 ml labelled containers (jars) (Table 1). The preservative in each container was replaced with 70% ethanol on October 9, 2023. UAB002 (Gregg River U/S), UAB004 (McLeod River D/S) and UAB006 (Embarras River) were transferred to 1 L jars as they were very full of vegetation. Given that CABIN recommends that sample jars be only one third to one half full of sample we'd suggest in the future to take either larger jars (1L) or multiple 500 ml jars to these sites as the degree of vegetation is probably the natural environment of these sites.

Sample Processing

Some samples contained significant amounts of macrophytes (twigs, leaves), silt/mud and sand. Large plant material like twigs and leaves were rinsed and then removed from the samples and discarded. The amount of smaller macrophytes and the silt/mud, gravel and sand were reduced in the samples by washing and sieving to separate the invertebrates from this debris. Samples were emptied on to stacked sieves, in order from the top: 4000 um, 2360 um and 400 um, and then gently washed with water. A pan or basin was placed under the bottom sieve (400 um). The large vegetation and substrate resting on the 4000 and 2360 um sieves were gently washed with water, inspected for invertebrates, and discarded. Any large invertebrates captured on the coarse sieves were transferred to a temporary holding jar. The contents resting on the sieves were inverted into a basin and gently washed into a shallow white pan. These invertebrates from the coarse and fine fractions were combined. Samples with coarse and fine (sand) particulates were also inspected for invertebrates and if any found were removed and add to the white pan. The fraction that passed through the 400-um sieve was inspected for invertebrates and none were found. This procedure was repeated for all 6 samples.

Subsampling and Sample Sorting

The invertebrates in the white pan were inspected and roughly counted to determine if subsampling was necessary. Subsampling was carried out as the invertebrates were found to be abundant in samples from all 6 of the sites (Table 2). The method of subsampling was accomplished following the CABIN procedure (Martens et al., 2021). Briefly, the samples were mixed with water and transferred to a Marchant box. The Marchant box was sealed, inverted, swirled, and quickly righted. Using a random number generator from Excel, the first five cells of the Marchant Box were selected, and the inverts removed to watch glasses using a transfer pipette. The inverts in each watch glass were counted and rough sorted into major taxa groups. If at least 300 organisms of the taxa of interest (listed in Table 4) were not reached in these five cells, additional cells were randomly chosen until the 300-



organism criterion was reached. If the count was met partway through the cell the entire cell contents was counted as per the CABIN protocol. At the end of sorting these invertebrates were placed in labeled glass vials with 70% ethanol. Excluded taxa were identified and noted (Table 5). For each of the samples, the sorted fractions (invertebrates removed) were bulked together, labeled as "sorted" and retained for auditing. For each of the samples, the unsorted fractions were labelled as "unsorted" and transferred back to their original containers and retained. These fractions will be retained for 90 days.

Sorting Audit Protocol

Three of the eleven samples (30%) were randomly chosen for resorting by another team member. Sorting precision was calculated as percent sorting efficiency (% SE) using the CABIN method.

$$\%SE = \left(1 - \frac{\# \text{ of Organisms Missed}}{\text{Total \# of Organisms Found}}\right) * 100$$

The sorting efficiency is in Table 3, the samples met or exceeded the CABIN protocol of 95% with an average sorting efficiency of 97.4% (Table 3).

Identification and Taxonomy

The rough sorted samples were further examined to identify organisms to the lowest taxonomic level possible. During identification the taxa were entered on paper data sheets and then transferred to an Excel spreadsheet. The CABIN protocols for effort and identification level of respective taxa were followed as closely as possible. In the case of Chironomidae, temporary glycerin slide mounts of dissected specimens were made to confirm identifications to the genus level. Where there were disarticulated specimens only those with heads were counted to avoid double counting specimens. There were also exuviae from larval moults in some samples that were not counted as this may have been double counting specimens present or counting specimens that were not in the sampled portion of the stream bed as exuviae tend to float downstream after a moult. This is especially true for Ephemeroptera. Where possible pupal keys were used to identify fly pupae to family/genus.

Counts per taxa and sample were summarized using a Pivot Table in Excel. Taxa counts for the subsampled (all 6 sites) samples were calculated as Count and Total Count. Total Count was calculated as the number per subsample scaled up to 100% and is the number of inverts present in an entire sample. The Count and Total Count data are presented in Tables 2 and 7, respectively. The number of organisms identified (Count) in the included taxa from the sub-samples were 2469 (Table 2). To facilitate comparisons among the samples, the subsampled collections were scaled up to a full sample (Total Count), with the total number of organisms being 37,198 (Tables 2 and 7). These organisms were distributed among 37 families and 65 genera (Table 7).



Auditing Protocol

The auditing protocol was performed on the same samples as the sorting efficiency. We followed the CABIN protocol for determining the Identification Error Rate and tabulated the incorrect identifications and missed organisms (Table 6A, 6B and 6C). The Identification Error Rate for samples UAB002, UAB005 and UAB007 were 0%, 0% and 0%, respectively. These error rates were within the tolerances for CABIN (%IE ≤ 5%).

$$\% \text{ Identification Error} = \left(\frac{\# \text{ Incorrect Identifications}}{\text{Total \# of Organisms in Audit}} \right) * 100$$

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Equipment List

- Tyler stainless steel and brass sieves: 13.3 mm, 4000 um, 2000, 1000 um and 400 um
- Catchment pan and basins
- Marchant box for subsampling
- Tools: Transfer pipettes, forceps, acid free paper, squeeze bottles
- Watch glasses – several diameter sizes: 6.5, 8.5, 10.5 cm
- Mason Jars: 125, 250, 500 and 1000 ml
- 70% Ethanol
- Glass vials with screw tops
- Glycerin for temporary slides, slides and cover slips
- Dissecting microscopes: Leica MZ6 and Leica MS5 (4 – 80X)
- Compound microscope Olympus CX41 (40-1000X)
- Light sources: two MI-150 Fiber-lights



Tables

Table 1. Sample reception – field site/sample identification and description, number and size of collection jars and date of collection from Upper McLeod River, Athabasca 2023.

No.	Sample ID	Field Site Description	Jar # & Size	Transfer Jar	Date Collected	Date Received ^A	Condition
1	UAB002	Gregg River U/S Test	1 – 500 ml	1 L	2023-10-02	2023-10-06	Very full, Algae - present
2	UAB003	Whitehorse Creek Potential Ref	1 – 500 ml	-	2023-10-02	2023-10-06	Unremarkable
3	UAB004	McLeod River D/S Test	1 – 500 ml	1L	2023-10-03	2023-10-06	Very full, Plant debris - medium
4	UAB005	McLeod River U/S Test	1 – 500 ml	1L	2023-10-03	2023-10-06	Very Full Unremarkable
5	UAB006	Embarras River Test	1 – 500 ml	-	2023-10-03	2023-10-06	Algae - present
6	UAB007	Gregg River D/S Test	1 – 500 ml	-	2023-10-02	2023-10-06	Unremarkable

A. Alcohol changed in jars by Oct 9, 2023.



Table 2. Subsampling effort and measured and calculated number of invertebrates per sample, Upper McLeod River, Athabasca 2023.

Sample ID	Number of cells sampled from Marchant box ¹	No. of organisms in subsamples ²	Total number of organisms in sample
UAB002	7	408	5829
UAB003	9	388	4311
UAB004	6	383	6383
UAB005	11	347	3155
UAB006	5	541	10820
UAB007	6	402	6700
Total		2469	37198

1. A Marchant box has 100 cells, this is the number/percentage sampled to reach at least 300 organisms. 2. Taxonomy performed on these organisms.



Table 3. Sorting efficiency (SE) for three randomly selected samples Upper McLeod River, Athabasca 2023.

Sample ID	Original Count	QA Audit Count	Comments	% SE
UAB002	396	408	12 Missed: 5 <i>Ameletus</i> , 2 <i>Cricotopus</i> , 2 <i>Eukiefferiella</i> , 1 <i>Leptophlebia</i> , 1 <i>Malenka</i> , 1 <i>Perlidae</i>	97.1
UAB005	337	347	10 Missed: 2 <i>Cricotopus</i> , 6 <i>Eukiefferiella</i> , 1 <i>Leptophlebia</i> , 1 <i>Nemouridae</i>	97.1
UAB007	394	402	8 missed: 1 <i>Brillia</i> , 3 <i>Cricotopus</i> , 1 <i>Ephemerella</i> , 1 <i>Eukiefferiella</i> , 1 <i>Leptophlebia</i> , 1 <i>Feltria</i> ,	98.0
Average % Sorting Efficiency				97.4

Table 4. Standard taxonomic effort for practical Identification.

Group	Taxa	Attained Level of Identification
Insects	Coleoptera	Family/Genus
	Diptera	Family/Genus
	Ephemeroptera	Family/Genus
	Plecoptera	Family/Genus
	Trichoptera	Family/Genus
Non-insects		
	Enchytraeidae (Annelida)	Family
	Gordioidea (Nematomorpha)	Family/Genus
	Lymnaeida (Bivalve)	Family/Genus/Species
	Tricladida (Platyhelminthes)	Family/Genus
	Trombidiformes (Mite)	Family/Genus
	Tubificida (Annelida)	Family/Genus



Table 5. Excluded Taxa -Total Count per site, Upper McLeod River, Athabasca 2023.

Taxonomic Group	UAB002	UAB003	UAB004	UAB005	UAB006	UAB007	Total
Coleoptera Lathridiidae						17	17
Diptera Chironomidae				9			9
Diptera Empididae			33			33	66
Hemiptera Rhyparochromidae				9			
Hymenoptera Formicidae					20		20
Metacopina	14		50	9		33	107
Total	14		83	27	20	83	228

Table 6A. Identification error rate for sample UAB002, Upper McLeod River, Athabasca 2023.

Order	Family	Genus	Raw Count	Audit Count	Audit Flag	IE Error	Comments
Ephemeroptera	Baetidae		10	7			(-3) Enumeration
Total			10	7			
Total organisms in audit			411	408			
Average % Identification Error Rate						0%	Pass



Table 6B. Identification error rate for sample UAB005, Upper McLeod River, Athabasca 2023.

Order	Family	Genus	Raw Count	Audit Count	Audit Flag	IE Error	Comments
Ephemeroptera	Heptageniidae	<i>Rhithrogena</i>	10	11			(+1) Enumeration
Total			10	11			
Total organisms in audit			346	347			
Average % Identification Error Rate						0%	Pass

Table 6C. Identification error rate for sample UAB007, Upper McLeod River, Athabasca 2023.

Order	Family	Genus	Raw Count	Audit Count	Audit Flag	IE Error	Comments
Ephemeroptera	Leptophlebiidae	<i>Leptophlebia</i>	42	46			(+4) Enumeration
Ephemeroptera	Ephemerellidae	<i>Serratella</i>	25	22			(-3) Rolled up to family, no caudal cerci
Ephemeroptera	Ephemerellidae		0	3			(+3) Enumeration
Plecoptera	Capniidae	<i>Capnia</i>	19	18			(-1) Enumeration
Plecoptera	Nemouridae	<i>Malenka</i>	10	8			(-2) Enumeration
Total			96	97			
Total organisms found in audit			401	402			
Average % Identification Error Rate						0%	Pass



Table 7. Total count of benthic macroinvertebrates from field sites in Upper McLeod River, Athabasca 2023.

Taxonomic Group	UAB002	UAB004	UAB006	UAB003	UAB005	UAB007	Total
Order: Coleoptera							
Family: Elmidae							
<i>Heterlimnius</i>	43	67	300			67	476
<i>Zaitzevia</i>	43					17	60
Order: Diptera							
Family: Chironomidae	29		20				49
<i>Ablabesmyia</i>	29		40				69
<i>Brillia</i>		17	120			100	237
<i>Cardiocladius</i>						17	17
<i>Cricotopus</i>	514	133	2900	133	100	383	4164
<i>Diamesa</i>	57		20	33	73	100	283
<i>Eukiefferiella</i>	1757	200	2220	300	355	1117	5948
<i>Krenosmittia</i>		33					33
<i>Orthocladius</i>	57	33		189	9	17	305
<i>Pagastia</i>	14	17	40	89			160
<i>Parakiefferiella</i>	14		80	11		17	122
<i>Polypedilum</i>		33	20	11		50	114
<i>Potthastia</i>				11			11
<i>Procladius</i>					73	67	139
<i>Thienemannimyia</i>	14						14
Family: Empididae							
<i>Clinocera</i>						17	17
<i>Neoplata</i>	29	17					45
<i>Oreogeton</i>	14		60	22			97
Family: Psychodidae							
<i>Pericoma</i>	29		80	11		67	186
Family: Simuliidae							
<i>Simulium</i>		17	40				57
Family: Tipulidae							
<i>Antocha</i>			40				40
<i>Dicranota</i>			20	11		17	48



Table 7. Total count of benthic macroinvertebrates from field sites in Upper McLeod River, Athabasca 2023.

Taxonomic Group	UAB002	UAB004	UAB006	UAB003	UAB005	UAB007	Total
Order: Ephemeroptera	100						100
Family: Ameletidae							
<i>Ameletus</i>	1400	767	1600	11	200	800	4778
Family: Baetidae							
<i>Baetis</i>			220	22		83	326
Family: Ephemerellidae				67		50	117
<i>Drunella</i>	71	150	20	56	64	33	394
<i>Ephemerella</i>						17	17
<i>Serratella</i>	157	83	640	11	118	367	1376
Family: Heptageniidae							
<i>Cinygmula</i>			60				60
<i>Epeorus</i>				11		17	28
<i>Rhithrogena</i>		1333	140	133	100	550	2257
Family: Leptophlebiidae							
<i>Leptophlebia</i>	414	1317	1040	1567	1418	783	6539
Order: Gordioidea							
Family: Gordiidae							
<i>Gordius</i>	29					33	62
Order: Lymnaeida							
Family: Planorbidae							
<i>Promenetus umblicatellus</i>			20				20
Order: Plecoptera							
Family: Capniidae							
<i>Capnia</i>	29	133	100	11	36	300	609
Family: Chloroperlidae			20				20
<i>Haploperla</i>		50					50
<i>Plumiperla</i>	57	67					124
<i>Suwallia</i>	14	67		178	18		277
<i>Sweltsa</i>	14	133				17	164
Family: Leuctridae							
<i>Despaxia</i>	43	67		22	9		141
Family: Nemouridae	114	33	60	11	55	383	657
<i>Malenka</i>	29	67	220			133	449
<i>Zapada</i>		300	120	400	118	333	1272
Family: Perlidae	57						57
<i>Doroneuria</i>						17	17
<i>Hesperoperla</i>	257	17	80			17	370
Family: Perlodidae		33					33
<i>Isoperla</i>	29	33			36	17	115
<i>Kogotus</i>	57	100	60	33	36	17	304
<i>Megarcys</i>		50		78	27		155
Family: Taeniopterygidae							
<i>Taenionema</i>	43	283	100	100	127	267	920



Table 7. Total count of benthic macroinvertebrates from field sites in Upper McLeod River, Athabasca 2023.

Taxonomic Group	UAB002	UAB004	UAB006	UAB003	UAB005	UAB007	Total
Order: Trichoptera							
Family: Apataniidae							
<i>Apatania</i>						33	33
Family: Brachycentridae							
<i>Brachycentrus</i>	43	150	140				333
Family: Glossosomatidae							
<i>Glossosoma</i>		17				17	33
Family: Hydropsychidae	14						14
<i>Arctopsyche</i>		17		44		50	111
<i>Parapsyche</i>				11	9	17	37
Family: Lepidostomatidae							
<i>Lepidostoma</i>			20				20
Family: Limnephilidae							
<i>Ecclisomyia</i>						17	17
Family: Rhyacophilidae							
<i>Rhyacophila</i>	43	50	60	22	9	67	251
Order: Tricladida							
Family: Planariidae							
<i>Polycelis</i>				33	27	17	77
Order: Trombidiformes							
Family: Aturidae							
<i>Aturus</i>	14						14
Family: Feltriidae							
<i>Feltria</i>			20	11	9	17	57
Family: Hydrachnidae							
<i>Hydrachna</i>				22			22
Family: Lebertiidae							
<i>Lebertia</i>	57	17	20	22	18	83	218
Family: Limnesiidae							
<i>Limnesia</i>		17	20			17	53
Family: Sperchontidae							
<i>Sperchon</i>		17		78	18	17	129
Family: Torrenticolidae							
<i>Torrenticola</i>	14		40				54
Order: Tubificida							
Family: Naididae							
<i>Specaria</i>	14						14
Family: Enchytraeidae							
	71	450		533	91	67	1212
Grand Total	5829	6383	10820	4311	3155	6700	37198