



2024

Benthic Macroinvertebrate Biomonitoring Summary Report - Learning By Doing

Prepared for:
Grand County
Learning By Doing Stakeholder Group

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Introduction

Human population growth, urban development, and changes in land-use practices can have long-term influences on aquatic environments¹⁻³. River impoundments, for example, are one of the most influential anthropogenic modifications known to affect free-flowing riverine ecosystems worldwide⁴. There are numerous studies that have shown how the construction of dams and reservoirs can significantly modify the downstream biotic and abiotic components of free-flowing rivers and streams⁵⁻¹⁰. Other urban development to support human populations in the United States has historically occurred in close proximity to river systems¹¹, and the evaluation of potential biological impacts from runoff associated with roads and highways has become an important topic of research¹²⁻¹⁶. For these reasons, sustained biomonitoring programs are essential, and the results from consistent sampling practices and accurate identifications can provide valuable information regarding anthropogenic influences and impacts on aquatic communities.

To evaluate the condition and sustainability of rivers and streams, routine and accurate monitoring of biological communities is critical. Evolution and ecological pressures have resulted in benthic macroinvertebrate communities that have specific adaptations and sensitivities to their surrounding environment¹⁷. The sensitivity of each taxon in a community often varies with the type of disturbance, and sensitivities can exist at a structural (species/taxon) level and/or functional (trophic) level¹⁷. Additionally, most macroinvertebrate taxa have a relatively long aquatic life-stage and limited mobility. These features result in benthic communities that inevitably respond differently to changes in environmental conditions. Therefore, the biological monitoring (biomonitoring) of benthic macroinvertebrate communities is a valuable tool in the evaluation of aquatic environments^{1,18-21}.

Due to the ability of certain taxa to survive, or even thrive, in the presence of various contaminants, it becomes necessary to employ the use of several biotic indices (metrics) when analyzing macroinvertebrate data. The wide range of stressors and potential interactions among disturbances can make the identification of the predominant sources of stress difficult²². However, some insight can be obtained through the evaluation of benthic macroinvertebrate community structure and function^{23,24}. Additionally, biomonitoring studies can be adjusted to evaluate the influence of various types of stressors at specific times and locations, due to the unique physical and behavioral attributes of benthic macroinvertebrates²⁴.

The Grand County Learning By Doing (LBD) biomonitoring study was designed to monitor and assess the health of aquatic life in a portion of the Upper Colorado River Basin in Grand County, Colorado. The specific study area includes sampling locations on several streams including segments of the Fraser River, Vasquez Creek, Ranch Creek, Willow Creek, Williams Fork, and Colorado River (Table 1; Figure 1). These streams support a wide variety of aquatic and terrestrial life; however, there are several potential sources of anthropogenic stress ranging from impoundments (which alter the natural temperature and flow regime) to runoff from roads, agricultural areas, urbanized areas, and portions of the watershed that were previously burned

in a wildfire. Results from this study will be used to provide an assessment of benthic macroinvertebrate community structure and function at specific locations within the study area.

Objective

The main objective for the LBD Benthic Macroinvertebrate Bioassessment Study in Grand County, Colorado was to provide an overall evaluation of the health of benthic macroinvertebrate communities at each study site in the project area, and to identify stream segments and specific locations affected by potential anthropogenic perturbations.

Study Area

In the fall of 2024, benthic macroinvertebrate data from three biomonitoring studies (Learning By Doing, Denver Water, and Northern Water) were compiled to assist in the evaluation of aquatic life in the Upper Colorado River and Fraser River basins in Grand County, Colorado. A comprehensive evaluation of spatial changes in benthic macroinvertebrate community health was made possible by the coordinated efforts provided by LBD, Denver Water, and Northern Water.

Learning By Doing (LBD) Cooperative Effort Area (CEA) Study Sites

In 2024, the LBD CEA included a total of 15 study sites: three on the Fraser River, one on Ranch Creek, two on Willow Creek, four on the Williams Fork, and five on the Colorado River (Table 1; Figure 1). On the Fraser River, the most upstream study site (FR-25.1) was located in riffle habitat upstream of Winter Park and the Union Pacific (UP) Moffat Tunnel. Farther downstream, site FR-15 was established on the Fraser River above the Fraser Flats Restoration Area and upstream from the confluence with Ranch Creek. Study site FR-3.5 was established in 2023 at Kaibab Park. One study site, RC-1.1, was also sampled on Ranch Creek (a tributary to the Fraser River) downstream from Meadow Creek.

The LBD Stakeholder Group was also responsible for macroinvertebrate sampling at several locations along the Colorado River and associated tributaries. In the fall of 2024, study sites on tributaries of the Colorado River included two sampling locations on Willow Creek and four study sites on the Williams Fork. The most upstream site on Willow Creek (WC-2.3) was located upstream of the Bunte Highline Ditch Diversion, while the downstream site (WC-0.5) was used to assess macroinvertebrate community structure in Willow Creek upstream from the Colorado River (Table 1; Figure 3). The four study sites on the Williams Fork included two sampling locations upstream from Williams Fork Reservoir and two study sites beneath the reservoir (Figure 4). Site WF-13.1 was located downstream from Henderson Mill. Site WF-5.5 was strategically positioned immediately upstream of the reservoir at a location that would assist in the evaluation of a recent habitat improvement project. Below Williams Fork Reservoir, site WF-2.0 was located approximately 1.5 km downstream from the impoundment, while site WF-0.5 was positioned near the confluence with the Colorado River (Figure 4).

LBD sampling locations on the Colorado River included: a newly established site CRCC-0.5 on the Windy Gap Firming Project's Connectivity Channel, site CR-24.9 on Sheriff Ranch, site CR-9.1 located upstream from the CR39 Bridge, site CR-7.4 downstream from Troublesome Creek, and the most downstream sampling location on the Colorado River, site CR-1.7, established upstream from the confluence with the Blue River near the Town of Kremmling, Colorado (Table 1; Figure 3). Several other sampling locations along the Fraser and Colorado rivers were sampled as part of the Denver Water and Northern Water biomonitoring studies and results from these studies were used to provide supplementary information within the LBD CEA.

Denver Water Study Sites

For the Denver Water biomonitoring study, benthic macroinvertebrates were collected from three sampling locations on the Fraser River and one study site on Vasquez Creek during the fall of 2024 (Table 1; Figure 2). These four study sites were selected to monitor benthic macroinvertebrate communities at locations that have historically (prior to 2018) produced low MMI v3 scores, some resulting in 'impairment' designations. Denver Water's most upstream study site on the Fraser River (FR-23.2) was established immediately upstream from the Winter Park Sanitation District (Figure 2). Site VC-WP was located on Vasquez Creek immediately upstream from its confluence with the Fraser River within the Town of Winter Park (Figure 2). Downstream from the confluence of the Fraser River and Vasquez Creek, sites FR-20 and FR-14 were used to assess potential influences from a variety of anthropogenic sources, including runoff from roads and urbanized areas, water diversions, elevated stream temperatures, and habitat improvement projects.

Northern Water Study Sites

Study sites for the Northern Water Conservancy District (Northern Water) included seven sampling locations on the Colorado River in 2024 (Table 1; Figure 3). Four of the sites have been routinely sampled as part of the Windy Gap Firming Project (WGFP) for the last eight years to assess the influence of Windy Gap Reservoir operations on benthic macroinvertebrate communities. These sites include: site CR-31.0 (WGU) located immediately upstream from Windy Gap Reservoir, site CR-28.7 (WGD) approximately 1.7 km downstream from Windy Gap Reservoir at River Mile 28.7, sites CR-22.1 (HSPP) and CR-16.7 (WFU), both located farther downstream on the Colorado River at River Miles 22.1 and 16.7. The other three sampling locations were established in 2020 and sampled intermittently to assess the effects of a habitat improvement project and include: site CR-bWF, the reference site located downstream from the confluence of the Williams Fork and Colorado River and upstream from the Habitat Project construction, site CR-R3 located near a wing deflector in Reach 3 of the habitat improvement area, and site CR-R4, established in a riffle near the lower boundary of the proposed habitat improvements (Table 1, Figure 3).

Table 1. Learning By Doing, Denver Water, and Northern Water biomonitoring studies in the Upper Colorado River Basin during fall 2024.

Station ID	Monitoring Project	Location	Latitude	Longitude
FR-25.1	Learning By Doing	Fraser River above UP Moffat Tunnel	39.8775	-105.7535
FR-23.2	Denver Water	Fraser River above Winter Park Sanitation District	39.89445	-105.76821
VC-WP	Denver Water	Vasquez Creek at Winter Park	39.9203	-105.78498
FR-20	Denver Water	Fraser River at Rendezvous Bridge	39.93412	-105.7896
FR-15	Learning By Doing	Fraser River above Fraser Flats Restoration	39.981338	-105.824946
FR-14	Denver Water	Fraser River at Tabernash below bridge on CR83	39.99053	-105.8299
RC-1.1	Learning By Doing	Ranch Creek below Meadow Creek	39.99912	-105.82746
FR-3.5	Learning By Doing	Fraser River at Kaibab Park	40.08103	-105.93121
WC-2.3	Learning By Doing	Willow Creek upstream Bunte Highline Ditch Diversion	40.13765	-105.9284
WC-0.5	Learning By Doing	Willow Creek upstream Colorado River	40.12963	-105.91741
CR-31.0	Northern Water	Colorado River upstream of Windy Gap Reservoir	40.10045	-105.97248
CRCC-0.5	Learning By Doing	Colorado River in Connectivity Channel	40.10391	-105.98517
CR-28.7	Northern Water	Colorado River downstream of Windy Gap Reservoir	40.10830	-106.00356
CR-24.9	Learning By Doing	Colorado River at Sheriff Ranch	40.0873	-106.0671
CR-22.1	Northern Water	Colorado River near Hot Sulphur Springs	40.07394	-106.10959
CR-16.7	Northern Water	Colorado River upstream of Williams Fork	40.04689	-106.14299
CR-bWF	Northern Water	Colorado River below Williams Fork	40.06262	-106.18113
CR-R3	Northern Water	Colorado River at Reach 3 downstream from bridge	40.06300	-106.19860
CR-R4	Northern Water	Colorado River at Reach 4 downstream from bridge	40.0623	-106.20423
WF-13.1	Learning By Doing	Williams Fork below Henderson Mill	39.9092	-106.1029
WF-5.5	Learning By Doing	Williams Fork above Williams Fork Reservoir	39.99293	-106.17079
WF-2.0	Learning By Doing	Williams Fork below Williams Fork Reservoir	40.04308	-106.19832
WF-0.5	Learning By Doing	Williams Fork below Williams Fork Reservoir at Kemp Breeze	40.0561	-106.1825
CR-9.1	Learning By Doing	Colorado River at CR39 Bridge - KB Ditch	40.05377	-106.28945
CR-7.4	Learning By Doing	Colorado River below Troublesome Creek	40.0509	-106.3112
CR-1.7	Learning By Doing	Colorado River above Blue River	40.0465	-106.373

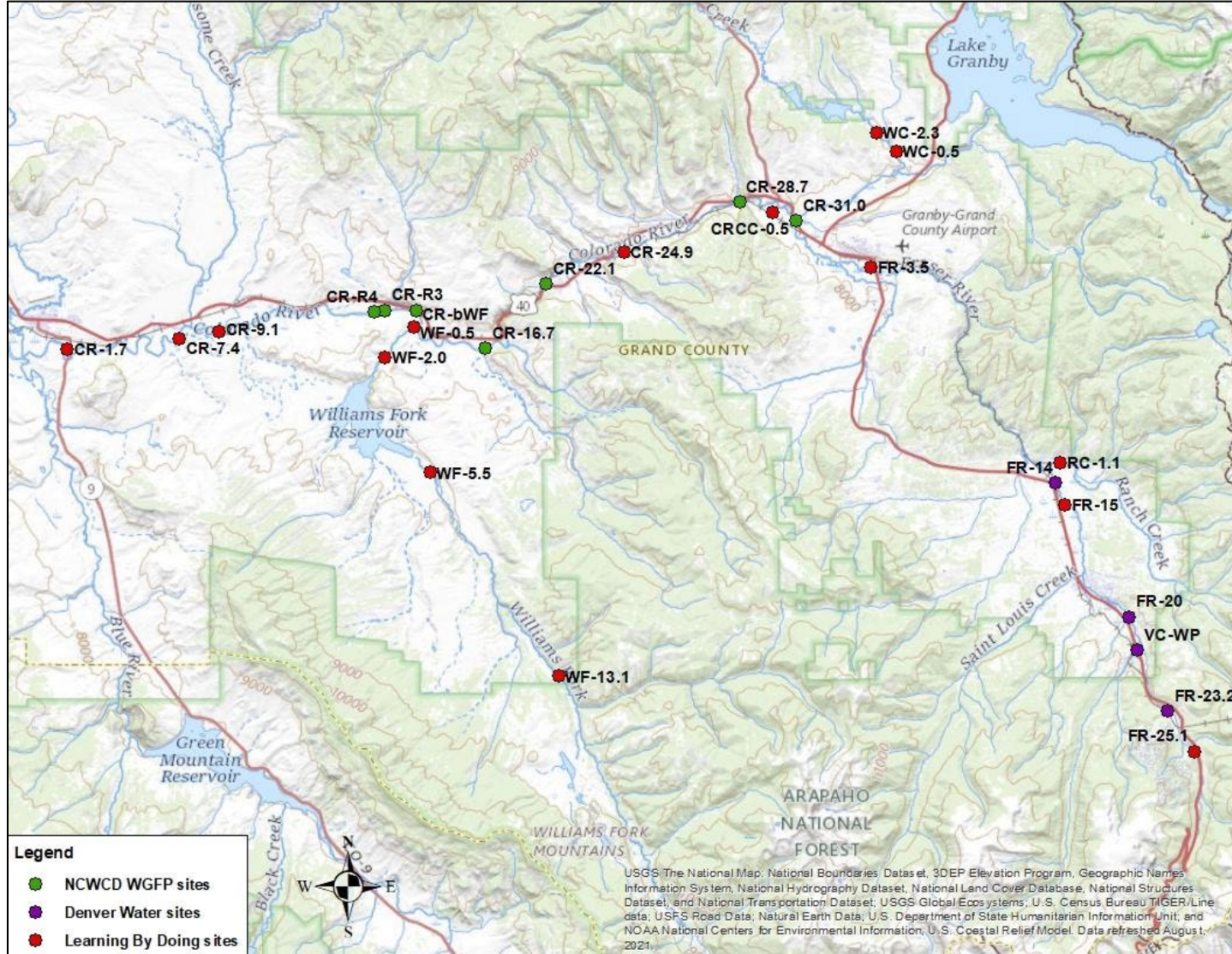


Figure 1. 2024 Learning By Doing, Denver Water, and Northern Water biomonitoring sites.

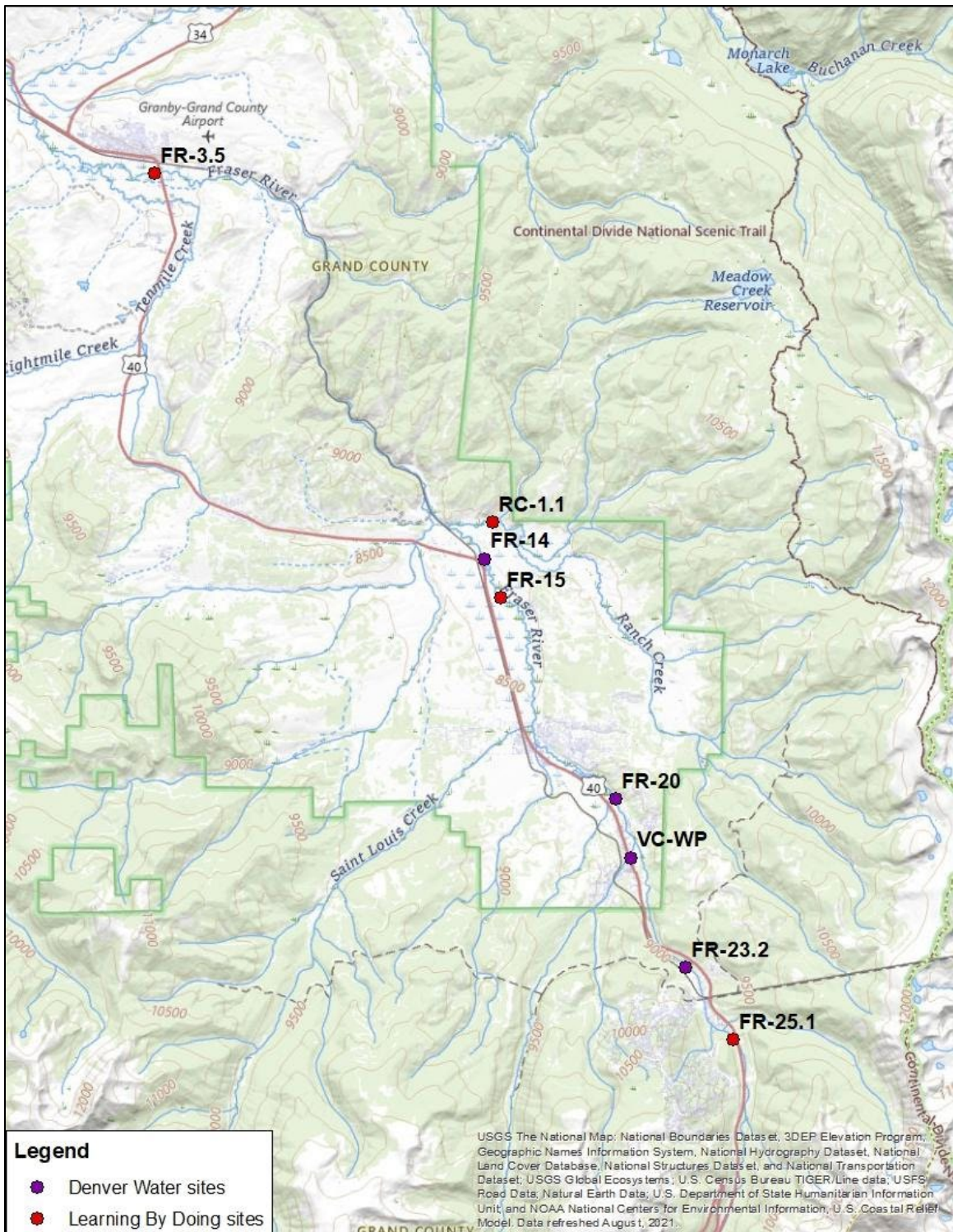


Figure 2. Learning By Doing and Denver Water biomonitoring study sites in the Fraser River Drainage during the fall of 2024.

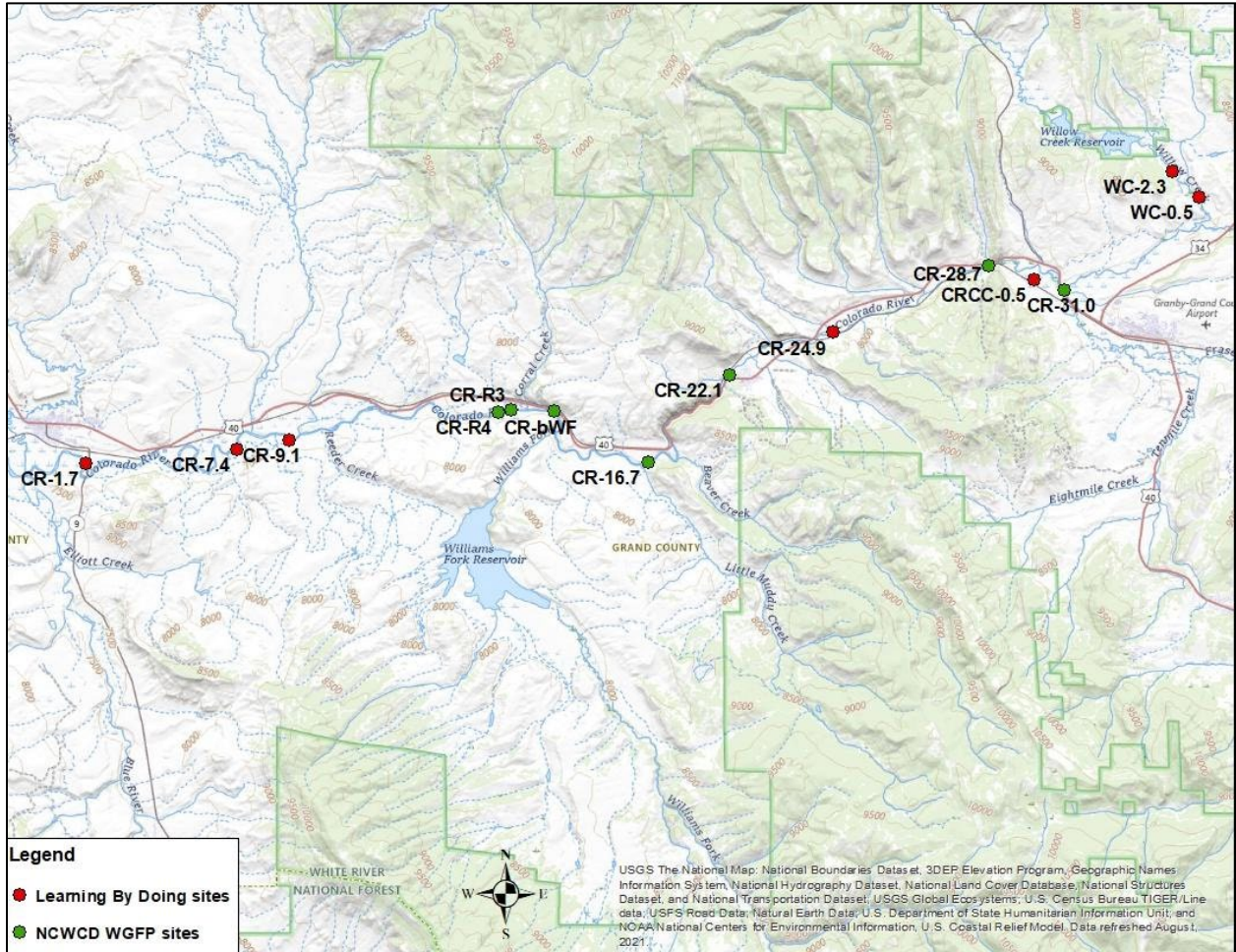


Figure 3. Learning By Doing and Northern Water biomonitoring study sites on Colorado River and Willow Creek in the fall of 2024.

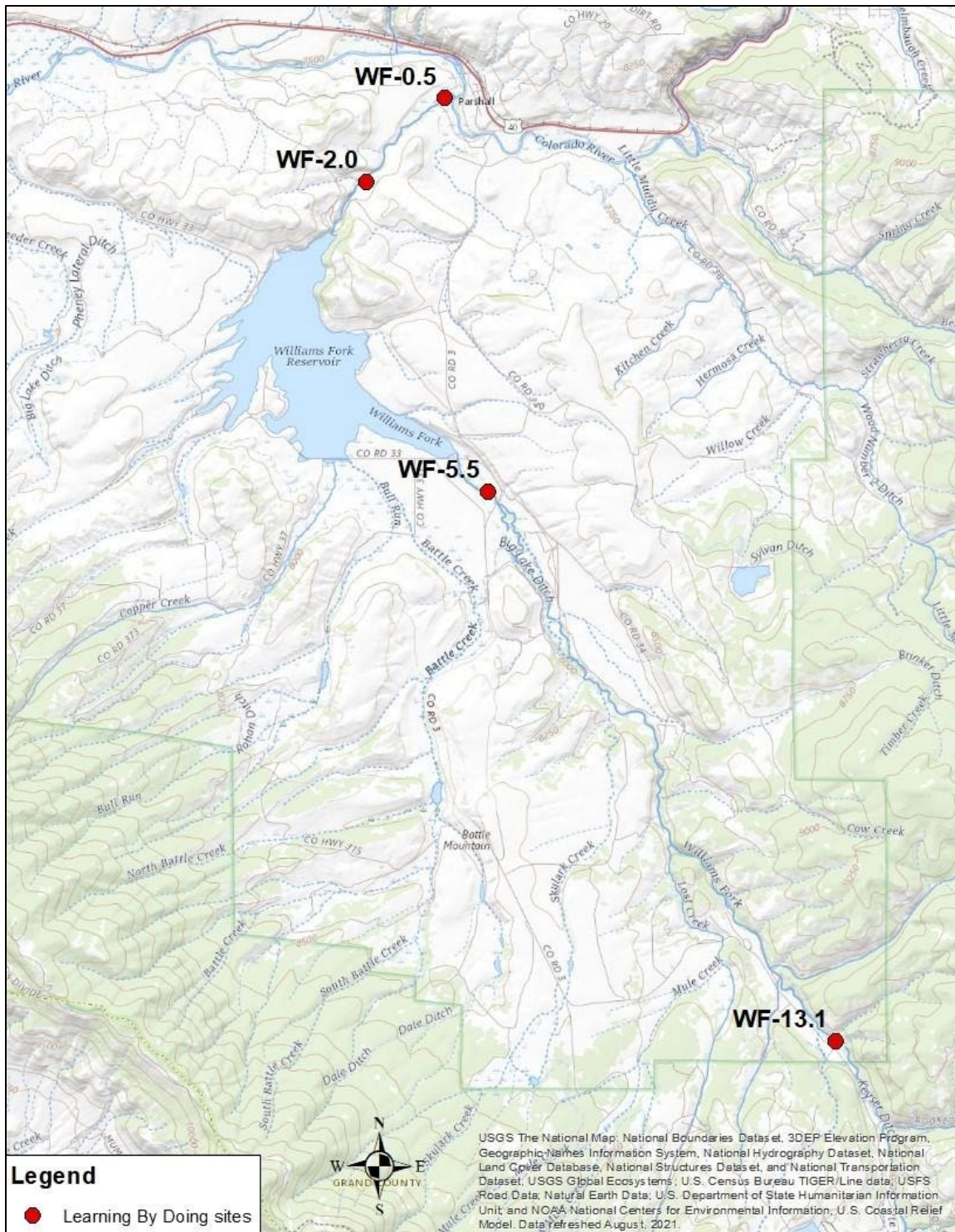


Figure 4. Learning By Doing biomonitoring study sites on Williams Fork in the fall of 2024.

Methods

Benthic macroinvertebrate sampling occurred September 16th through 19th 2024. Three replicate, quantitative Hess bottom samples²⁵ were taken from similar riffle habitat (based on substrate size, water depth, and velocity) at each study site. Substrate within each sample area was thoroughly agitated and individual rocks were scrubbed by hand to dislodge all benthic organisms. Each sample jar was labeled (with date, location, and sample ID number) on the outside and inside of each container, and the contents were preserved in 80% ethanol solution.

After collection, samples were transported to the lab at LRE Water (formerly Timberline Aquatics, Inc.), in Fort Collins, Colorado, where specimens were sorted, identified, and enumerated. To ensure accuracy and eliminate potential bias or inconsistency associated with subsampling, the entire contents of each sample were processed in full. All benthic macroinvertebrate samples were processed according to the guidelines found in the *Aquatic Life Use Attainment: Methodology to Determine Use Attainment for Rivers and Streams, Policy 10-1* and Appendix D in the *Section 303(d) Listing Methodology 2020 Listing Cycle*^{26,27}.

All benthic macroinvertebrates collected from the study area were identified to a taxonomic level consistent with the Operational Taxonomic Unit (OTU) established by the Colorado Department of Public Health and Environment (CDPHE). Specimens were identified using a variety of taxonomic keys including Ward et al. (2002) and Merritt et al. (2019). This level of identification was typically genus or species for mayflies, stoneflies, caddisflies, and many dipterans. Members of the family Chironomidae were also identified to the genus level. As part of the quality control protocols all sorted macroinvertebrate samples were checked by a qualified taxonomist, and approximately 10% of the identifications were checked for accuracy by an SFS certified taxonomist. The following section provides a description of the MMI v4 and other analysis tools used in this study.

The Multi-Metric Index (MMI v4)

In 2017, the CDPHE published detailed guidelines for benthic macroinvertebrate sampling and analysis to assist in the evaluation of aquatic life in the State of Colorado²⁶ which describe specific protocols for the evaluation of benthic macroinvertebrate data using a Multi-Metric Index (the MMI v4). This most recent version of the MMI provides a single index score based on eight equally weighted metrics that are selected and modified based on the sampling location and corresponding Biotype (Mountains, Transitional, or Plains). In the LBD CEA, site FR-25.1 was located in Biotype 2 (Mountains), while all other sampling locations were located within Biotype 1 (the Transition Zone). Each of the individual metrics used in this data analysis produces a score that is adjusted to a scale from 1 to 100 based on the range of metric scores found at “reference sites”. In Biotype 1, these metrics include: EPT Taxa, % Non-Insect Individuals, % EPT Individuals-no Baetidae, % Coleoptera Individuals, % Intolerant Taxa, % Increasers (Mid-Elevation), Clinger Taxa, and Predator/Shredder Taxa. In Biotype 2, these metrics include: EPT Taxa, % EPT Individuals-no Baetidae, Clinger Taxa, Total Taxa, Intolerant Taxa, % Increasers

(Mountains), Predator Taxa, and % Scraper Individuals A detailed description of these metrics and methods used to calculate MMI v4 scores can be found in the *Aquatic Life Use Attainment: Methodology to Determine Use Attainment for Rivers and Streams, Policy 10-1* and Appendix D in the *Section 303(d) Listing Methodology 2020 Listing Cycle*^{26,27}. Thresholds for the MMI v4 in Biotype 1 and Biotype 2 are as follows:

<u>Biotype</u>	<u>Attainment Threshold</u>	<u>Impairment Threshold</u>
Transitional (Biotype 1)	45.2	33.7
Mountains (Biotype 2)	47.5	39.8

Metric scores that fall between the thresholds for 'attainment' and 'impairment' (the 'Grey Zone') require further evaluation using auxiliary metrics to determine an aquatic life use designation. The additional metrics include the Shannon Diversity (Diversity) and Hilsenhoff Biotic Index (HBI). Specific thresholds for the auxiliary metrics in Biotype 1 and Biotype 2 are listed below, followed by descriptions of each metric:

<u>Biotype</u>	<u>HBI</u>	<u>Diversity</u>
Transitional (Biotype 1)	5.8	2.1
Mountains (Biotype 2)	4.9	3.2

Shannon Diversity (Diversity): Diversity was used as an auxiliary metric for the MMI v4 and as an independent metric in this study to evaluate changes in macroinvertebrate community structure by providing a measure of community balance. In unpolluted waters, Diversity values typically range from near 3.0 to 4.0. In polluted waters, this value is generally less than 1.0²⁸. Protocols for the MMI v4 suggest that Diversity values less than 2.1 in Biotype 1, and 3.2 for Biotype 2, may be an indication of impairment.

Hilsenhoff Biotic Index (HBI): The HBI is another auxiliary metric used for the MMI v4; however, it is also valuable as an independent metric and has been widely used and/or recommended in numerous regional biomonitoring studies. Most of the value from this metric lies in the detection of organic pollution (nutrient-enrichment), but it can also be used to evaluate aquatic conditions in a variety of other circumstances. The HBI was originally developed using macroinvertebrate taxa from streams in Wisconsin²⁹; however, tolerance values for most taxa occurring in this study area have been derived from a variety of regional sources and provided by the CDPHE. Although HBI values may naturally vary among regions, a comparison of the values produced within the same river system should provide information regarding locations

impacted by nutrients and/or other aquatic disturbances. Values from the HBI range from 0.0 to 10.0 and increase as water quality decreases.

An additional means of determining 'attainment' or 'impairment' designations using the MMI v4 involves the rapid decline of scores in high scoring waters. When MMI v4 scores are available from multiple years at the same sampling location, and a large decline in scores occurs over the span of at least 12 months, a site will automatically be considered 'impaired' for aquatic life use. The requirements for an allowable decline in MMI v4 scores for Biotype 1 and Biotype 2 are as follows:

<u>Biotype</u>	<u>High Scoring Water (MMI score)</u>	<u>Allowable MMI Decline</u>
Transitional (Biotype 1)	>56	-22
Mountains (Biotype 2)	>62	-22

TIV: The sediment Tolerance Indicator Value (TIV) was specifically developed for Colorado streams by the CDPHE. This value is derived from the proportions of different macroinvertebrate taxa in a sample and their various tolerances to sedimentation. The TIV scale ranges from 0.0 to 10.0, with higher values indicating greater stress. It is important to note that TIV scores are related to what ecoregion a site is in, but not every ecoregion has the information needed to produce a TIV score, which is why not all sites in this study have an associated TIV value. The thresholds for samples collected is 6.1 in Sediment Region 1 and 7.0 for Sediment Region 2.

Additional metrics used in this study:

In addition to the MMI v4 and associated metrics, several individual metrics were applied in the analysis of macroinvertebrate data from the LBD, Denver Water, and Northern Water study areas to provide a more thorough evaluation of macroinvertebrate community structure and function. The following section provides a description of each individual metric used in this study:

Density: Macroinvertebrate abundance (Density) was reported as the mean number of macroinvertebrates/m² found at each study site. The Density metric provides an opportunity to measure and compare standing crop among study sites. This metric becomes more useful when paired with other individual metrics or when monitoring the abundances of certain sensitive taxa throughout the study area.

Biomass: Biomass was reported as the mean dry weight of benthic macroinvertebrates per square meter (g/m²) at each site. Biomass values were obtained by drying macroinvertebrates

from each sample in a scientific drying oven at 100° C for 24 hours or until all water content had evaporated (no decrease in weight could be detected). Biomass values provide production-related information in terms of weight of macroinvertebrates produced at each site. Density and Biomass values offered a strategy for measuring standing crop, which provided an indication of productivity for the macroinvertebrate portion of the food web at each sampling location.

Taxa Richness (Total Taxa): Taxa Richness was reported as the total number of identifiable taxa collected from each sampling location. Taxa Richness has become one of the most widely used metrics to evaluate stream health, as it provides a general indication of community health and stability³⁰. Taxa Richness values are expected to decrease with increased perturbations in the aquatic environment³¹.

Ephemeroptera Plecoptera Trichoptera Taxa (EPT Taxa): The design of this metric is based on the assumption that the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally more sensitive to pollution than other benthic macroinvertebrate orders³². The EPT Taxa metric is currently an important and widely used metric in many regions of the United States¹⁸. The EPT Taxa value is simply given as the total number of distinguishable taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera found at each sampling location. This number will naturally vary among river systems, but it can be an excellent indicator of disturbances within a specific drainage. The EPT Taxa value is expected to decrease in response to a variety of stressors, including nutrients³³.

Density of *Pteronarcys californica*: This metric measures the abundance of *Pteronarcys californica* from three replicate quantitative samples at each study site to provide an estimate of the number of individuals per square meter. *Pteronarcys californica* is a large species of stonefly that requires specific aquatic conditions and a relatively long period of time (four years) to complete its life cycle³⁴. Therefore, this species is known to be sensitive to a variety of anthropogenic disturbances. Additionally, *Pteronarcys californica* is considered an important part of the aquatic food-web because it typically requires leaf material from a healthy riparian corridor to process.

Percent EPT-excluding Baetidae: As previously stated, most taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera are expected to be sensitive to environmental perturbations or pollution. However, members of the mayfly family Baetidae (Order: Ephemeroptera) tend to be more tolerant to disturbances than other EPT taxa. Therefore, the Percent EPT-excluding Baetidae metric provides a measure of the percent composition of benthic macroinvertebrates at each sampling location that are expected to be highly sensitive to anthropogenic stressors or pollution. A decrease in this metric value suggests that negative impacts to the aquatic environment, such as poor water quality or degraded habitat, may be responsible for reducing the proportions of the most sensitive individuals at a sampling location.

Percent Chironomidae: Members of the family Chironomidae are considered relatively tolerant to environmental disturbances when compared to other aquatic insect families¹⁸. The Percent

Chironomidae metric relies on the assumption that the proportion of Chironomidae will increase with decreasing water quality at a given location. Streams that are undisturbed often have similar proportional distributions of Ephemeroptera, Plecoptera, Trichoptera, and Chironomidae³⁵, while study sites degraded by metals, nutrients, or other pollutants are often dominated by individuals in the Chironomidae family³⁶. Most species of Chironomidae tend to have relatively short life-cycles, which also enables them to continually re-colonize unstable or polluted habitats³⁷.

Percent Hydropsychidae: The Percent Hydropsychidae metric was reported for each study site as the proportion of caddisflies (Order: Trichoptera) in the family Hydropsychidae. Members of this family provide some insight into macroinvertebrate community structure and function because they are almost always collector-filterers, and their large body size makes them an important food source for fish. These caddisflies are known to be moderately sensitive to a variety of stressors, particularly ammonia and fine sediment. Seven taxa representing the family Hydropsychidae (*Arctopsyche grandis*, *Cheumatopsyche* sp., *Ceratopsyche morosa* grp., *Hydropsyche* sp., *Hydropsyche cockerelli*, *Hydropsyche occidentalis*, and *Hydropsyche oslari*) were found in this study area during the fall of 2024.

Percent Tolerant Taxa: The Percent Tolerant Taxa metric value was reported as the percentage of taxa that are considered tolerant to a variety of environmental disturbances and stressors. This metric measures the relative abundance of taxa that have tolerance values of 7 or greater.

Percent Intolerant Taxa: This metric was expressed as the proportion of taxa expected to be sensitive to a variety of anthropogenic disturbances and environmental stressors. Intolerant taxa include taxa with tolerance values of 3 or lower.

Functional Feeding Groups: Most of the previously described metrics utilize macroinvertebrate information that is related to community structure; however, macroinvertebrate taxa were also separated into functional guilds based on their method of food acquisition to provide a measure of ecological function at each site. When reviewing the proportions of various feeding groups, it is important that most groups are adequately represented; however, it is common for certain groups (such as collector-gatherers) to be more abundant than others^{28,38}. Scrapers and shredders are often considered sensitive to disturbance because they are specialized feeders¹⁸. Consequently, scrapers, shredders (and sometimes collector-filterers) are expected to respond poorly to anthropogenic disturbances. A more balanced distribution among feeding groups is typically an indication of better aquatic conditions. Much of the value from this type of analysis comes from comparisons among sites within a specific study area. Changes in the proportion of functional feeding groups can provide insight into various types of stress in river systems³⁹.

Results and Discussion

Benthic Macroinvertebrate Sampling – Fall 2024

Benthic macroinvertebrate biomonitoring studies were conducted at 26 sampling locations in the Upper Colorado River Basin in Grand County, Colorado by LBD, Denver Water, and Northern Water during September 2024. Data and results from these three projects were shared to provide a comprehensive evaluation of macroinvertebrate community structure and function in the Fraser River, Vasquez Creek, Ranch Creek, Willow Creek, Colorado River, and Williams Fork. Following collection, samples were sorted, identified, and enumerated (Appendix A, B, and C). The previously described metrics and analysis tools were applied to the macroinvertebrate data to provide a detailed assessment of community structure and function within the study area (Tables 2-13). Results provided by select metrics (MMI v4, Diversity, HBI, EPT, and % EPT-excluding Baetidae) were also used to illustrate differences or similarities in community parameters among sites (Figures 5-22), and the Functional Feeding Group analysis was used to provide an evaluation of ecological function (Tables 11-13; Figures 23-25). Results from 2024 sampling indicate that all sampling locations in the three study areas were in attainment for aquatic life use according to the MMI v4; however, some evidence of stress ranging from minor to moderate was detected at a few locations. A detailed evaluation of data from individual metrics help identify possible sources of stress.

Results from the MMI v4

Fraser River Study Area

The Fraser River study area consisted of eight sites: six on the Fraser River (FR-25.1, FR-23.2, FR-20, FR-15, FR-14, and FR-3.5), one on Vasquez Creek (VC-WP), and one on Ranch Creek (RC-1.1). Site FR-25.1 was in Biotype 2; all others were in Biotype 1 (Table 3).

Results from the MMI v4 indicated that all sampling locations in the Fraser River study area were well-above the attainment threshold for aquatic life use during sampling in 2024 (Tables 2 and 3; Figure 5). MMI v4 scores ranged from 70.6 at FR-14 to 90.1 at RC-1.1, indicating that aquatic conditions remained relatively stable with little evidence of anthropogenic impacts and any minor stress to the watershed in previous years was alleviated prior to 2024 sampling. Five sampling locations scored higher than expected compared to historical data while two locations (FR-14 and FR-3.5) received slightly lower scores (Figure 5). The lower MMI v4 score at FR-14 was likely influenced by the slightly lower values produced by some of the metrics (EPT Taxa, Clinger Taxa, and Predator/Shredder Taxa) at this site when compared to other sampling locations. Since site FR-3.5 has only been sampled one other time in 2023, future biomonitoring studies will provide more information to determine what a typical macroinvertebrate community structure looks like at this location. Despite these minor differences, all sampling locations appear to support relatively high numbers of sensitive and specialized taxa, based on the EPT

Taxa, %Intolerant Taxa, and Clinger Taxa component metric values (Table 5). Historical MMI v4 scores for sites sampled in 2024 can be found in Figure 6.

An evaluation of the auxiliary metrics (Diversity and HBI) and TIV sediment scores suggest that sampling locations in the Fraser River study area maintained aquatic conditions to support healthy benthic macroinvertebrate communities in 2024. The Diversity value at each site demonstrated well-balanced communities throughout the study area, and site FR-23.2 obtained a much higher score (4.53) when compared to previous sampling events (Figure 7). HBI metric values suggest a limited presence of nutrient-tolerant individuals at all sampling locations, with four sites exhibiting improved scores (lower values) relative to previous years (Figure 8). Finally, the TIV scores produced for the sites did not suggest any negative impacts from sedimentation, and variability in scores could probably be attributed to natural changes in habitat (stream size, gradient, etc.) (Table 3). Overall, all sampling locations in the Fraser River study area obtained MMI v4 metric scores that do not indicate substantial anthropogenic impacts at the time of sampling in 2024, and some improvements were observed compared to previous sampling events.

Table 2. Aquatic life use designations based on MMI v4 scores for sites in the Fraser River study area during fall of 2024.

Aquatic Life Use Designations		
Site	Project	Quantitative (Hess) Samples
FR-25.1	LBD	Attainment
FR-23.2 (abvWPSD)	DW	Attainment
VC-WP	DW	Attainment
FR-20 (Rendezvous)	DW	Attainment
FR-15	LBD	Attainment
FR-14 (CR83)	DW	Attainment
RC-1.1	LBD	Attainment
FR-3.5 (KP)	LBD	Attainment

Table 3. Component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Fraser River study area during the fall of 2024. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID							
	Biotype 2	Biotype 1						
Monitoring Project	LBD	DW			LBD	DW	LBD	
	FR-25.1	FR-23.2	VC-WP	FR-20	FR-15	FR-14	RC-1.1	FR-3.5
EPT Taxa	93.9	95.8	100.0	66.7	75.0	66.7	91.7	91.7
% Non-Insect individuals	--	71.6	71.7	87.8	97.1	97.4	96.0	99.4
% EPT, no Baetidae	54.2	46.8	37.0	31.9	70.5	69.0	100.0	87.5
% Coleoptera individuals	--	12.2	87.1	37.5	15.7	20.2	44.7	43.7
% Intolerant Taxa	--	88.0	95.0	89.9	89.0	87.4	91.1	92.2
% Increasers, Mid-Elev.	--	70.6	74.4	90.2	100.0	97.4	97.3	100.0
Clinger Taxa	95.0	81.7	79.3	62.5	86.5	62.5	100.0	100.0
Predator/Shredder taxa	--	100.0	100.0	100.0	85.7	64.3	100.0	57.1
Total Taxa	88.1	--	--	--	--	--	--	--
Intolerant Taxa	100.0	--	--	--	--	--	--	--
% Increasers, Mountain Trn	53.1	--	--	--	--	--	--	--
Predator Taxa	84.6	--	--	--	--	--	--	--
% Scraper individuals	46.2	--	--	--	--	--	--	--
MMI	76.9	70.8	80.6	70.8	77.4	70.6	90.1	83.9
	Auxiliary Metrics							
Diversity	3.87	4.53	3.89	3.60	3.80	3.82	3.70	4.24
HBI	3.36	3.66	3.61	3.26	2.86	2.92	1.96	3.20
Sediment Region	SR1	SR2	SR2	SR2	SR2	SR2	SR2	
TIV	4.95	5.54	5.96	6.04	5.08	5.09	4.33	--

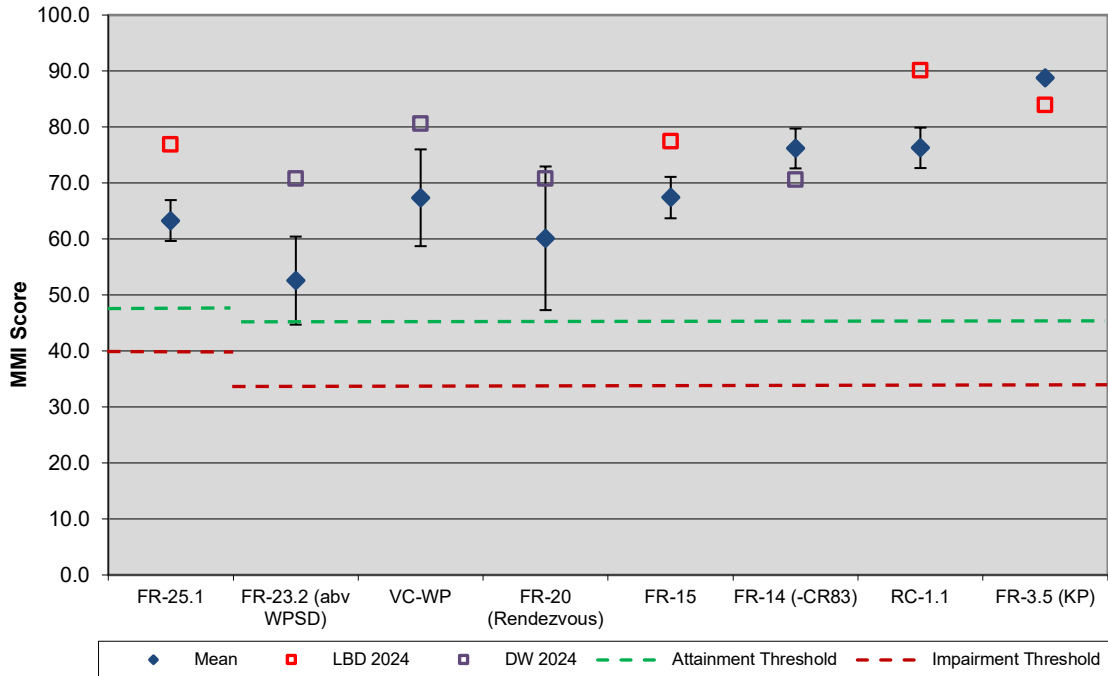


Figure 5. MMI v4 scores for the Fraser River study area from the fall of 2024 and historical mean MMI scores (±1 SD) based on the MMI v4 subsampling.

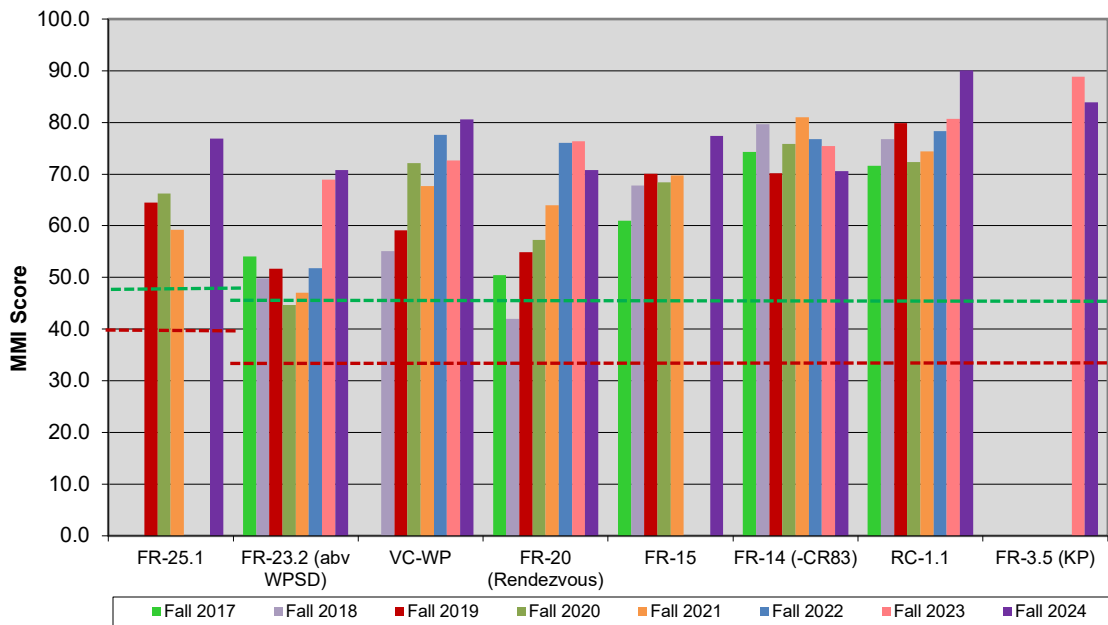


Figure 6. Historical MMI v4 scores for the Fraser River study area.

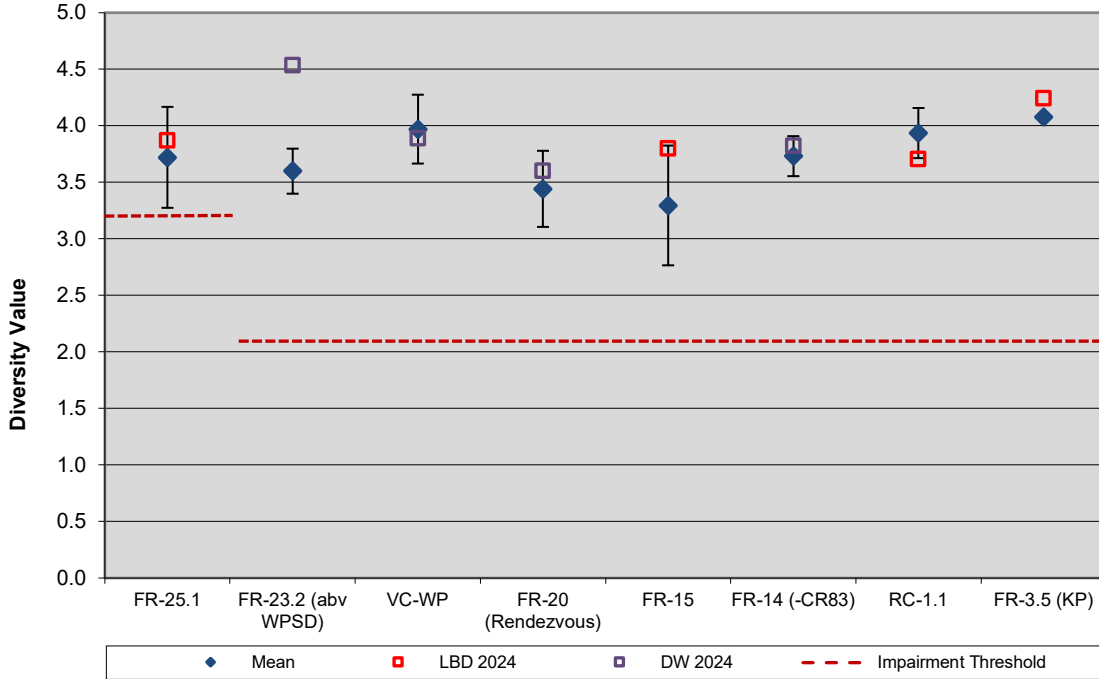


Figure 7. Diversity values in the Fraser River study area from the fall of 2024 and mean Diversity values compared to historical means (± 1 SD) based on the MMI v4 subsampling.

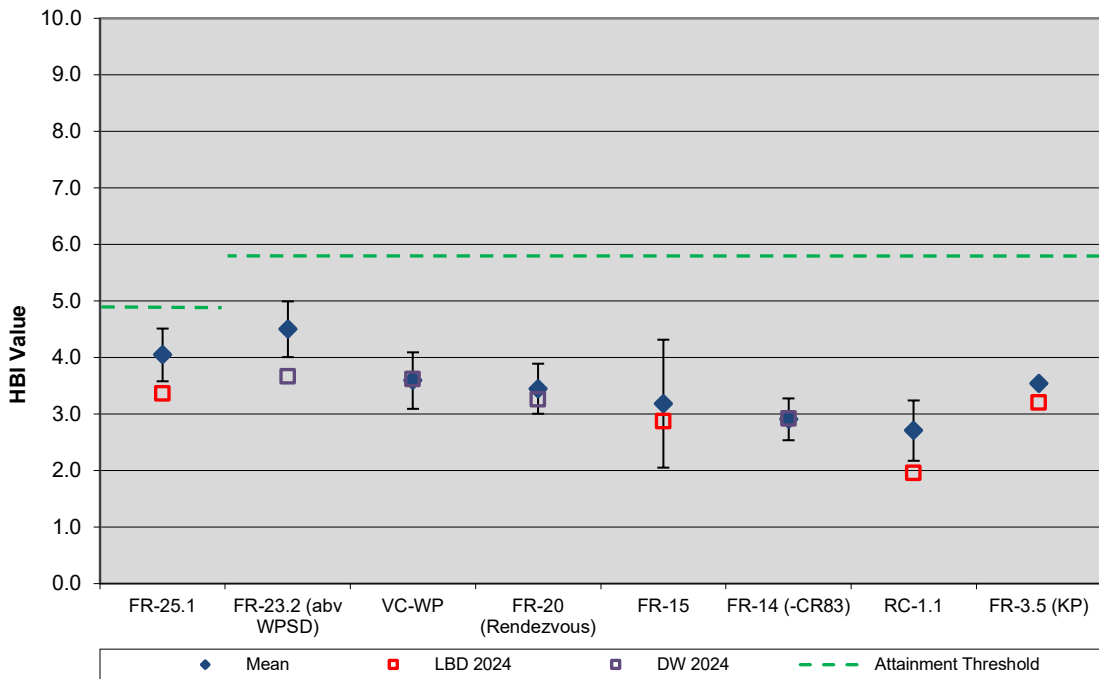


Figure 8. HBI values in the Fraser River study area from the fall of 2024 and historical mean HBI values (± 1 SD) based on the MMI v4 subsampling process.

Colorado River Study Area

In 2024, sampling in the Colorado River Study Area consisted of fourteen sites: twelve on the Colorado River and two on Willow Creek (Table 4). A new site, CRCC-0.5, was established in 2024 on the recently completed Connectivity Channel. The Connectivity Channel was created to help minimize the impact from the reservoir on the ecological function of the Colorado River by allowing fish, macroinvertebrates, and sediment to maintain river connectivity around the reservoir⁴⁰. Site CRCC-0.5 will help to evaluate the effectiveness of the Connectivity Channel in maintaining benthic macroinvertebrate communities, as well as provide valuable data for potentially similar projects in the future.

Results from the MMI v4 indicated that all sampling locations in the Colorado River study area were in attainment for aquatic life use in 2024 (Tables 4 and 5; Figure 9). However, some evidence of stress was observed on Willow Creek directly below Willow Creek Reservoir (WC-2.3) which obtained an MMI v4 score located in the 'grey zone'. However, an evaluation of the auxiliary metrics (Diversity and HBI), indicated that this site was in attainment for aquatic life use which has improved, from impairment designations since 2022 when the site was established (Figure 10). The site further downstream on Willow Creek (WC-0.5) had notable improvements to the macroinvertebrate community based on EPT Taxa, %EPT no Baetidae, %Intolerant Taxa, and %Increasers (mid-elevation) (Table 4). These improvements were reflected in the MMI v4 score of 75.7 at site WC-0.5. A comparison of historical MMI v4 scores can be seen in Figure 10.

The twelve sampling locations on the Colorado River used to evaluate macroinvertebrate communities were located upstream from the Windy Gap Reservoir (CR-31.0) to almost the confluence with the Blue River (CR-1.7) generated MMI v4 values that ranged from 65.0 at CRCC-0.5 to 81.5 at CR-16.7 (Table 4). Following a 22-point MMI v4 decline observed in 2020, site CR-31.0 (the most upstream sampling location) is now considered in attainment based on the most recent MMI v4 score from 2024 that reflects a recovery of at least half the original decline and exceeds the attainment threshold, in accordance with the 303(d) Listing Methodology.²⁷ Downstream from site CR-31.0, the recently established site, CRCC-0.5, on the constructed Connectivity Channel obtained the lowest MMI v4 result on the Colorado River (65.0) but was still well-above the attainment threshold (Figure 9). There was a slight decline in component metric values that monitor sensitive and specialized feeders (specifically, % EPT, no Baetidae and % Clinger Taxa) at this location, which contributed to the lower MMI v4 score (Table 4). All other study sites on the Colorado River obtained MMI v4 values that were well-above the attainment threshold which had maintained or improved historical mean MMI v4 scores upon their community parameters (Figure 9).

Results from the two auxiliary metrics, Diversity and HBI, provided valuable insight into what may be contributing to lower MMI v4 scores in the Colorado River and Willow Creek study area (Figures 11-12). There was considerable variability in Diversity values

across sites in 2024, with some sites having improved values compared to historical sampling events and others obtaining slightly lower scores (Figure 11). In general, the Diversity values across all sampling locations suggest that sites maintained a relatively stable and healthy community balance. However, when comparing HBI results, the two sampling locations with the lowest MMI v4 scores (WC-2.3 and CRCC-0.5) had the highest HBI scores (5.33 and 4.23, respectively). While these values are below the impairment threshold of 6.1, they do indicate a higher proportion of nutrient-tolerant taxa at these locations. Most other sampling locations obtained relatively low HBI scores, when compared to historical means (Figure 12).

Table 4. Aquatic life use designations based on MMI v4 scores for sites in the Colorado River study area during fall of 2024.

Aquatic Life Use Designations		
Site	Project	Quantitative (Hess) Samples
WC-2.3 (BHU)	LBD	Attainment
WC-0.5 (CRU)	LBD	Attainment
CR-31.0	NW	Attainment
CRCC-0.5	LBD	Attainment
CR-28.7	NW	Attainment
CR-24.9	LBD	Attainment
CR-22.1	NW	Attainment
CR-16.7	NW	Attainment
CR-bWF	NW	Attainment
CR-R3	NW	Attainment
CR-R4	NW	Attainment
CR-9.1	LBD	Attainment
CR-7.4	LBD	Attainment
CR-1.7	LBD	Attainment

Table 5. Component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Colorado River study area during the fall of 2024. All scores are based on the MMI v4 subsampling and ‘impairment’ values are shown in red.

Metric	Station ID													
	LBD		NW	LBD	NW	LBD	NW					LBD		
Monitoring Project	Biotype 1													
	WC-2.3	WC-0.5	CR-31.0	CRC-C-0.5	CR-28.7	CR-24.9	CR-22.1	CR-16.7	CR-bWF	CR-R3	CR-R4	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	48.6	72.6	91.7	70.8	79.2	87.5	87.5	100.0	83.3	75.0	83.3	80.5	100.0	90.1
% Non-Insect individuals	64.0	97.0	59.8	94.8	96.9	97.0	94.8	93.1	77.8	96.3	94.3	92.7	94.3	84.1
% EPT, no Baetidae	23.9	79.5	56.8	50.6	92.5	83.8	86.7	88.8	100.0	100.0	100.0	76.1	69.3	32.1
% Coleoptera individuals	4.9	39.6	9.8	10.7	12.3	9.3	6.6	8.7	3.2	9.2	1.6	25.0	31.1	100.0
% Intolerant Taxa	36.1	94.5	74.5	62.0	84.3	82.0	82.0	88.0	89.9	99.4	100.0	80.9	83.6	71.9
% Increasers, Mid-Elev.	52.3	97.0	88.2	94.7	98.8	98.5	90.8	94.9	93.6	96.3	98.7	96.0	92.9	70.5
Clinger Taxa	55.1	68.6	86.5	72.1	81.7	81.7	81.7	100.0	81.7	81.7	81.7	92.6	100.0	89.3
Predator/Shredder taxa	71.4	57.1	71.4	64.3	50.0	64.3	42.9	78.6	50.0	71.4	57.1	85.7	78.6	64.3
MMI	44.5	75.7	67.3	65.0	74.5	75.5	71.6	81.5	72.4	78.7	77.1	78.7	81.2	75.3
	Auxiliary Metrics													
Diversity	3.33	3.64	4.31	3.98	3.73	4.07	3.18	3.90	3.17	3.36	3.26	4.40	4.18	4.09
HBI	5.33	3.49	2.78	4.23	3.24	2.96	2.73	2.95	1.62	1.58	1.72	2.72	2.90	4.15
Sediment Region					SR2			SR2						
TIV	--	--	--	--	4.91	--	--	4.69	--	--	--	--	--	--

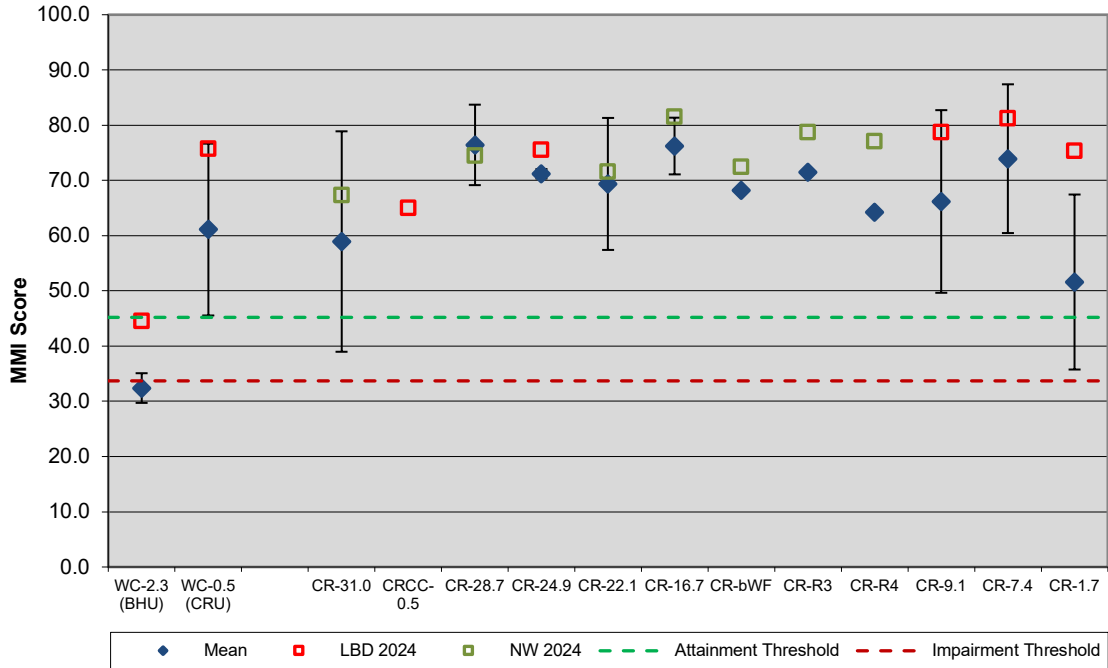


Figure 9. MMI v4 scores for the Colorado River study area from the fall of 2024 compared to historical mean MMI v4 scores (± 1 SD) based on the MMI v4 subsampling.

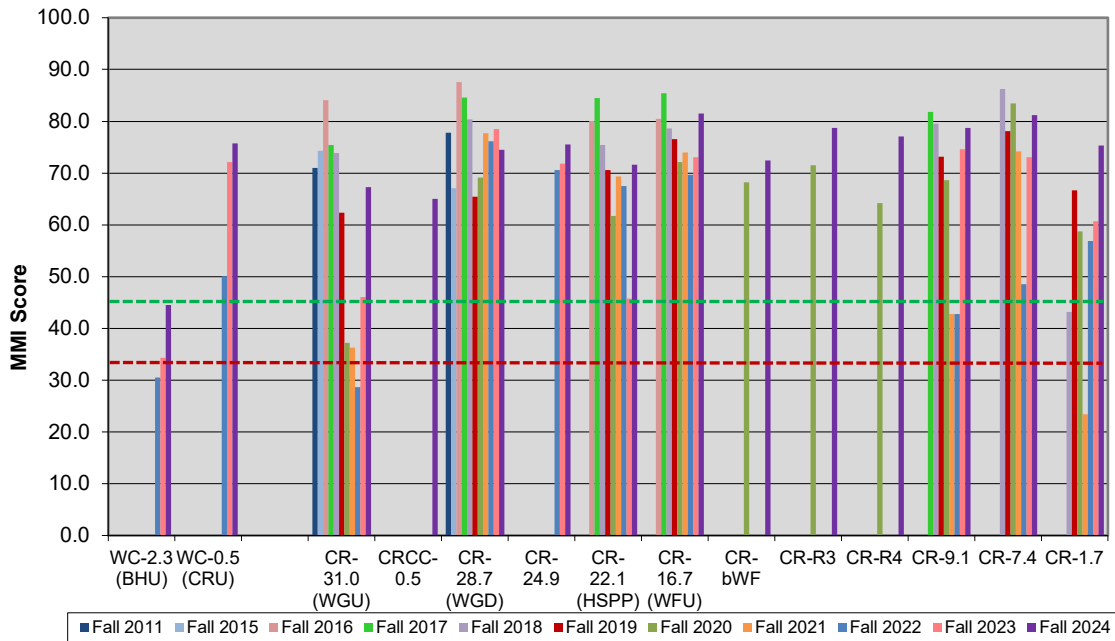


Figure 10. Historical MMI v4 scores for the Colorado River study area based on the MMI v4 subsampling.

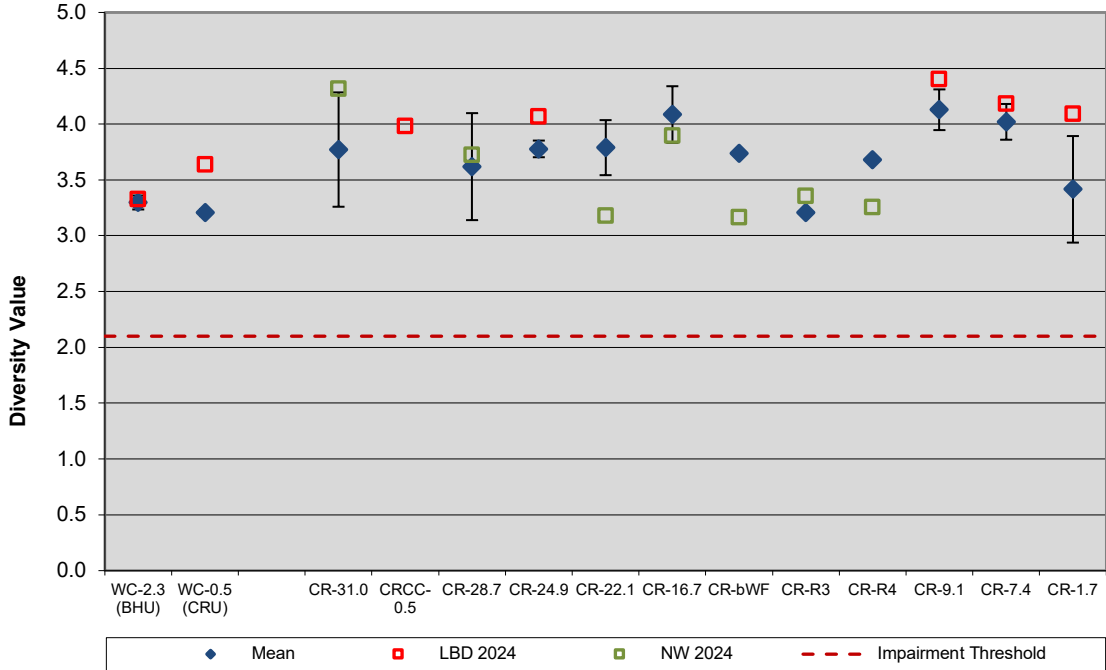


Figure 11. Diversity values for the Colorado River study area from the fall of 2024 and mean historical Diversity values (± 1 SD) based on the MMI v4 subsampling.

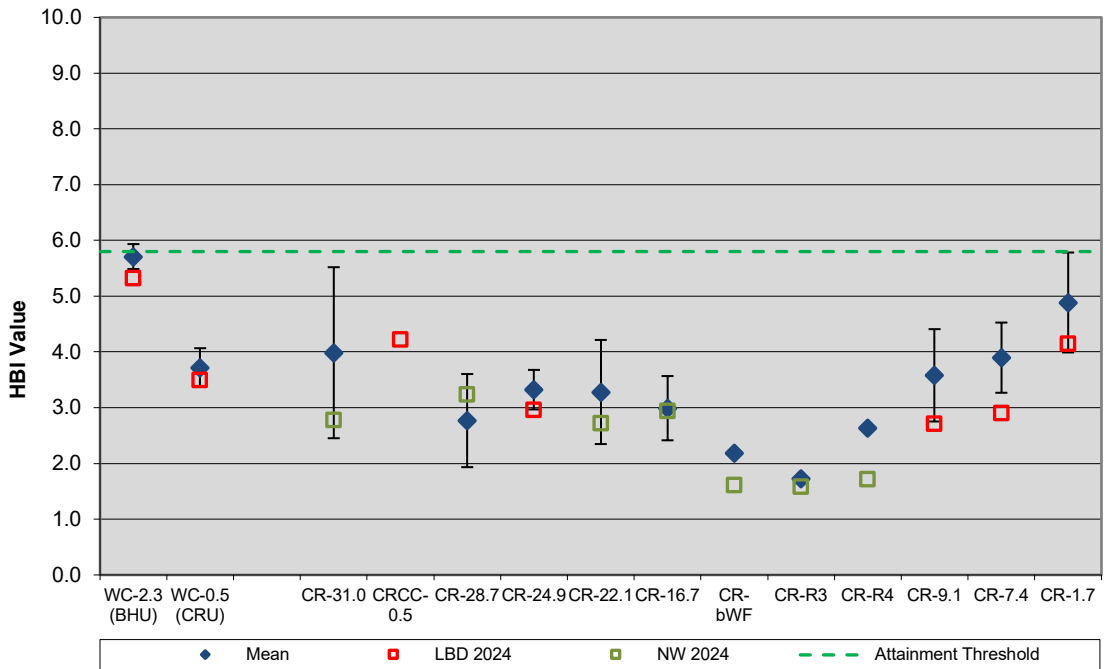


Figure 12. HBI values for the Colorado River study area from the fall of 2024 and mean historical HBI values (± 1 SD) based on the MMI v4 subsampling.

Williams Fork Study Area

In 2024, benthic macroinvertebrate sampling on the Williams Fork occurred at four LBD monitoring sites (Table 7). Three are routinely sampled to evaluate the potential impact of the Williams Fork Reservoir on macroinvertebrate communities, and site WF-13.1 was sampled once in 2021 (Figure 14). Results from the MMI v4 indicated that all sampling locations were in attainment for aquatic life use, though some evidence of stress was observed (Tables 6 and 7; Figure 13). MMI v4 scores ranged from 40.3 at site WF-2.0 (located directly below the impoundment) to 73.3 at site WF 13.1 (the most upstream sampling location). All historical MMI v4 scores can be found in Figure 14.

The two sites (WF-13.1 and WF-5.5) above Williams Fork Reservoir were sampled to assess established macroinvertebrate communities in the stream reach prior to reservoir operations. The most upstream site (WF-13.1) generated the highest MMI v4 score (73.3) in the study area. This sampling location supported relatively high numbers of sensitive and specialized taxa, based on metric values from EPT Taxa, % Intolerant Taxa, Clinger Taxa, and Predator/Shredder Taxa (Table 6). Farther downstream but still above the reservoir, site WF-5.5 had an MMI v4 score of 55.1, which is above the attainment threshold but lower than expected based on previous sampling events (Figures 13 and 14). An evaluation of the auxiliary metrics, including Diversity and HBI, indicated that these two sites maintained relatively balanced macroinvertebrate communities but had slightly higher proportions of nutrient tolerant taxa than previous years (Figures 15-16).

A noticeable decline in the MMI v4 scores at the two sites downstream of the reservoir (Table 6) were observed. The site immediately downstream of the dam, WF-2.0, obtained an MMI v4 score of 40.3 which is in the 'grey zone' although the evaluation of Diversity and HBI indicated that this sampling location remained in attainment for aquatic life use. Site WF-0.5 obtained an MMI v4 score of 47.0, slightly above the attainment threshold of 45.2. These two locations had low values of the component metrics %EPT, no Baetidae, and %Coleoptera Individuals, which heavily impacted the MMI v4 score (Table 6). It is likely that benthic macroinvertebrates at these sites were impacted by the hypolimnetic releases from the dam, given their close proximity to the impoundment^{9,41-44}. Overall, a slight increase in stress was observed at site WF-5.5 in 2024 and evidence perturbations were still occurring in the downstream portion of the study area.

An evaluation of the MMI v4 and associated metrics provided valuable insight into the macroinvertebrate community structures in the Fraser River, Colorado River, and Williams Fork study areas. All sampling locations obtained MMI v4 scores indicating attainment for aquatic life use, though there was evidence of stress at several sites on the Williams Fork and Colorado River. Continued biomonitoring efforts will allow for future assessments of macroinvertebrate communities as anthropogenic influences (through reservoir operations and habitat improvements) expand across the study area.

Table 6. Aquatic life use designations based on MMI v4 scores for sites in the Williams Fork study area during September of 2024.

Aquatic Life Use Designations		
Site	Project	Quantitative (Hess) Samples
WF-13.1	LBD	Attainment
WF-5.5	LBD	Attainment
WF-2.0	LBD	Attainment
WF-0.5	LBD	Attainment

Table 7. MMI v4 scores and component metrics and from September 2024 benthic macroinvertebrate samples collected in the Williams Fork study area. All scores reflect MMI v4 subsampling and ‘impairment’ values are shown in red.

Metric	Station ID			
Monitoring Project	Learning By Doing (LBD)			
	Biotype 1			
	WF-13.1	WF-5.5	WF-2.0	WF-0.5
EPT Taxa	62.5	41.7	29.1	40.1
% Non-Insect individuals	83.1	76.1	61.5	71.6
% EPT, no Baetidae	63.4	34.2	3.0	5.4
% Coleoptera individuals	22.0	60.2	0.8	0.0
% Intolerant Taxa	90.4	49.7	59.6	81.4
% Increasers, Mid-Elev.	92.7	64.4	87.0	94.5
Clinger Taxa	72.1	43.3	38.5	40.3
Predator/Shredder taxa	100.0	71.4	42.9	42.9
MMI v4	73.3	55.1	40.3	47.0
Auxiliary Metrics				
Diversity	3.67	3.88	2.46	2.47
HBI	2.67	4.43	4.98	4.65
Sediment Region	SR2			
TIV	5.57	--	--	--

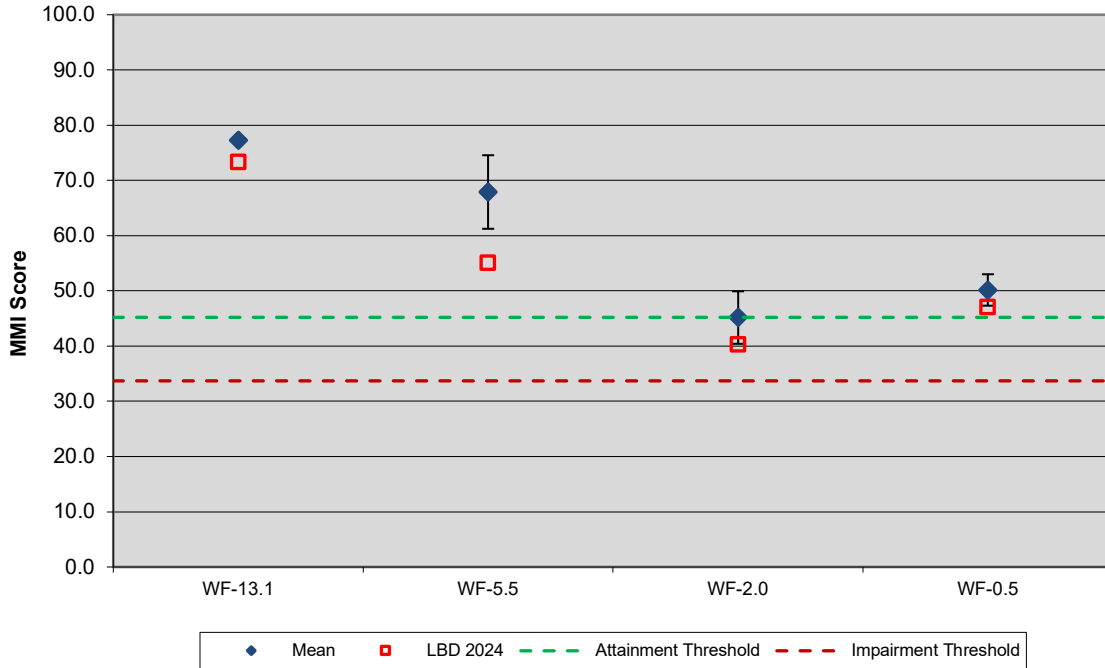


Figure 13. MMI v4 scores for the Williams Fork study area from the fall of 2024 and historical mean MMI scores (± 1 SD) based on the MMI v4 subsampling.

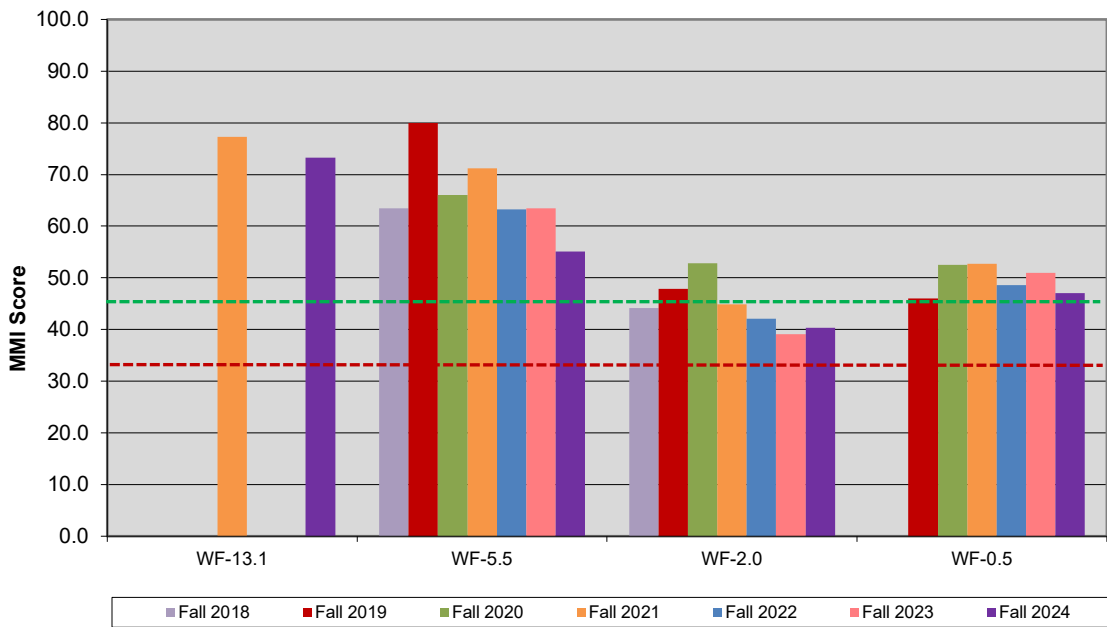


Figure 14. Historical MMI v4 scores for the Williams Fork study area based on MMI v4 subsampling.

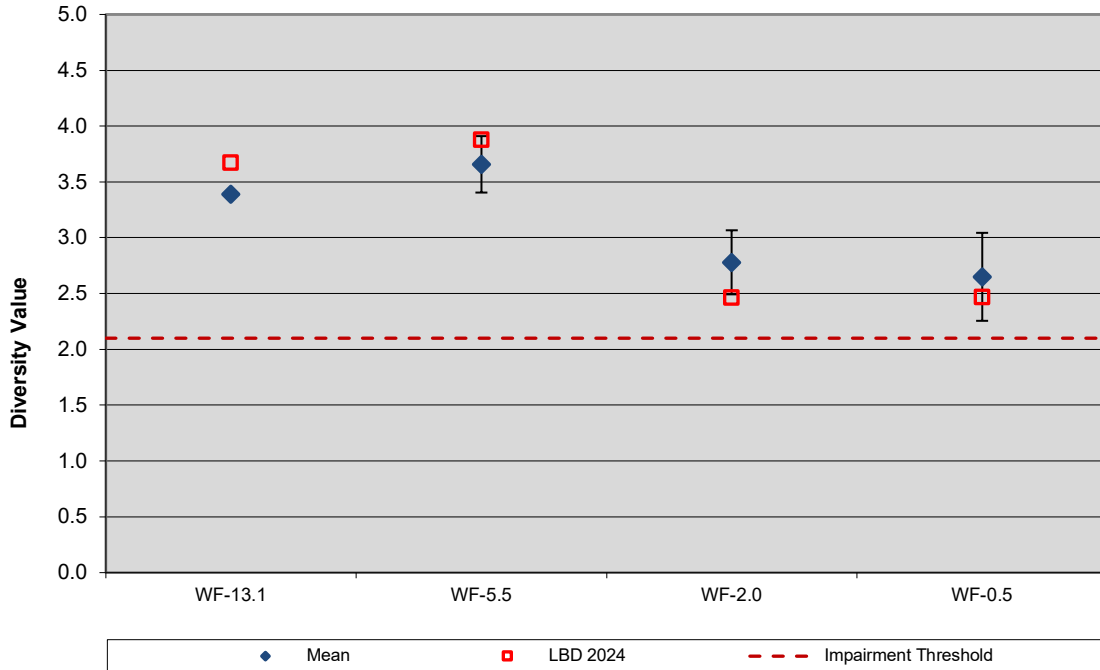


Figure 15. Diversity values for the Williams Fork study area from the fall of 2024 and historical mean Diversity values (± 1 SD based on MMI v4 subsampling).

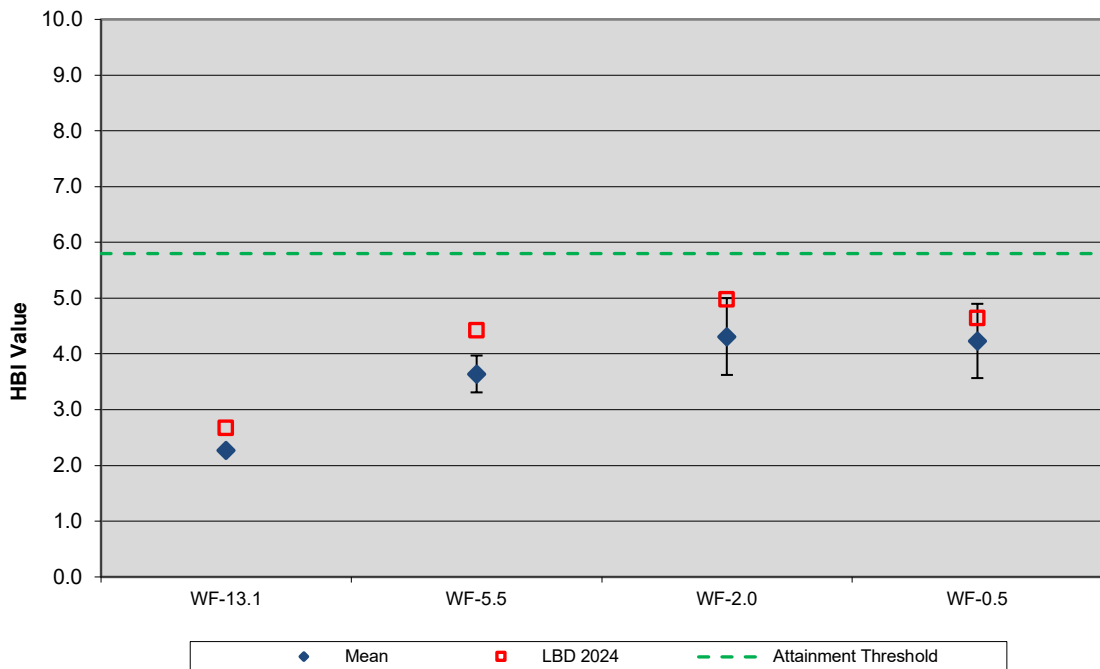


Figure 16. HBI values for the Williams Fork study area from the fall of 2024 and historical mean HBI values (± 1 SD) based on MMI v4 subsampling.

Results from Additional Metrics

Ten additional metrics were used to analyze macroinvertebrate data collected from the Fraser River, Colorado River, and Williams Fork study areas during the fall of 2024 (Tables 8-10) to detect changes in macroinvertebrate community structure among sites. Benthic macroinvertebrate communities are influenced and impacted by a wide range of environmental factors and stressors, including runoff from roads and developed areas, periphyton dynamics, temperature regimes, changes in water flows, or changes in habitat. Therefore, it can be difficult to identify the exact source of the differences between sites. Generally, the location of a study site determines which influences or stressors contribute to the observed macroinvertebrate community structure and function.

In the fall of 2024, most sampling locations in the Fraser River, Colorado River, and Williams Fork study areas supported robust macroinvertebrate communities (Tables 8-10; Figures 17-22). Taxa Richness values ranged from 30 to 65, many of which were taxa generally considered sensitive to disturbances (EPT), with values ranging from 11-35 across all sites (Tables 8-10). Additionally, the giant stonefly *Pteronarcys californica*, an indicator of quality coldwater stream habitat³⁴, was present at five sites: FR-3.5 on the Fraser River and CR-16.1, CR-bWF, CR-R4, and CR-7.1 on the Colorado River (Tables 8-9). an increase from the previous five years. Future biomonitoring efforts will help to determine if the newly constructed Connectivity Channel increases the presence and abundance of the giant stonefly at additional sites along the Colorado River, most detections of this species are downstream of the new channel.

Fraser River Study Area

In 2024, the eight sampling locations on the Fraser River supported relatively healthy benthic macroinvertebrate communities, based on results from the individual metrics (Table 8). Specifically, values from the Taxa Richness, EPT Taxa, and % Intolerant taxa indicated that study sites on the Fraser River, Vasquez Creek, and Ranch Creek had a large variety of taxa, including taxa sensitive to disturbances. Taxa Richness (which is the total taxa collected) values ranged from 44 at site FR-14 to 57 at site FR-15 (Table 8). EPT taxa values and % EPT- excluding Baetidae (a family that tends to be one of the more tolerant EPT taxa) had similar, or slightly improved, values at most sites sampled when compared to previous sampling events (Figures 17 and 18). The exception occurred at site FR-3.5, a site established in 2023 at Kaibab Park and therefore only sampled once before. Future biomonitoring studies at this location will help to determine typical macroinvertebrate community at this site (Figures 17 and 18).

There was greater variability in the proportions of individuals in the community among sites, based on Density, Biomass, % Chironomidae and % Hydropsychidae metrics (Table 8). Density and Biomass metrics, which measure the standing crop of macroinvertebrates, were highest at site FR-15 and much lower at the two most upstream sites in the study area (Table 8). Notably, three taxa composed 57% of the

total macroinvertebrate density at site FR-15: the mayfly *Ephemerella dorothea infrequens* (25%), the chironomid *Cricotopus/Orthocladius* sp. (21%), and the caddisfly *Hydropsyche cockerelli* (11%) (Appendix A; Table A2). This site also had the highest number of the caddisfly *Glossosoma* sp. which constructs cases out of small rocks. These rock cases likely influenced the higher biomass measurements, as the caddisflies are not removed from their cases prior to drying. Meanwhile, the % Chironomidae metric had a larger disparity in values, which ranged from 2.41% at site FR-3.5 to 39.30% at FR-20. While the caddisfly family Hydropsychidae were collected at all sampling locations, the uppermost half of the sampling location supported much lower proportions than the lower sampling sites (Table 8). Differences in community structure at sites in the Fraser River study area are likely attributed to natural changes in habitat, stream size, gradient, and minor anthropogenic influences. A complete review of individual metric values from previous sampling events (2017-2023) can be found in Appendix D: Tables D8-D14.

Table 8. Additional individual metrics and comparative values for benthic macroinvertebrate samples collected from the Fraser River study area during fall of 2024. All additional metric values are based on full count (quantitative) Hess samples.

Metric	FR-25.1	FR-23.2	VC-WP	FR-20	FR-15	FR-14	RC-1.1	FR-3.5
Biomonitoring Project	LBD	DW			LBD	DW	LBD	
Density (mean #/m ²)	2,664	2155	6573	10288	16,668	5442	7,693	5,480
Taxa Richness	43	46	52	49	57	44	46	48
EPT Taxa	27	26	28	24	28	22	27	29
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0	0	0	0	4
% EPT-excluding Baetidae	44.66%	37.75%	32.01%	22.42%	52.28%	49.68%	75.20%	65.08%
% Chironomidae	9.08%	35.03%	9.53%	39.30%	34.00%	33.31%	2.68%	2.41%
% Hydropsychidae	0.44%	0.91%	0.18%	0.87%	14.76%	14.72%	6.11%	30.94%
% Tolerant Taxa	6.98%	10.87%	11.54%	10.20%	5.26%	13.64%	15.22%	16.67%
% Intolerant Taxa	58.14%	56.52%	50.00%	51.02%	45.61%	45.45%	50.00%	43.75%
Biomass (g/m ²)	0.57	0.92	1.73	4.36	9.62	6.27	2.54	3.59

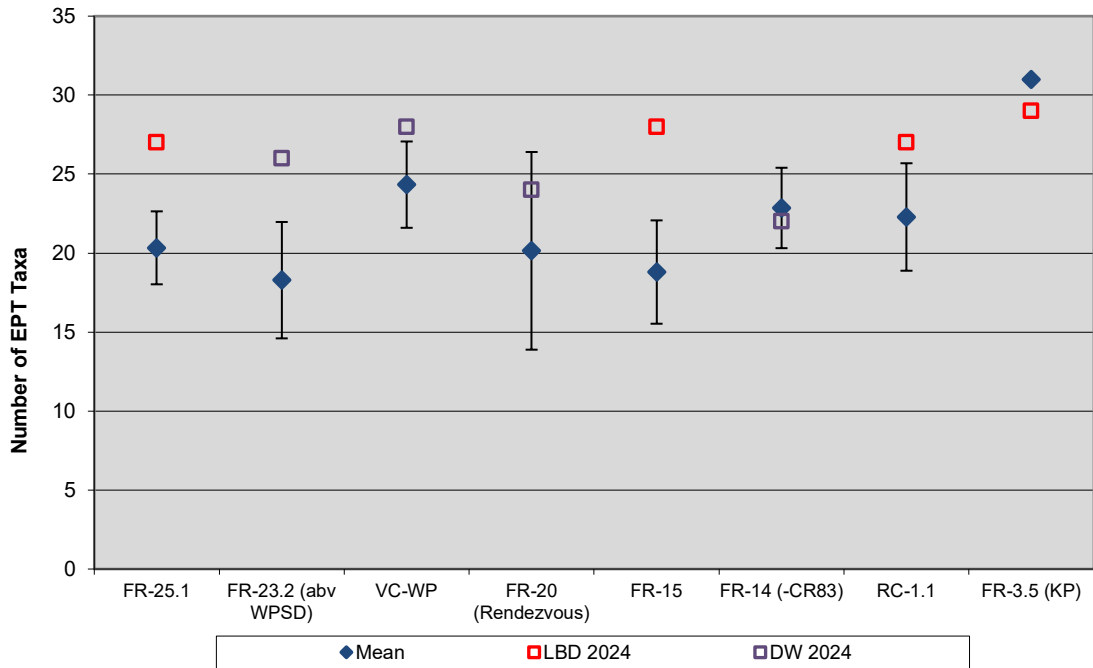


Figure 17. EPT Taxa values, Fraser River, fall 2024 and mean values (± 1 standard deviation) from previous sampling events.

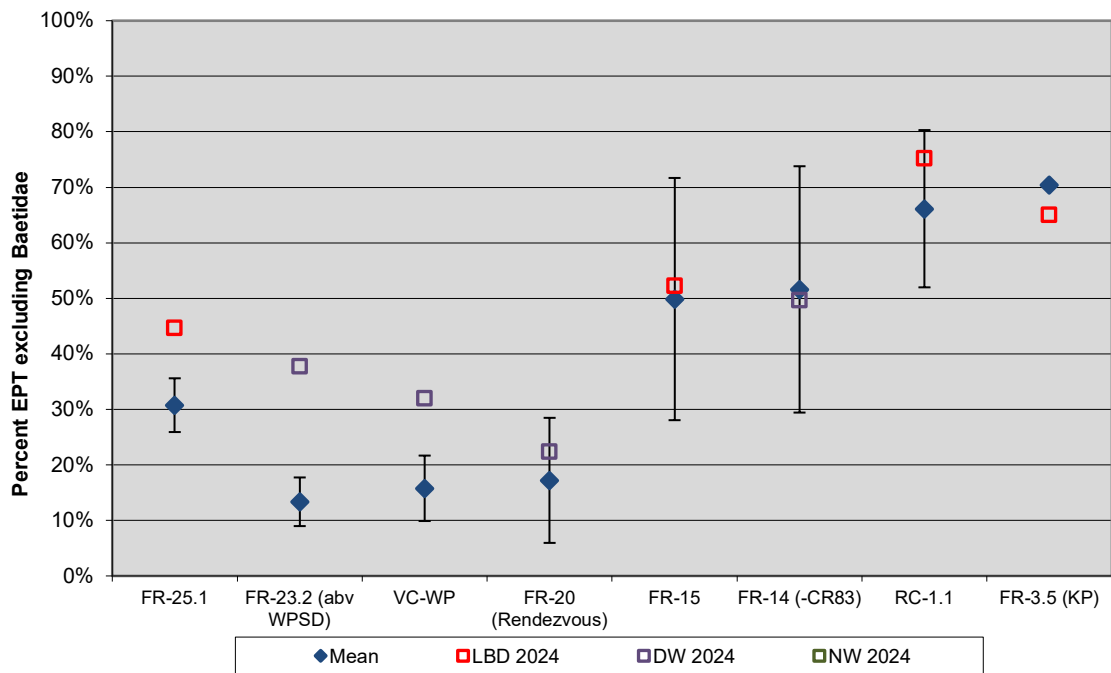


Figure 18. Percent EPT (excluding Baetidae) values from fall 2024 compared to historical means (± 1 SD) in the Fraser River study area.

Colorado River Study Area

In 2024, results from individual metrics supported the findings from the MMI v4, suggesting that all sites supported relatively healthy benthic macroinvertebrate communities (Table 9). However, some differences in biological condition were observed throughout the study area. On Willow Creek, the site directly below the dam (WC-2.3) showed impacts to the aquatic community which are typical of stream segments downstream of reservoirs⁴⁴. Metrics indicating sensitive taxa (EPT and % EPT excluding Baetidae) had the lowest values in the study while metrics that evaluate tolerant species (% Chironomidae and % Tolerant Taxa) were the highest (Table 9). As often observed below dams, aquatic community condition improved with distance downstream and Willow Creek (WC-0.5) EPT values, % EPT excluding Baetidae, % Chironomidae, % Hydropsychidae, % Tolerant Taxa, and % Intolerant Taxa values (Table 9) indicated recovery.

Differences in community structures at sites on the Colorado River are mostly attributed to natural changes in stream dynamics or other anthropogenic impacts. Overall, sampling locations in this area supported relatively healthy and stable macroinvertebrate communities, based on the values from the EPT, Total Taxa, % EPT excluding Baetidae, and % Intolerant Taxa metrics (Table 9). In fact, results from EPT Taxa and % EPT excluding Baetidae metrics indicated that most sites were similar or improved in their ability to support sensitive taxa (Figures 19 and 20). Additionally, the giant stonefly, *Pteronarcys californica*, was observed at more locations than historically (Table 9). A comparison of standing crop and species composition helps show the impact of Baetids on Biomass values. Baetids are typically small mayflies, so having a high percentage of other EPT (which are often larger taxa) would increase the Biomass value. The most downstream site, CR-1.7, had the lowest number of individuals collected (based on Density and Biomass metrics), as well as the lowest % EPT excluding Baetidae. Comparatively, site CR-R4 had the highest Biomass and % EPT excluding Baetidae, as well as a fairly high Density value (Table 9).

In 2024, a new site (CRCC-0.5) was established on the recently finished Connectivity Channel, constructed around the Windy Gap Reservoir. Initial sampling results indicate that this site was able to support macroinvertebrate communities similar to other sites on the Colorado River (Table 9). It is not surprising that many of the metric values are close to values found at the upstream site, CR-31.0, as this site was likely the source for many of the taxa present at CRCC-0.5. While CRCC-0.5 had the highest percentage of tolerant taxa collected at sampling locations on the Colorado River, it also demonstrated the ability to support sensitive species as seen in metric values for EPT and % Hydropsychidae (Table 9). Future biomonitoring studies will help to evaluate how this site's benthic macroinvertebrate community establishes and is maintained.

Table 9. Additional individual metrics and comparative values for benthic macroinvertebrate samples collected from the Colorado River study area during fall of 2024. All additional metric values are based on full count (quantitative) Hess samples.

Metric	WC-2.3	WC-0.5	CR-31.0	CRCC-0.5	CR-28.7	CR-24.9	CR-22.1	CR-16.7	CR-bWF	CR-R3	CR-R4	CR-9.1	CR-7.4	CR-1.7
Biomonitoring Project	LBD		NW	LBD	NW	LBD	NW					LBD		
Density (mean #/m²)	8,575	5,095	7,690	7,902	13,771	8,681	14,798	7,802	12,500	14,132	12,159	10,439	9,684	6,359
Taxa Richness	49	44	58	54	60	48	50	58	48	54	55	59	65	50
EPT Taxa	19	22	25	23	33	26	30	33	24	26	32	30	35	25
Density of <i>Pteronarcys californica</i> (#/m²)	0	0	0	0	0	0	0	16	4	0	4	0	4	0
% EPT-excluding Baetidae	17.26%	57.33%	39.67%	40.53%	68.22%	62.94%	62.76%	63.14%	79.50%	84.04%	85.02%	56.08%	53.93%	20.93%
% Chironomidae	58.31%	17.33%	35.43%	19.43%	13.20%	20.19%	19.72%	16.00%	3.50%	5.79%	6.69%	21.81%	28.97%	16.77%
% Hydropsychidae	9.06%	29.16%	9.88%	24.20%	32.76%	13.70%	8.46%	15.00%	10.23%	7.57%	13.55%	4.65%	3.85%	4.90%
% Tolerant Taxa	24.49%	15.91%	18.97%	20.37%	13.33%	6.25%	10.00%	10.34%	14.58%	12.96%	14.55%	15.25%	18.46%	16.00%
% Intolerant Taxa	26.53%	43.18%	37.93%	31.48%	48.33%	41.67%	42.00%	43.10%	43.75%	44.44%	47.27%	42.37%	40.00%	36.00%
Biomass (g/m²)	1.13	2.55	1.85	1.89	3.90	2.63	3.57	5.12	3.49	13.49	14.96	12.20	1.92	1.59

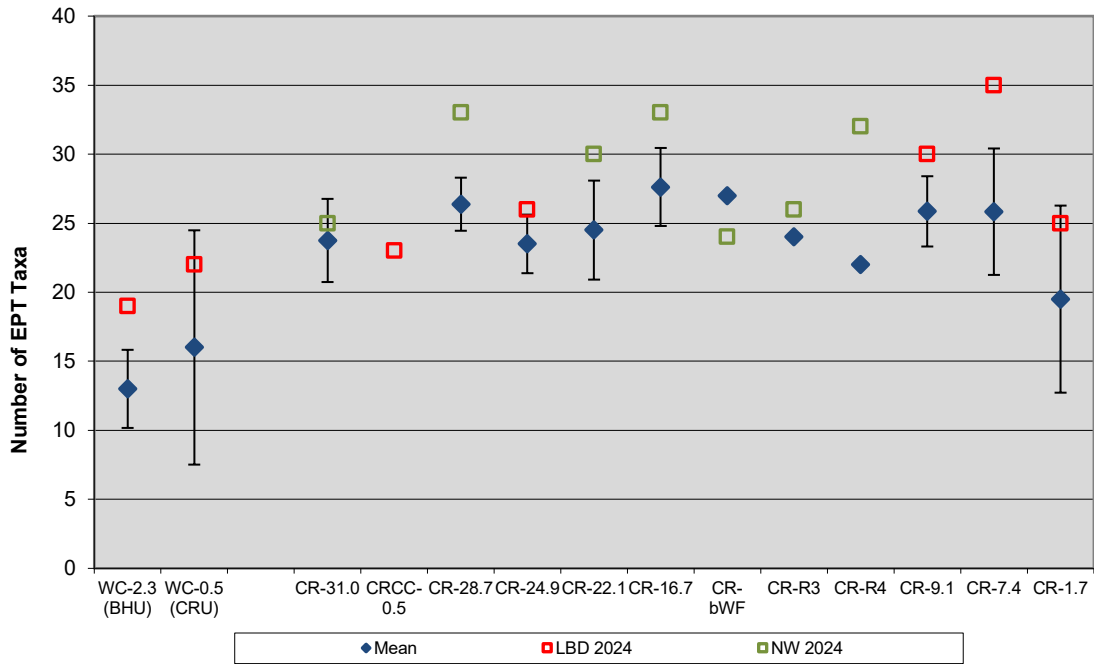


Figure 19. EPT Taxa values from the Colorado River study area during the fall of 2024 and historical mean values (± 1 SD).

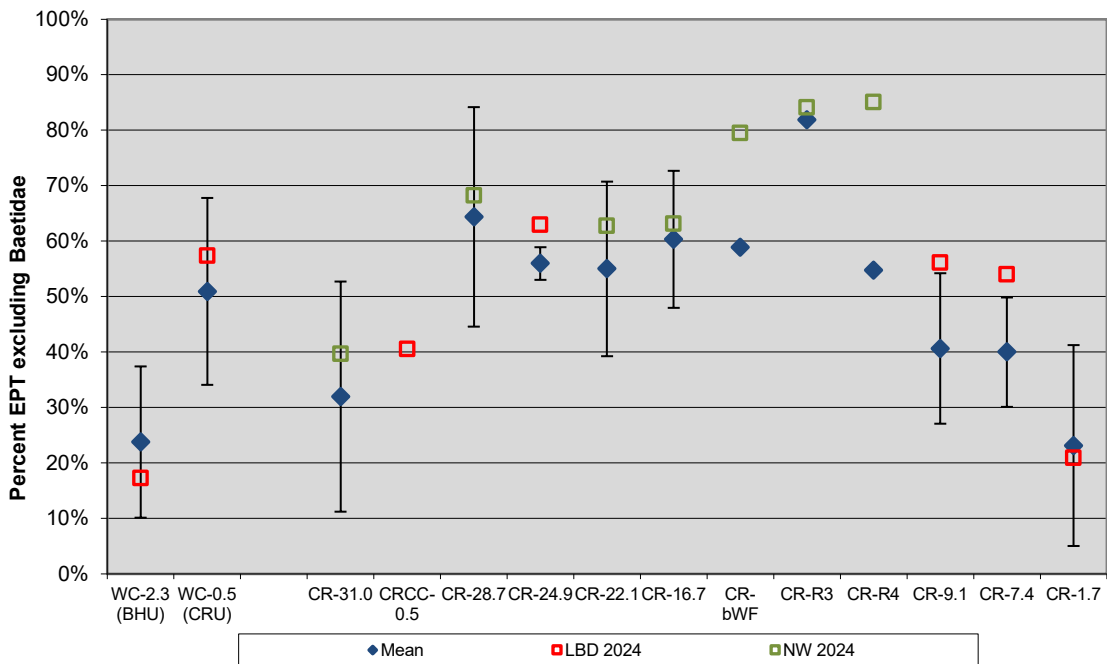


Figure 20. Percent EPT-excluding Baetidae values from the Colorado River study area during the fall of 2024 and historical mean values (± 1 SD).

Williams Fork Study Area

In 2024, a review of the individual metric results demonstrated a strong shift in benthic macroinvertebrate communities from the two upstream sites to the two downstream sampling locations on the Williams Fork (Table 10). The two sites above the reservoir had the ability to support more total taxa (see Taxa Richness values), including those sensitive to disturbances (based on EPT and % EPT excluding Baetidae) than the two downstream sites (Table 10). Immediately downstream from the impoundment (site WF-2.), Total Taxa and EPT Taxa diminished from 30 to 11, respectively, and a slight improvement to the number of sensitive individuals occurred farther downstream (Table 10). While all sites had EPT values similar to previous sampling events, the % EPT-excluding Baetidae values were lower than expected at the two upstream sites (Figures 21 and 22). However, this metric value was much lower at the downstream sites (1.46% at WF-2.0 and 4.44% at WF-0.5), and when looking at the identification data, site WF-2.0 and WF-0.5 supported very high numbers (1,579 and 1,463, respectively) of the tolerant Baetid, *Baetis tricaudatus*. Additionally, site WF-2.0 had high numbers of the chironomid *Eukiefferiella* sp. and flatworm *Polycelis coronata*, both of which are considered tolerant taxa, and site WF-5.0 supported high numbers of the black fly, *Simulium* sp. (Appendix A: Tables A11-A12). Therefore, while the Density at the lower two sites was much higher, most of the increase was found in tolerant species. The increased distance downstream from the impoundment, as well as nearby habitat enhancements, could be contributing to minor improvements in community structure at site WF-0.5. Overall, results from biomonitoring on the Williams Fork suggested that benthic macroinvertebrate communities remain impacted by reservoir operations in the downstream portion of the study area, though a slight increase in stress was observed at the uppermost sites in 2024.

Table 10. Additional individual metrics and comparative values for benthic macroinvertebrate samples collected from the Williams Fork study area during September of 2024. All additional metric values are based on full count (quantitative) Hess samples.

Metric	WF-13.1	WF-5.5	WF-2.0	WF-0.5
Monitoring Project	Learning By Doing (LBD)			
Density (mean #/m ²)	5,143	7,523	13,563	12,245
Taxa Richness	41	50	30	30
EPT Taxa	21	17	11	15
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0
% EPT-excluding Baetidae	44.60%	24.85%	1.46%	4.44%
% Chironomidae	10.73%	16.17%	30.75%	12.14%
% Hydropsychidae	0.08%	4.65%	0.03%	0.03%
% Tolerant Taxa	12.20%	26.00%	20.00%	13.33%
% Intolerant Taxa	48.78%	24.00%	36.67%	46.67%
Biomass (g/m ²)	3.22	1.57	2.44	2.16

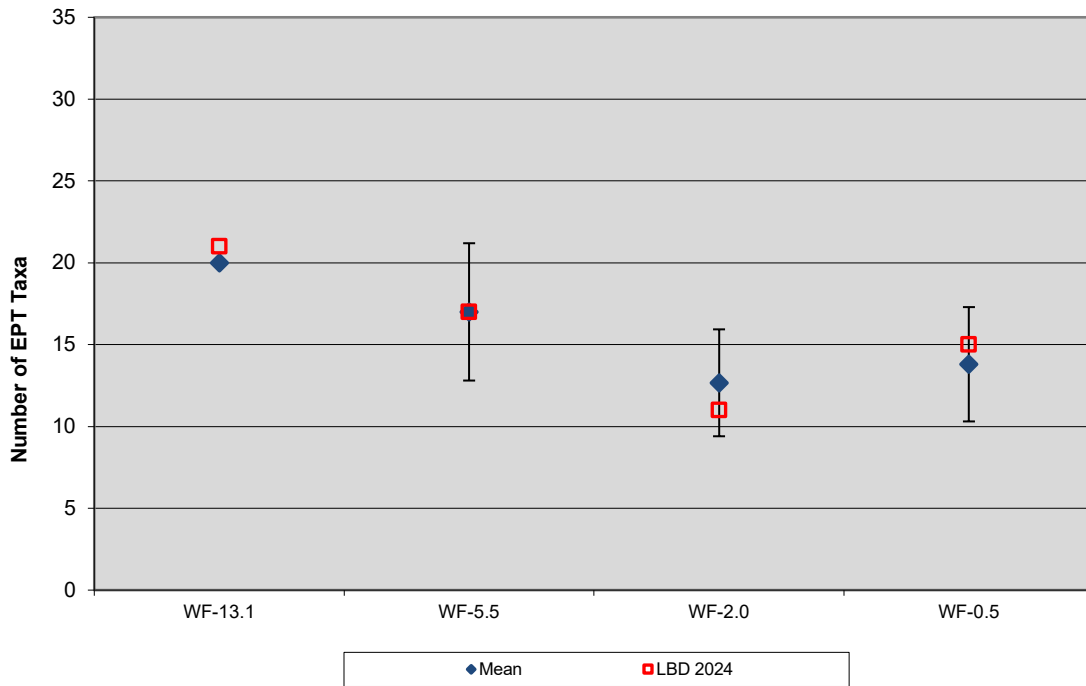


Figure 21. EPT Taxa values in the Williams Fork study area from the fall of 2024 and historical mean values (± 1 SD).

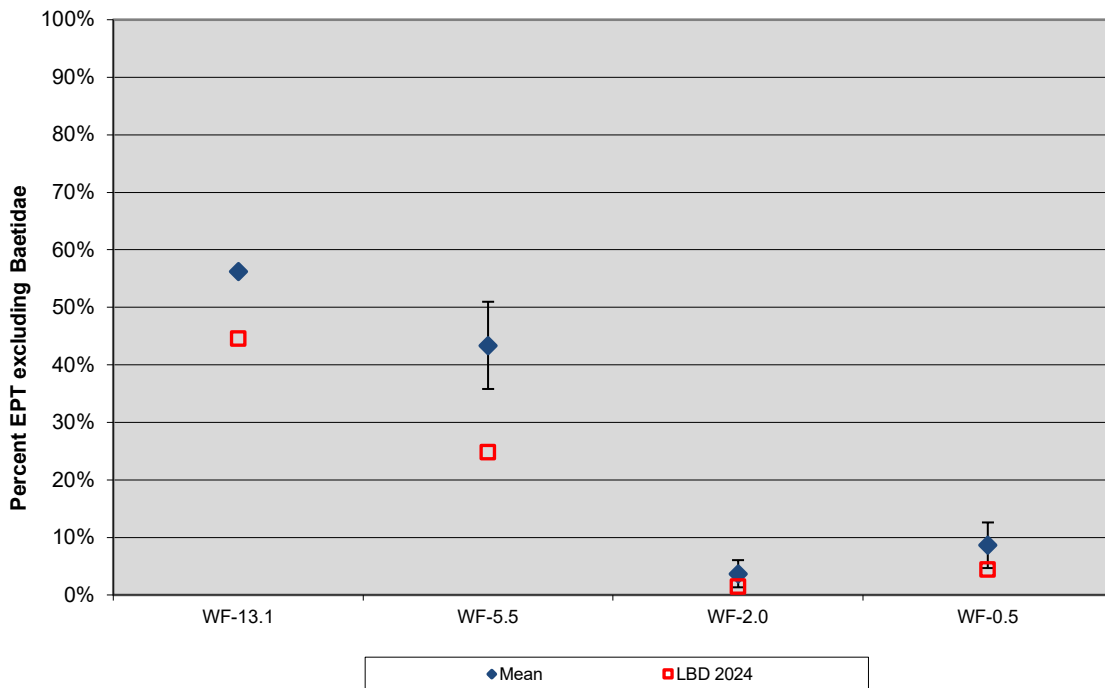


Figure 22. Percent EPT-excluding Baetidae values in the Williams Fork study area from the fall of 2024 and historical mean values (± 1 SD).

Functional Feeding Group Analysis

The proportional distribution of functional feeding groups provided insight into the ecological balance of macroinvertebrate communities at all sampling sites associated with the LBD, Denver Water, and Northern Water biomonitoring studies in the fall of 2024. Healthy Colorado streams typically support diverse macroinvertebrate communities that exhibit a variety of feeding strategies; however, it is common for certain feeding groups (such as collector-gatherers) to be slightly dominant²⁸. The major functional feeding groups are 1) scrapers/grazers which consume algae and associated material; 2) shredders, which consume leaf litter or other coarse particulate organic matter (CPOM), including wood; 3) collector-gatherers, which collect fine particulate organic matter (FPOM) from the stream bottom; 4) collectors-filterers, which collect FPOM from the water column using a variety of filters; 5) predators, which feed on other consumers; and 6) omnivores or other species that simply do not fit neatly into the other categories^{45,46}.

Fraser River Study Area

There was considerable variability in the proportion of feeding groups between sites in the Fraser River study area in 2024; however, all sites appeared to support healthy macroinvertebrate communities (Table 11; Figure 23). Collector-gatherers made up the highest proportion of all feeding groups at most sites, and shredders and scrapers (which are considered sensitive feeding groups) were collected at all sampling locations (Table 11). The relatively low numbers of collector-filterers at sites FR-23.2, VC-WP, and FR-20 could indicate less available FPOM in the water column at these locations. The site on Ranch Creek (RC-1.1) had the highest proportion of shredders and scrapers (58.3% combined), which aligns with results from the MMI v4 score of 90.1 indicating a relatively healthy macroinvertebrate community. Site FR-3.5 had similar proportions of collector-gatherers and collector-filterers, and the highest number of scrapers collected (Table 11). In general, the results from the functional feeding group analysis supported findings from the MMI v4 and individual metrics, indicating that all sampling locations in the Fraser River study area supported well-balanced macroinvertebrate communities.

Table 11. Relative abundance of functional feeding groups in the Fraser River study area during the fall of 2024.

Site	Project	Functional Feeding Group					
		Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
FR-25.1	LBD	30.31%	23.28%	2.49%	19.03%	23.87%	1.02%
FR-23.2	DW	51.18%	4.17%	1.45%	8.17%	34.30%	0.73%
VC-WP	DW	53.49%	1.30%	2.78%	19.94%	12.49%	10.00%
FR-20	DW	68.89%	6.72%	1.13%	10.76%	8.80%	3.70%
FR-15	LBD	63.97%	17.68%	1.77%	11.92%	4.31%	0.35%
FR-14	DW	47.32%	17.01%	2.50%	21.59%	11.58%	0.00%
RC-1.1	LBD	16.31%	16.06%	34.24%	24.09%	9.24%	0.05%
FR-3.5	LBD	30.31%	34.49%	4.68%	26.26%	4.26%	0.00%

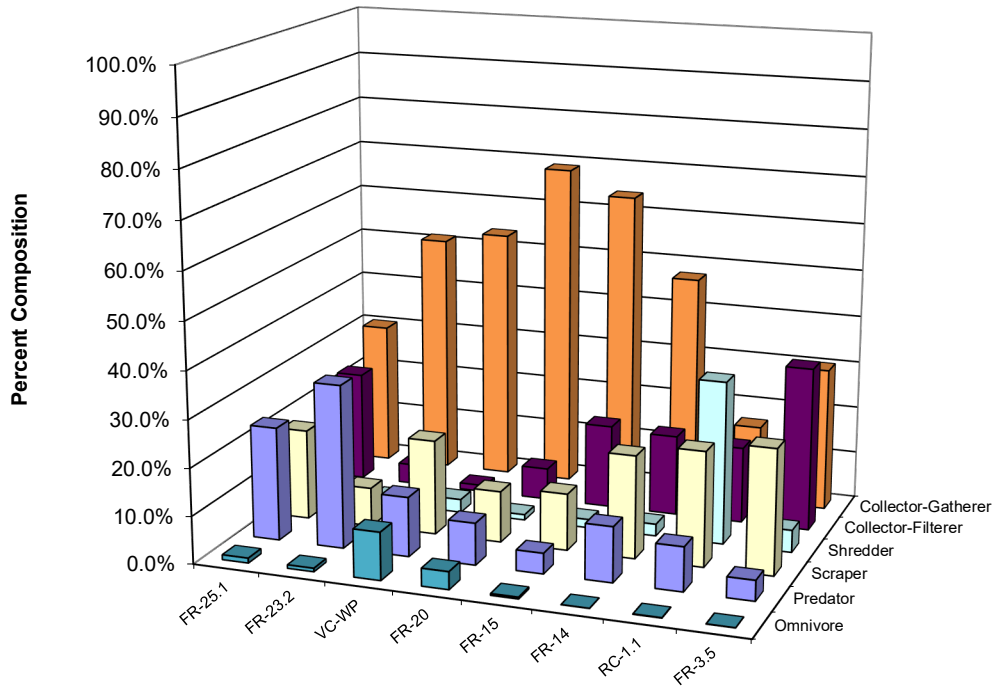


Figure 23. Functional feeding group composition for study sites in the Fraser River study area during the fall of 2024.

Colorado River Study Area

In 2024, functional feeding group assessments in the Colorado River study area continued to evaluate ecological function as well as overall macroinvertebrate community health (Table 12; Figure 24). On Willow Creek, the site directly below the dam (WC-2.3) was dominated (77.48%) by collector-gatherers, and while sensitive feeding groups were present, they comprised a very small proportion of the community (Table 12). Community structure balanced farther downstream at site WC-0.5, though it was the only site in the study area with no macroinvertebrate classified as omnivore present (Table 12). Sites in the downstream portion on the Colorado River (CR-bWF and below) had higher proportions of shredders and scrapers (specialized and sensitive feeders) than upstream sites (Table 12). Site CR-22.1 had the least functionally balanced assemblage, with collector gatherers making up over 77% of the community, and specialized groups representing less than 10% of the community (Table 12). At site CRCC-0.5 on the newly constructed Connectivity Channel, all functional feeding groups were represented. Collector-gatherers made up the highest proportion of the community (48.89%), followed by collector-filterers (37.92%), then shredders (5.80%) and scrapers (5.16%). The proportion of sensitive and specialized feeders at this site may improve now that the river can flow freely around the Windy Gap Reservoir. Overall, sites in the Colorado River study area supported the results from MMI v4 and individual metrics, detecting increased stress at WC-2.3 and a fairly balanced and stable macroinvertebrate community in the remainder of the study area.

Table 12. Relative abundance of functional feeding groups in the Colorado River study area during the fall of 2024.

Site	Project	Functional Feeding Group					
		Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
WC-2.3	LBD	77.48%	12.23%	0.68%	2.81%	6.66%	0.14%
WC-0.5	LBD	30.53%	40.84%	6.87%	17.94%	3.82%	0.00%
CR-31.0	NW	43.90%	16.43%	13.05%	6.80%	3.93%	15.88%
CRCC-0.5	LBD	48.89%	37.92%	5.80%	5.16%	2.12%	0.10%
CR-28.7	NW	47.90%	36.67%	2.20%	7.29%	5.88%	0.06%
CR-24.9	LBD	51.75%	18.35%	8.91%	16.34%	4.48%	0.18%
CR-22.1	NW	77.24%	10.45%	2.33%	7.23%	2.72%	0.03%
CR-16.7	NW	61.25%	19.47%	2.38%	12.27%	2.88%	1.74%
CR-bWF	NW	17.36%	49.40%	16.71%	6.54%	0.74%	9.24%
CR-R3	NW	43.36%	20.84%	4.66%	26.82%	3.35%	0.96%
CR-R4	NW	52.47%	22.38%	3.76%	16.64%	2.52%	2.23%
CR-9.1	LBD	47.08%	21.99%	6.51%	17.05%	5.21%	2.16%
CR-7.4	LBD	61.64%	6.86%	9.95%	15.93%	5.58%	0.04%
CR-1.7	LBD	44.49%	9.36%	3.98%	37.94%	4.16%	0.06%

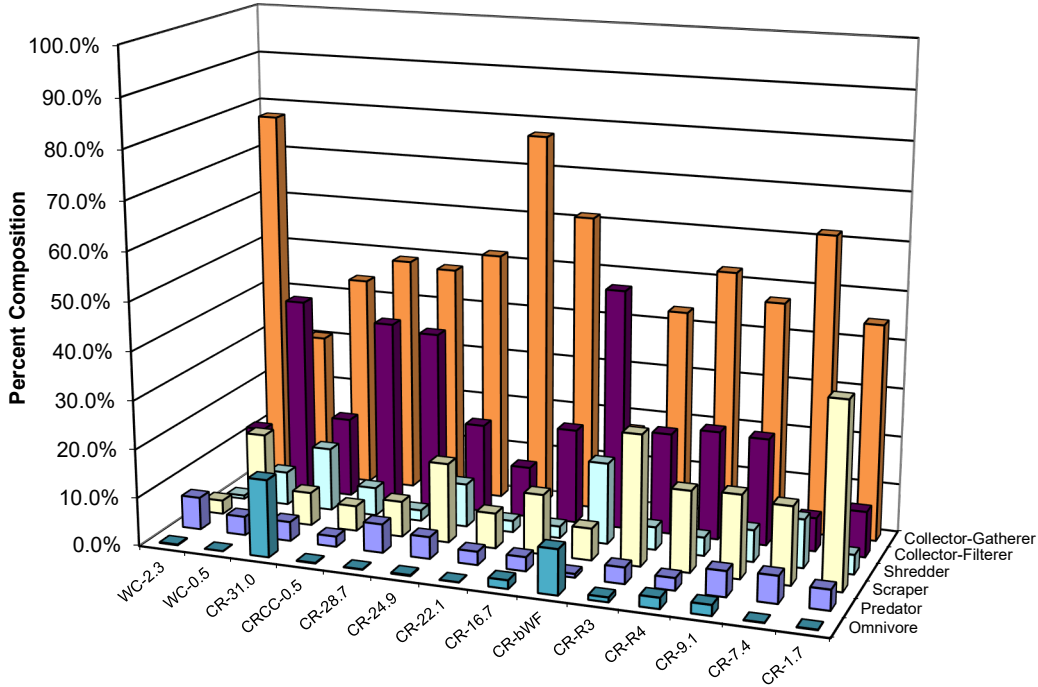


Figure 24. Functional feeding group composition for study sites in the Colorado River study area during the fall of 2024.

Williams Fork Study Area

The functional feeding group analysis on the Williams Fork demonstrated how benthic macroinvertebrate community composition can change beneath a deep-release reservoir (Table 13; Figure 25). While the most upstream site, WF-13.1, supported members from all six feeding groups, individuals that consume FPOM (collector-gatherers and collector-filterers) dominated the community (76.19% combined). The most functionally balanced community occurred immediately upstream from the reservoir at site WF-5.5, where the proportion of specialized feeders comprised over 26% of the community (Table 13). Directly downstream from the reservoir at site WF-2.0, collector-gatherers dominated the community, and shredders and scrapers represented a very low proportion of the assemblage (0.06% and 0.11%, respectively). There was a substantial increase in the proportion of collector-filterers downstream at site WF-0.5; however, specialized feeders still represented a low percentage of the community (Table 13). In 2024, the results from the functional feeding group analysis supported findings from other metrics, indicating an impact on macroinvertebrate communities at the site directly beneath the impoundment and a slight improvement with distance downstream.

Table 13. Relative abundance of functional feeding groups in the Williams Fork study area during the fall of 2024.

Site	Project	Functional Feeding Group					
		Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
WF-13.1	LBD	48.90%	27.29%	10.43%	1.51%	6.35%	5.52%
WF-5.5	LBD	29.08%	34.04%	5.63%	20.56%	9.14%	1.55%
WF-2.0	LBD	77.95%	2.83%	0.06%	0.11%	1.80%	17.25%
WF-0.5	LBD	60.08%	23.04%	0.16%	0.03%	2.19%	14.51%

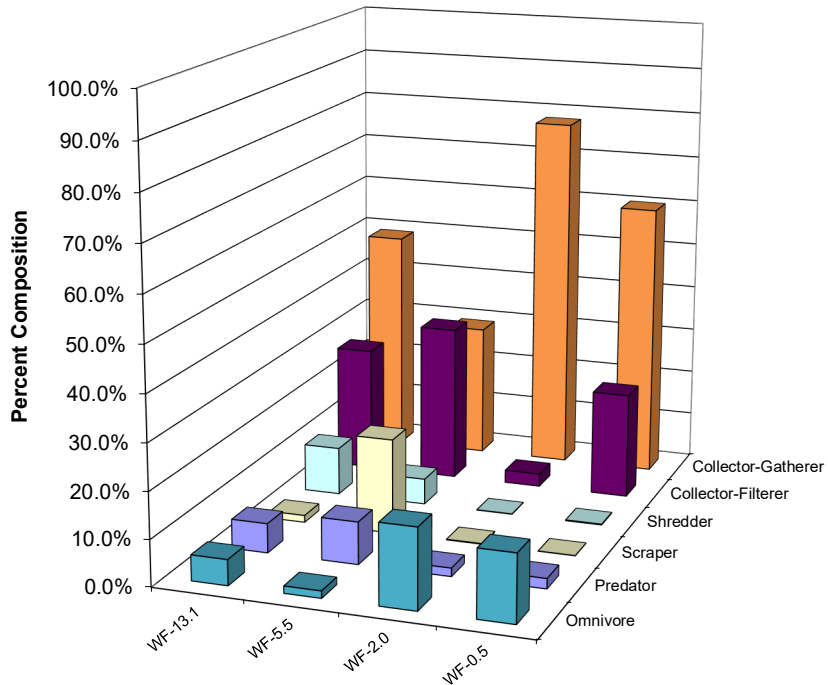


Figure 25. Functional feeding group composition for study sites in the Williams Fork study area during the fall of 2024.

Conclusions

In the fall of 2024, three major drainages in Grand County, Colorado were assessed through benthic macroinvertebrate biomonitoring studies on sections of the Fraser River, Colorado River, and Williams Fork River (as well as several tributaries) for Learning By Doing, Denver Water, and Northern Water. Macroinvertebrate community structure and function were evaluated using the MMI v4, ten additional individual metrics, as well as functional feeding groups to determine the overall condition of aquatic life. Results from the MMI v4 indicated that all sampling locations were in attainment for aquatic life use in 2024. Importantly, site CR-31.0, which has been designated as 'impaired' the previous few years of sampling after a notable drop in MMI v4 score is now considered in 'attainment'. Additionally, the recently established site on the new Connectivity Channel around the Windy Gap Reservoir appeared to support similar (and relatively healthy) macroinvertebrate communities to other sites on the Colorado River. Sites with the lowest MMI v4 scores occurred on Willow Creek at WC-2.3 and on the Williams Fork River at WF-2.0 both of which are directly beneath reservoir impoundments. Other stress on the Fraser River, Colorado River, and Williams Fork could be attributed to natural changes in stream dynamics (flow, temperature regimes, etc.) rather than major anthropogenic perturbations. Overall, individual metrics and functional feeding group analyses supported the findings from the MMI v4, indicating that most sampling locations in the study areas supported well-balanced and stable macroinvertebrate communities. Future biomonitoring efforts will continue to assess changes in the influences of human activities as well as an ongoing assessment of habitat improvement projects.

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Appendix A

Learning By Doing

Benthic Macroinvertebrate Data – Fall 2024

2024 Learning by Doing Benthic Macroinvertebrate Summary Report

Table A1. Macroinvertebrate data collected from site FR-25.1 on 16 Sept. 2024.

Fraser River						
FR-25.1		Sample				
16 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.	1				1	4
<i>Acentrella</i> sp.	4	2			6	24
<i>Baetis flavistriga</i>	4	2			6	24
<i>Baetis (tricaudatus)</i>	9	12	23		44	171
<i>Dipheter hageni</i>						
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>	1		1		2	8
<i>Drunella doddsii</i>	21	13	33		67	260
<i>Drunella grandis</i>						
<i>Ephemerella dorothea infrequens</i>	8		3		11	43
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.	8	1	4		13	51
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>		3	1		4	16
<i>Epeorus longimanus</i>		2			2	8
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.		2	7		9	35
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia</i> sp.						
Plecoptera (stoneflies)						
Capniidae			1		1	4
<i>Paracapnia angulata</i>						
Chloroperlidae	3	1			4	16
<i>Sweltsa</i> sp.	1		6		7	28
<i>Zapada cinctipes</i>	2		5		7	28
<i>Zapada oregonensis</i>	5		4		9	35
<i>Claassenia sabulosa</i>						
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.	2		5		7	28
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>	1		2		3	12
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>						
<i>Taenionema</i> sp.	7	32	59		98	380
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>		1			1	4
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bacro</i>						
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.			1		1	4
<i>Protoptila</i> sp.						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	1				1	4
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	1		1		2	8
<i>Hydroptila</i> sp.						
<i>Ochrotrichia</i> sp.						
<i>Lepidostoma</i> sp.						
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.						
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>	1	5	12		18	70
<i>Rhyacophila coloradensis</i>	1	2	3		6	24
<i>Rhyacophila sibirica</i> group	17	3	9		29	113
<i>Oligophlebodes</i> sp.	1		1		2	8



Table A1. cont. Macroinvertebrate data collected from FR-25.1 on 16 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Cardiocladius</i> sp.						
<i>Cricotopus nostocicola</i>						
<i>Cricotopus/Orthocladius</i> sp.	35	6	3	44	171	
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.		1		1	4	
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.		2	4	6	24	
<i>Lopescladius</i> sp.						
<i>Microspectral/Tanytarsus</i> sp.			3	3	12	
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Paqastia</i> sp.	1			1	4	
<i>Parakiefferiella</i> sp.						
<i>Parametrioicnemus</i> sp.						
<i>Paratanytarsus</i> sp.						
<i>Phaenopsectra</i> sp.						
<i>Polypedilum</i> sp.						
<i>Potthastia</i> sp.						
<i>Potthastia gaedii</i>						
<i>Procladius</i> sp.						
<i>Rheotanytarsus</i> sp.						
<i>Sublettea</i> sp.						
<i>Synorthocladius</i> sp.	1			1	4	
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	1	3	2	6	24	
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	2			2	8	
<i>Hemerodromia</i> sp.						
<i>Wiedemannia</i> sp.						
<i>Lispoides</i> sp.						
<i>Pericoma</i> sp.	1	1	1	3	12	
<i>Simulium</i> sp.	3	61	91	155	601	
Tipulidae						
<i>Antocha</i> sp.						
<i>Dicranota</i> sp.						
<i>Hexatoma</i> sp.						
<i>Pedicia</i> sp.						
<i>Tipula</i> sp.						
Coleoptera (beetles)						
<i>Liodessus</i> sp.						
<i>Cleptelmis</i> sp.						
<i>Heterolimnius</i> sp.	44	11	20	75	291	
<i>Microcyloepus</i> sp.						
<i>Optioservus</i> sp.		1		1	4	
<i>Zaitzevia parvula</i>						
<i>Brychius</i> sp.						
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.	1			1	4	
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	4		1	5	20	
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Ferrissia</i> sp.						
Lymnaeidae						
<i>Physa</i> sp.						
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	2	1	4	7	28	
<i>Crangonyx</i> sp.						
<i>Gammarus lacustris</i>						
Erpobdellidae						
Enchytraeidae						
Lumbricidae						
Naididae						
Tubificidae						
Nematoda		2	9	11	43	
Totals	194	170	319	683	2664	

2024 Learning by Doing Benthic Macroinvertebrate Summary Report

Table A2. Macroinvertebrate data collected from site FR-15 on 16 Sept. 2024.

Fraser River					
FR-15		Sample			
16 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	3	6	3	12	47
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	52	53	113	218	845
<i>Dipheter hageni</i>	1	3		4	16
<i>Attenella margarita</i>		1		1	4
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>		2		2	8
<i>Drunella grandis</i>	31	30	41	102	396
<i>Ephemerella dorothea infrequens</i>	380	385	299	1064	4125
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>	1	2	1	4	16
<i>Heptagenia</i> sp.					
<i>Rhithrogena</i> sp.	1			1	4
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	28	16	4	48	187
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>					
Chloroperlidae	1	1		2	8
<i>Sweltsa</i> sp.		4		4	16
<i>Zapada cinctipes</i>		1	1	2	8
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>					
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)					
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.			1	1	4
<i>Isoperla fulva</i>	3	5	7	15	59
<i>Megarcys signata</i>					
<i>Skwala americana</i>	3	7	1	11	43
<i>Pteronarcella badia</i>		1		1	4
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	10	8	6	24	94
<i>Brachycentrus occidentalis</i>					
<i>Micrasema bactro</i>	1	2	1	4	16
<i>Culoptila</i> sp.					
<i>Glossosoma</i> sp.	158	36	71	265	1028
<i>Protoptila</i> sp.			1	1	4
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>	16	16	18	50	194
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.		1	1	2	8
<i>Hydropsyche</i> sp.					
<i>Hydropsyche cockerelli</i>	83	186	221	490	1900
<i>Hydropsyche occidentalis</i>					
<i>Hydropsyche oslari</i>	43	22	27	92	357
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	7	25	25	57	221
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>		1		1	4
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.		1		1	4



Table A2. cont. Macroinvertebrate data collected from site FR-15 on 16 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.		2		2	8
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	211	192	519	922	3574
<i>Cryptochironomus</i> sp.					
<i>Damesa</i> sp.		6	12	18	70
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	49	57	87	193	749
<i>Lopescladius</i> sp.					
<i>Micropsectra/Tanytarsus</i> sp.	7	2	9	18	70
<i>Microtendipes</i> sp.	10		21	31	121
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	26	26	26	78	303
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.	1	3	4	8	32
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.	2	4	5	11	43
<i>Potthastia</i> sp.	2	1	2	5	20
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.			1	1	4
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.	1	3	3	7	28
<i>Thienemanniella</i> sp.	1		6	7	28
<i>Thienemannimyia</i> group	2		1	3	12
<i>Tvetenia</i> sp.	23	40	93	156	605
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	3		2	5	20
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.			1	1	4
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.	1			1	4
<i>Simulium</i> sp.	12	27	30	69	268
Tipulidae		1		1	4
<i>Antocha</i> sp.	1	1	1	3	12
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.		1		1	4
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	73	85	82	240	931
<i>Zaitzevia parvula</i>		1		1	4
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.		1	1	2	8
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.	1	7	3	11	43
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>	3	5	7	15	59
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae					
Lumbricidae	1			1	4
Naididae					
Tubificidae					
Nematoda	1	3		4	16
Totals	1253	1283	1758	4294	16668

2024 Learning by Doing Benthic Macroinvertebrate Summary Report

Table A3. Macroinvertebrate data collected from site RC-1.1 on 16 Sept. 2024.

Ranch Creek					
RC-1.1		Sample			
16 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.					
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	29	8	9	46	179
<i>Dipheter hageni</i>					
<i>Attenella margarita</i>					
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>	39	25	20	84	326
<i>Ephemerella dorothea infrequens</i>	47	50	35	132	512
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.	4	3	4	11	43
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>	9	17	17	43	167
<i>Heptagenia</i> sp.					
<i>Rhithrogena</i> sp.					
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	3	35	15	53	206
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>					
Chloroperlidae	2	6	3	11	43
<i>Sweltsa</i> sp.	5	7		12	47
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>			3	3	12
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)					
<i>Diura knowltoni</i>		1		1	4
<i>Isoperla</i> sp.					
<i>Isoperla fulva</i>	3	4	5	12	47
<i>Megarcys signata</i>					
<i>Skwala americana</i>		1	1	2	8
<i>Pteronarcella badia</i>			1	1	4
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	55	63	76	194	752
<i>Brachycentrus occidentalis</i>			2	2	8
<i>Micrasema bactro</i>	10	10		20	78
<i>Culoptila</i> sp.	16	17	5	38	148
<i>Glossosoma</i> sp.	19	5	39	63	245
<i>Protoptila</i> sp.	13	6	15	34	132
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>	4	4	4	12	47
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.					
<i>Hydropsyche</i> sp.		1	4	5	20
<i>Hydropsyche cockerelli</i>	7	11	5	23	90
<i>Hydropsyche occidentalis</i>	1			1	4
<i>Hydropsyche oslari</i>	27	32	21	80	311
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	187	275	187	649	2516
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.		1		1	4
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>					
<i>Rhyacophila coloradensis</i>		1	1	2	8
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



2024 Learning by Doing Benthic Macroinvertebrate Summary Report

Table A3. cont. Macroinvertebrate data collected from RC-1.1 on 16 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.					
<i>Cricotopus nostocicola</i>	1	1		2	8
<i>Cricotopus/Orthocladius</i> sp.	4	2		6	24
<i>Cryptochironomus</i> sp.					
<i>Damesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	20	2	4	26	101
<i>Lopescladius</i> sp.					
<i>Micropsectra/Tanytarsus</i> sp.					
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	2	1		3	12
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.					
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.	2	3	1	6	24
<i>Potthastia</i> sp.					
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.					
<i>Thienemanniella</i> sp.					
<i>Thienemannimyia</i> group					
<i>Tvetenia</i> sp.	3	6	1	10	39
Other Diptera (true flies)					
<i>Atherix pachypus</i>	11	6	2	19	74
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	2			2	8
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.			2	2	8
<i>Simulium</i> sp.	1			1	4
Tipulidae					
<i>Antocha</i> sp.	1	1		2	8
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	93	80	114	287	1113
<i>Zaitzevia parvula</i>	16	10	16	42	163
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.		1	1	2	8
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.	2	1		3	12
<i>Protzia</i> sp.	1	2	3	6	24
<i>Sperchon</i> sp.	6	11	7	24	94
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>			1	1	4
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae			1	1	4
Lumbricidae					
Naididae					
Tubificidae					
Nematoda					
Totals	645	710	625	1980	7693

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Table A4. Macroinvertebrate data collected from FR-3.5 on 16 Sept. 2024.

Fraser River						
FR-3.5		Sample				
16 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.	5	12	2		19	74
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	58	81	45		184	714
<i>Dipheter hageni</i>	1				1	4
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>			1		1	4
<i>Drunella grandis</i>	2	5	2		9	35
<i>Ephemerella dorothea infrequens</i>	17	38	17		72	280
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>	6	9	9		24	94
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.						
<i>Tricorythodes explicatus</i>			1		1	4
<i>Paraleptophlebia</i> sp.	8	54	29		91	353
Plecoptera (stoneflies)						
Capniidae						
<i>Paracapnia angulata</i>		5	1		6	24
Chloroperlidae	1	6	10		17	66
<i>Sweltsa</i> sp.						
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>	2	5	2		9	35
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)	1	5	1		7	28
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.						
<i>Isoperla fulva</i>		1			1	4
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>			1		1	4
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	3	11	7		21	82
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bactro</i>						
<i>Culoptila</i> sp.		2			2	8
<i>Glossosoma</i> sp.	9	36	23		68	264
<i>Protophila</i> sp.	2	40	42		84	326
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	4	4	2		10	39
<i>Ceratopsyche morosa</i> group	27	19	8		54	210
<i>Cheumatopsyche</i> sp.	18	53	27		98	380
<i>Hydropsyche</i> sp.	23	104	57		184	714
<i>Hydropsyche cockerelli</i>	9	22	14		45	175
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	22	18	5		45	175
<i>Hydroptila</i> sp.						
<i>Ochrotrichia</i> sp.						
<i>Lepidostoma</i> sp.	18	21	17		56	218
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.		2			2	8
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.	1		3		4	16
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>	1	3	1		5	20
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



Table A4. cont. Macroinvertebrate data collected from FR-3.5 on 16 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.	1			1	4
<i>Cricotopus nostocicola</i>			2	2	8
<i>Cricotopus/Orthocladius</i> sp.	1	1		2	8
<i>Cryptochironomus</i> sp.					
<i>Damesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	4	5		9	35
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.		1		1	4
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	1	1		2	8
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.					
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.	1			1	4
<i>Potthastia</i> sp.					
<i>Potthastia gaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.					
<i>Thienemanniella</i> sp.					
<i>Thienemannimyia</i> group					
<i>Tvetenia</i> sp.	4	10	2	16	63
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.		2	1	3	12
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.	23	5	1	29	113
Tipulidae					
<i>Antocha</i> sp.			1	1	4
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	41	82	68	191	741
<i>Zaitzevia parvula</i>	10	5	8	23	90
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.			2	2	8
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.					
<i>Protzia</i> sp.		1		1	4
<i>Sperchon</i> sp.		1		1	4
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.		1		1	4
<i>Polycelis coronata</i>					
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae					
Lumbricidae					
Naididae			1	1	4
Tubificidae					
Nematoda			1	1	4
Totals	324	671	414	1409	5480

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Table A5. Macroinvertebrate data collected from WC-2.3 on 18 Sept. 2024.

Willow Creek						
WC-2.3		Sample				
18 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.		1			1	4
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	7	10	19		36	140
<i>Dipheter hageni</i>		1	1		2	8
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>						
<i>Drunella grandis</i>						
<i>Ephemerella dorothea infrequens</i>	27	20	46		93	361
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>	5		7		12	47
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.						
<i>Tricorythodes explicatus</i>	3	1	1		5	20
<i>Paraleptophlebia</i> sp.						
Plecoptera (stoneflies)						
Capniidae						
<i>Paracapnia angulata</i>						
Chloroperlidae	1	1			2	8
<i>Sweltsa</i> sp.						
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>						
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.		4	8		12	47
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>						
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	1	7	29		37	144
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bactro</i>		1	1		2	8
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.			1		1	4
<i>Protoptila</i> sp.						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>			5		5	20
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.			3		3	12
<i>Hydropsyche</i> sp.	1	5	15		21	82
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	13	23	135		171	663
<i>Hydroptila</i> sp.			2		2	8
<i>Ochrotrichia</i> sp.						
<i>Lepidostoma</i> sp.		8	5		13	51
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.			1		1	4
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>			1		1	4
<i>Rhyacophila coloradensis</i>						
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



Table A5. cont. Macroinvertebrate data collected from WC-2.3 on 18 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.					
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	368	295	297	960	3721
<i>Cryptochironomus</i> sp.					
<i>Diamesa</i> sp.					
<i>Dicrotendipes</i> sp.	5	4		9	35
<i>Eukiefferiella</i> sp.	14	20	24	58	225
<i>Lopescladius</i> sp.					
<i>Micropsectra/Tanytarsus</i> sp.	4	6	9	19	74
<i>Microtendipes</i> sp.	15	5	13	33	128
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.			1	1	4
<i>Parakiefferiella</i> sp.		2	1	3	12
<i>Parametrioicnemus</i> sp.	3	6	12	21	82
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.					
<i>Potthastia</i> sp.	6	16	26	48	187
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.		2	3	5	20
<i>Thienemanniella</i> sp.	6	1	1	8	32
<i>Thienemannimyia</i> group	9	7	13	29	113
<i>Tvetenia</i> sp.	9	18	66	93	361
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	1	3	1	5	20
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispidoides</i> sp.			1	1	4
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.					
Tipulidae					
<i>Antocha</i> sp.		2		2	8
<i>Dicranota</i> sp.		1	1	2	8
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	16	11	12	39	152
<i>Zaitzevia parvula</i>					
<i>Brychius</i> sp.	3	1	1	5	20
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.	19	8	10	37	144
<i>Lebertia</i> sp.	8	15	6	29	113
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.	3	8	4	15	59
<i>Torrenticola</i> sp.					
<i>Caecidotrea</i> sp.	93	105	94	292	1132
<i>Ferrissia</i> sp.					
Lymnaeidae	1			1	4
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.	1	1		2	8
<i>Polycelis coronata</i>					
<i>Crangonyx</i> sp.	21	23	3	47	183
<i>Gammarus lacustris</i>	2	1		3	12
Erpobdellidae	5	5	2	12	47
Enchytraeidae					
Lumbricidae					
Naididae					
Tubificidae		7		7	28
Nematoda	1			1	4
Totals	671	655	881	2207	8575

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Table A6. Macroinvertebrate data collected from site WC-0.5 on 18 Sept. 2024.

Willow Creek					
WC-0.5		Sample			
18 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.		3		3	12
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	31	74	31	136	528
<i>Dipheter hageni</i>			1	1	4
<i>Attenella margarita</i>					
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>	1			1	4
<i>Ephemerella dorothea infrequens</i>	1	5	9	15	59
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>	7	4	55	66	256
<i>Heptagenia</i> sp.					
<i>Rhithrogena</i> sp.					
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	3		4	7	28
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>	2	1	3	6	24
Chloroperlidae	3			3	12
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>					
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)					
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.	1	1		2	8
<i>Isoperla fulva</i>		1		1	4
<i>Megarcys signata</i>					
<i>Skwala americana</i>	2	3	9	14	55
<i>Pteronarcella badia</i>					
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	5	3	2	10	39
<i>Brachycentrus occidentalis</i>	37	90	15	142	551
<i>Micrasema bactro</i>			1	1	4
<i>Culoptila</i> sp.					
<i>Glossosoma</i> sp.			12	12	47
<i>Protoptila</i> sp.					
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>		2	3	5	20
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.					
<i>Hydropsyche</i> sp.					
<i>Hydropsyche cockerelli</i>			2	2	8
<i>Hydropsyche occidentalis</i>					
<i>Hydropsyche oslari</i>	36	239	100	375	1454
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	9	2	72	83	322
<i>Ceraclea</i> sp.			1	1	4
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>		3	2	5	20
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



Table A6. cont. Macroinvertebrate data collected from WC-0.5 on 18 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.	2	2	5	9	35
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	20	7	67	94	365
<i>Cryptochironomus</i> sp.					
<i>Diamesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	14	28	49	91	353
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.	2		6	8	32
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.			1	1	4
<i>Paqastia</i> sp.		1		1	4
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.		1	1	2	8
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.					
<i>Potthastia</i> sp.					
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.	2	1	2	5	20
<i>Thienemanniella</i> sp.	1	1	1	3	12
<i>Thienemannimyia</i> group	1		2	3	12
<i>Tvetenia</i> sp.	1	4	5	10	39
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	1	1		2	8
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.		1		1	4
Tipulidae					
<i>Antocha</i> sp.	4			4	16
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	47	17	93	157	609
<i>Zaitzevia parvula</i>			3	3	12
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.	4	1	2	7	28
<i>Lebertia</i> sp.			1	1	4
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.			2	2	8
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.	2	2	8	12	47
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>					
<i>Crangonyx</i> sp.	1		1	2	8
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae					
Lumbricidae					
Naididae			1	1	4
Tubificidae					
Nematoda					
Totals	240	498	572	1310	5095

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Table A7. Macroinvertebrate data collected from CRCC-0.5 on 18 Sept. 2024.

Colorado River					
CRCC-0.5		Sample			
18 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	7	14	45	66	256
<i>Baetis flavistriga</i>	1	1	1	3	12
<i>Baetis (tricaudatus)</i>	148	202	81	431	1671
<i>Dipheter hageni</i>		6	1	7	28
<i>Attenella margarita</i>					
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>		2	4	6	24
<i>Ephemerella dorothea infrequens</i>	27	51	15	93	361
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>		6	3	9	35
<i>Heptagenia</i> sp.	2			2	8
<i>Rhithrogena</i> sp.					
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	3	3		6	24
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>	3	2		5	20
Chloroperlidae		3		3	12
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>		1		1	4
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)					
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.					
<i>Isoperla fulva</i>					
<i>Megarcys signata</i>					
<i>Skwala americana</i>					
<i>Pteronarcella badia</i>					
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	18	36	36	90	349
<i>Brachycentrus occidentalis</i>			3	3	12
<i>Micrasema bactro</i>					
<i>Culoptila</i> sp.					
<i>Glossosoma</i> sp.		2		2	8
<i>Protoptila</i> sp.					
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>	1	1	3	5	20
<i>Ceratopsyche morosa</i> group	6	6	6	18	70
<i>Cheumatopsyche</i> sp.	1	1		2	8
<i>Hydropsyche</i> sp.	20	17	8	45	175
<i>Hydropsyche cockerelli</i>	6	16	31	53	206
<i>Hydropsyche occidentalis</i>					
<i>Hydropsyche oslari</i>	90	217	62	369	1431
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	40	70	1	111	431
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.	1			1	4
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>					
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



Table A7. cont. Macroinvertebrate data collected from CRCC-0.5 on 18 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.	3	7	4	14	55
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	8	3	12	23	90
<i>Cryptochironomus</i> sp.		1		1	4
<i>Diamesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	14	24	22	60	233
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.	14	17		31	121
<i>Microtendipes</i> sp.	1	10	1	12	47
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	4	2	1	7	28
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.	11	28		39	152
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.		2		2	8
<i>Potthastia</i> sp.	1	3		4	16
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.			1	1	4
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.			1	1	4
<i>Thienemanniella</i> sp.					
<i>Thienemannimyia</i> group	3	1	2	6	24
<i>Tvetenia</i> sp.	68	82	44	194	752
Other Diptera (true flies)					
<i>Atherix pachypus</i>	1	2		3	12
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	2	1		3	12
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.	2			2	8
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.	54	96	24	174	675
Tipulidae					
<i>Antocha</i> sp.	1			1	4
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	12	77	2	91	353
<i>Zaitzevia parvula</i>	1	4		5	20
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.					
<i>Protzia</i> sp.	1			1	4
<i>Sperchon</i> sp.		1		1	4
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.	1	10		11	43
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.	1			1	4
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>	1			1	4
<i>Crangonyx</i> sp.	2	1		3	12
<i>Gammarus lacustris</i>	1			1	4
Erpobdellidae					
Enchytraeidae					
Lumbricidae	1	2		3	12
Naididae		1		1	4
Tubificidae	3	2		5	20
Nematoda					
Totals	585	1034	414	2033	7902

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Table A8. Macroinvertebrate data collected from CR-24.9 on 19 Sept. 2024.

Colorado River					
CR-24.9		Sample			
19 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	6	5	3	14	55
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	46	95	68	209	811
<i>Dipheter hageni</i>		6	4	10	39
<i>Attenella margarita</i>					
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>		1		1	4
<i>Ephemerella dorothea infrequens</i>	109	133	190	432	1675
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>	3	6	1	10	39
<i>Heptagenia</i> sp.			1	1	4
<i>Rhithrogena</i> sp.		4	2	6	24
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	2	11	16	29	113
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>		3	2	5	20
Chloroperlidae		9	1	10	39
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>	1	9	12	22	86
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)	1	2	1	4	16
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.	6	13	6	25	97
<i>Isoperla fulva</i>					
<i>Megarcys signata</i>					
<i>Skwala americana</i>		3	5	8	32
<i>Pteronarcella badia</i>		1		1	4
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	25	41	22	88	342
<i>Brachycentrus occidentalis</i>					
<i>Micrasema bactro</i>					
<i>Culoptila</i> sp.	64	141	48	253	981
<i>Glossosoma</i> sp.	2		1	3	12
<i>Protoptila</i> sp.	3	4		7	28
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>	5	6	4	15	59
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.					
<i>Hydropsyche</i> sp.	1	1	3	5	20
<i>Hydropsyche cockerelli</i>	9	11	29	49	190
<i>Hydropsyche occidentalis</i>					
<i>Hydropsyche oslari</i>	72	71	94	237	919
<i>Hydroptila</i> sp.		6		6	24
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	26	120	43	189	733
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>					
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



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Table A8. cont. Macroinvertebrate data collected from CR-24.9 on 19 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.	1			1	4
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	9	52	73	134	520
<i>Cryptochironomus</i> sp.					
<i>Damesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	33	60	66	159	617
<i>Lopescladius</i> sp.					
<i>Micropsectra/Tanytarsus</i> sp.					
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.					
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.	2		15	17	66
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.		1	3	4	16
<i>Potthastia</i> sp.		1		1	4
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.			1	1	4
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.		1		1	4
<i>Thienemanniella</i> sp.		1	4	5	20
<i>Thienemannimyia</i> group			2	2	8
<i>Tvetenia</i> sp.	27	33	66	126	489
Other Diptera (true flies)					
<i>Atherix pachypus</i>		1	4	5	20
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	4	7	1	12	47
<i>Hemerodromia</i> sp.		1		1	4
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.	4	6	5	15	59
Tipulidae					
<i>Antocha</i> sp.					
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcyloepus</i> sp.					
<i>Optioservus</i> sp.	12	27	40	79	307
<i>Zaitzevia parvula</i>	1	6	4	11	43
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.					
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.	4	1	4	9	35
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>	4			4	16
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae					
Lumbricidae		1	1	2	8
Naididae	4		1	5	20
Tubificidae		1		1	4
Nematoda					
Totals	486	902	846	2234	8681

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Table A9. Macroinvertebrate data collected from WF-13.1 on 18 Sept. 2024.

Williams Fork						
WF-13.1		Sample				
18 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.						
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	40	106	66		212	822
<i>Dipheter hageni</i>	1				1	4
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>		2	5		7	28
<i>Drunella grandis</i>	2	8	12		22	86
<i>Ephemerella dorothea infrequens</i>	2	23	22		47	183
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.		1			1	4
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>						
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.						
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia</i> sp.						
Plecoptera (stoneflies)						
Capniidae		1	3		4	16
<i>Paracapnia angulata</i>						
Chloroperlidae						
<i>Sweltsa</i> sp.	1	6	2		9	35
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>			1		1	4
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.			2		2	8
<i>Isoperla fulva</i>			1		1	4
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>						
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	37	147	166		350	1357
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bactro</i>			1		1	4
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.	1	1			2	8
<i>Protoptila</i> sp.						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>			1		1	4
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>						
<i>Hydroptila</i> sp.						
<i>Ochrotrichia</i> sp.	1				1	4
<i>Lepidostoma</i> sp.	38	46	41		125	485
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.						
<i>Dolophilodes</i> sp.			1		1	4
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>	1	1	1		3	12
<i>Rhyacophila coloradensis</i>	1	5	2		8	32
<i>Rhyacophila sibirica</i> group		1	3		4	16
<i>Oligophlebodes</i> sp.						



Table A9. cont. Macroinvertebrate data collected from WF-13.1 on 18 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.					
<i>Cricotopus nostocicola</i>					
<i>Cricotopus/Orthocladius</i> sp.	15	40	19	74	287
<i>Cryptochironomus</i> sp.					
<i>Diamesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	1	21	9	31	121
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.		1		1	4
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	3	11	5	19	74
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.					
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.	3	3	2	8	32
<i>Potthastia</i> sp.					
<i>Potthastia qaedii</i>			1	1	4
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.	3	5		8	32
<i>Synorthocladius</i> sp.					
<i>Thienemanniella</i> sp.					
<i>Thienemannimyia</i> group					
<i>Tvetenia</i> sp.					
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae			1	1	4
<i>Chelifera/Neoplasta</i> sp.					
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.	40	70	30	140	543
<i>Simulium</i> sp.		1		1	4
Tipulidae					
<i>Antocha</i> sp.	7	14	5	26	101
<i>Dicranota</i> sp.		2	3	5	20
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.			1	1	4
<i>Heterelmis</i> sp.	19	36	38	93	361
<i>Microcyloopus</i> sp.					
<i>Optioservus</i> sp.	3	7	7	17	66
<i>Zaitzevia parvula</i>					
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.	1			1	4
<i>Lebertia</i> sp.	4	4	7	15	59
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.			2	2	8
<i>Torrenticola</i> sp.	2	1		3	12
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>	14	28	31	73	283
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
Enchytraeidae					
Lumbricidae					
Naididae					
Tubificidae					
Nematoda					
Totals	240	592	491	1323	5143

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Table A10. Macroinvertebrate data collected from WF-5.5 on 18 Sept. 2024.

Williams Fork						
WF-5.5		Sample				
18 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.	17	15	26		58	225
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	12	4	18		34	132
<i>Dipheter hageni</i>	1		1		2	8
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>						
<i>Drunella grandis</i>						
<i>Ephemerella dorothea infrequens</i>			1		1	4
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>						
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.						
<i>Tricorythodes explicatus</i>	1				1	4
<i>Paraleptophlebia</i> sp.						
Plecoptera (stoneflies)						
Capniidae	1				1	4
<i>Paracapnia angulata</i>						
Chloroperlidae		2	1		3	12
<i>Sweltsa</i> sp.		2	1		3	12
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>						
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.						
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>						
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	43	41	143		227	880
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bactro</i>			1		1	4
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.						
<i>Proptila</i> sp.						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>						
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche</i> sp.	12	5	34		51	198
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	13	10	16		39	152
<i>Hydroptila</i> sp.	1				1	4
<i>Ochrotrichia</i> sp.			1		1	4
<i>Lepidostoma</i> sp.	58	6	39		103	400
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.						
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>	3	14	14		31	121
<i>Rhyacophila coloradensis</i>	1	10	7		18	70
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



Table A10. cont. Macroinvertebrate data collected from WF-5.5 on 18 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.					
<i>Cricotopus nostocicola</i>	1		2	3	12
<i>Cricotopus/Orthocladius</i> sp.	56	51	84	191	741
<i>Cryptochironomus</i> sp.	1			1	4
<i>Diamesa</i> sp.		1		1	4
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	5	13	12	30	117
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.	27	4	3	34	132
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.	12	4	5	21	82
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.	1	1	1	3	12
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.	1		1	2	8
<i>Polypedilum</i> sp.			1	1	4
<i>Potthastia</i> sp.	3	1	1	5	20
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.	1			1	4
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.					
<i>Thienemanniella</i> sp.		1		1	4
<i>Thienemannimyia</i> group	8	1		9	35
<i>Tvetenia</i> sp.	2	3	5	10	39
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	18	6	14	38	148
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.	2	2	2	6	24
<i>Simulium</i> sp.	70	73	199	342	1326
Tipulidae					
<i>Antocha</i> sp.					
<i>Dicranota</i> sp.		1		1	4
<i>Hexatoma</i> sp.		3	4	7	28
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.	1			1	4
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	119	67	209	395	1532
<i>Zaitzevia parvula</i>		4	5	9	35
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.	8		2	10	39
<i>Lebertia</i> sp.	10	11	7	28	109
<i>Protzia</i> sp.	1	6	1	8	32
<i>Sperchon</i> sp.	3	3	9	15	59
<i>Torrenticola</i> sp.		2		2	8
<i>Caecidotea</i> sp.	1	1		2	8
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.					
Gyraulidae					
<i>Gyraulius</i> sp.					
<i>Polycelis coronata</i>	10	1	19	30	117
<i>Crangonyx</i> sp.					
Gammarus lacustris					
Erpobdellidae					
Enchytraeidae					
Lumbricidae					
<i>Naididae</i>	42	34	67	143	555
<i>Tubificidae</i>	5	3	2	10	39
<i>Nematoda</i>	1			1	4
Totals	572	406	958	1936	7523

Table A11. Macroinvertebrate data collected from site WF-2.0 on 18 Sept. 2024.

Williams Fork						
WF-2.0		Sample				
18 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.						
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	534	468	577		1579	6121
<i>Dipheter hageni</i>						
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>						
<i>Drunella grandis</i>	1	1	2		4	16
<i>Ephemerella dorothea infrequens</i>	1	3	5		9	35
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus albertae</i>			1		1	4
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>						
<i>Heptagenia</i> sp.						
<i>Rhithrogena</i> sp.						
<i>Tricorythodes explicatus</i>			1		1	4
<i>Paraleptophlebia</i> sp.		2			2	8
Plecoptera (stoneflies)						
Capniidae						
<i>Paracapnia angulata</i>						
Chloroperlidae						
<i>Sweltsa</i> sp.						
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>						
<i>Hesperoperla pacifica</i>						
Periodidae (<i>Cultus</i> sp.)						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.		1	1		2	8
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Pteronarcella badia</i>						
<i>Pteronarcys californica</i>						
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	4	2	1		7	28
<i>Brachycentrus occidentalis</i>						
<i>Micrasema bactro</i>						
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.						
<i>Proptila</i> sp.						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	1				1	4
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>						
<i>Hydroptila</i> sp.						
<i>Ochrotrichia</i> sp.						
<i>Lepidostoma</i> sp.						
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.						
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>	5	4	9		18	70
<i>Rhyacophila coloradensis</i>	1	2	3		6	24
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



Table A11. cont. Macroinvertebrate data collected from WF-2.0 on 18 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Cardiocladius</i> sp.						
<i>Cricotopus nostocicola</i>						
<i>Cricotopus/Orthocladius</i> sp.	78	18	33	129	500	
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.						
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	389	132	172	693	2687	
<i>Lopescladius</i> sp.						
<i>Microspectral/Tanytarsus</i> sp.	24	13	2	39	152	
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Paqastia</i> sp.	111	19	52	182	706	
<i>Parakiefferiella</i> sp.						
<i>Parametrioicnemus</i> sp.		1		1	4	
<i>Paratanytarsus</i> sp.						
<i>Phaenopsectra</i> sp.						
<i>Polypedilum</i> sp.						
<i>Potthastia</i> sp.	4	8	4	16	63	
<i>Potthastia qaedii</i>						
<i>Procladius</i> sp.						
<i>Rheotanytarsus</i> sp.						
<i>Sublettea</i> sp.						
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	7	6	2	15	59	
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.						
<i>Hemerodromia</i> sp.						
<i>Wiedemannia</i> sp.						
<i>Lispoides</i> sp.						
<i>Pericoma</i> sp.						
<i>Simulium</i> sp.	66	10	15	91	353	
Tipulidae						
<i>Antocha</i> sp.						
<i>Dicranota</i> sp.						
<i>Hexatoma</i> sp.						
<i>Pedicia</i> sp.						
<i>Tipula</i> sp.		2		2	8	
Coleoptera (beetles)						
<i>Liodessus</i> sp.	1			1	4	
<i>Cleptelmis</i> sp.						
<i>Heterolimnius</i> sp.		1		1	4	
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	3			3	12	
<i>Zaitzevia parvula</i>						
<i>Brychius</i> sp.						
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.	1	3	5	9	35	
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	1	1	16	18	70	
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Ferrissia</i> sp.						
Lymnaeidae						
<i>Physa</i> sp.						
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	83	336	184	603	2338	
<i>Crangonyx</i> sp.		1		1	4	
<i>Gammarus lacustris</i>						
Erpobdellidae						
Enchytraeidae						
Lumbricidae						
Naididae	4	45	7	56	218	
Tubificidae	1			1	4	
Nematoda		5		5	20	
Totals	1320	1084	1092	3496	13563	

Table A12. Macroinvertebrate data collected from site WF-0.5 on 18 Sept. 2024.

Williams Fork					
WF-0.5		Sample			
18 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	2	5	9	16	63
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	469	422	572	1463	5671
<i>Dipheter hageni</i>					
<i>Attenella margarita</i>	2	1	3	6	24
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>	4	3	5	12	47
<i>Ephemerella dorothea infrequens</i>	4	2		6	24
<i>Serratella tibialis</i>	2			2	8
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>	1			1	4
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>					
<i>Heptagenia</i> sp.					
<i>Rhithrogena</i> sp.					
<i>Tricorythodes explicatus</i>	1			1	4
<i>Paraleptophlebia</i> sp.					
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>					
Chloroperlidae					
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>					
<i>Hesperoperla pacifica</i>					
Periodidae (<i>Cultus</i> sp.)					
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.	1	1		2	8
<i>Isoperla fulva</i>					
<i>Megarcys signata</i>					
<i>Skwala americana</i>					
<i>Pteronarcella badia</i>					
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	22	18	21	61	237
<i>Brachycentrus occidentalis</i>			1	1	4
<i>Micrasema bactro</i>					
<i>Culoptila</i> sp.					
<i>Glossosoma</i> sp.					
<i>Proptila</i> sp.					
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>			1	1	4
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.					
<i>Hydropsyche</i> sp.					
<i>Hydropsyche cockerelli</i>					
<i>Hydropsyche occidentalis</i>					
<i>Hydropsyche oslari</i>					
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.			2	2	8
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>	10	6	7	23	90
<i>Rhyacophila coloradensis</i>	4	4	14	22	86
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



Table A12. cont. Macroinvertebrate data collected from WF-0.5 on 18 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Cardiocladius</i> sp.						
<i>Cricotopus nostocicola</i>						
<i>Cricotopus/Orthocladius</i> sp.	70	20	22	112	435	
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.						
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	48	36	17	101	392	
<i>Lopescladius</i> sp.						
<i>Microspectral/Tanytarsus</i> sp.	56	5	12	73	283	
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Paqastia</i> sp.	32	34	17	83	322	
<i>Parakiefferiella</i> sp.						
<i>Parametrioicnemus</i> sp.	1			1	4	
<i>Paratanytarsus</i> sp.						
<i>Phaenopsectra</i> sp.						
<i>Polypedilum</i> sp.						
<i>Potthastia</i> sp.	1	1	1	3	12	
<i>Potthastia qaedii</i>						
<i>Procladius</i> sp.						
<i>Rheotanytarsus</i> sp.						
<i>Sublettea</i> sp.						
<i>Synorthocladius</i> sp.			1	1	4	
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	1	6	2	9	35	
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.						
<i>Hemerodromia</i> sp.						
<i>Wiedemannia</i> sp.						
<i>Lispoides</i> sp.						
<i>Pericoma</i> sp.						
<i>Simulium</i> sp.	170	374	120	664	2574	
Tipulidae						
<i>Antocha</i> sp.						
<i>Dicranota</i> sp.						
<i>Hexatoma</i> sp.						
<i>Pedicia</i> sp.						
<i>Tipula</i> sp.	2	1		3	12	
Coleoptera (beetles)						
<i>Liodessus</i> sp.						
<i>Cleptelmis</i> sp.						
<i>Heterolimnius</i> sp.						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.						
<i>Zaitzevia parvula</i>						
<i>Brychius</i> sp.						
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.	2	1	3	6	24	
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	1			1	4	
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Ferrissia</i> sp.						
Lymnaeidae						
<i>Physa</i> sp.						
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	275	22	161	458	1776	
<i>Crangonyx</i> sp.						
<i>Gammarus lacustris</i>						
Erpobdellidae						
Enchytraeidae						
Lumbricidae						
Naididae	11	2	6	19	74	
Tubificidae						
Nematoda		2	1	3	12	
Totals	1192	966	998	3156	12245	

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Table A13. Macroinvertebrate data collected from site CR-9.1 on 19 Sept. 2024.

Colorado River					
CR-9.1		Sample			
19 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	10	22	17	49	190
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	17	35	41	93	361
<i>Dipheter hageni</i>		2		2	8
<i>Attenella margarita</i>					
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>		1	2	3	12
<i>Ephemerella dorothea infrequens</i>	224	90	170	484	1876
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>	6		1	7	28
<i>Heptagenia</i> sp.					
<i>Rhithrogena</i> sp.	28	14	31	73	283
<i>Tricorythodes explicatus</i>	1		1	2	8
<i>Paraleptophlebia</i> sp.	32	22	15	69	268
Plecoptera (stoneflies)					
Capniidae	1			1	4
<i>Paracapnia angulata</i>		1		1	4
Chloroperlidae	8	3	2	13	51
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>	9	5	7	21	82
<i>Hesperoperla pacifica</i>	1			1	4
Periodidae (<i>Cultus</i> sp.)	4	2	2	8	32
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.	15	13	10	38	148
<i>Isoperla fulva</i>	2		4	6	24
<i>Megarcys signata</i>					
<i>Skwala americana</i>	4		4	8	32
<i>Pteronarcella badia</i>	1			1	4
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	142	120	128	390	1512
<i>Brachycentrus occidentalis</i>					
<i>Micrasema bactro</i>					
<i>Culoptila</i> sp.	3	1		4	16
<i>Glossosoma</i> sp.	53	13	18	84	326
<i>Protoptila</i> sp.	11	7	4	22	86
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>		1		1	4
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.	2			2	8
<i>Hydropsyche</i> sp.	1	1	4	6	24
<i>Hydropsyche cockerelli</i>	18	11	19	48	187
<i>Hydropsyche occidentalis</i>		1		1	4
<i>Hydropsyche oslari</i>	30	10	27	67	260
<i>Hydroptila</i> sp.					
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.	69	27	50	146	566
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>					
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



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Table A13. cont. Macroinvertebrate data collected from CR-9.1 on 19 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Cardiocladius</i> sp.	12	7	3		22	86
<i>Cricotopus nostocicola</i>		1			1	4
<i>Cricotopus/Orthocladius</i> sp.	61	117	38		216	838
<i>Cryptochironomus</i> sp.						
<i>Damesa</i> sp.						
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	53	69	26		148	574
<i>Lopescladius</i> sp.	1	2	1		4	16
<i>Micropsectra/Tanytarsus</i> sp.	30	11	2		43	167
<i>Microtendipes</i> sp.	1		1		2	8
<i>Nanocladius</i> sp.		2	1		3	12
<i>Paqastia</i> sp.	6	12	3		21	82
<i>Parakiefferiella</i> sp.						
<i>Parametrioicnemus</i> sp.	6	5	3		14	55
<i>Paratanytarsus</i> sp.						
<i>Phaenopsectra</i> sp.						
<i>Polypedilum</i> sp.	11	8	6		25	97
<i>Potthastia</i> sp.	2				2	8
<i>Potthastia qaedii</i>						
<i>Procladius</i> sp.						
<i>Rheotanytarsus</i> sp.						
<i>Sublettea</i> sp.						
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.	2	5			7	28
<i>Thienemannimyia</i> group	2		1		3	12
<i>Tvetenia</i> sp.	33	28	14		75	291
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	2	4			6	24
<i>Hemerodromia</i> sp.						
<i>Wiedemannia</i> sp.						
<i>Lispoides</i> sp.						
<i>Pericoma</i> sp.						
<i>Simulium</i> sp.	4	57	13		74	287
Tipulidae						
<i>Antocha</i> sp.	1				1	4
<i>Dicranota</i> sp.						
<i>Hexatoma</i> sp.			1		1	4
<i>Pedicia</i> sp.						
<i>Tipula</i> sp.						
Coleoptera (beetles)						
<i>Liodessus</i> sp.						
<i>Cleptelmis</i> sp.						
<i>Heterolimnius</i> sp.						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	116	83	64		263	1020
<i>Zaitzevia parvula</i>	7	9	9		25	97
<i>Brychius</i> sp.						
Miscellaneous						
<i>Atractides</i> sp.	1				1	4
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.	1				1	4
<i>Protzia</i> sp.	2		1		3	12
<i>Sperchon</i> sp.	2	2	1		5	20
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Ferrissia</i> sp.						
Lymnaeidae						
<i>Physa</i> sp.		4	1		5	20
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	27	20	11		58	225
<i>Crangonyx</i> sp.						
Gammarus lacustris						
Erpobdellidae						
Enchytraeidae						
		2			2	8
Lumbricidae						
<i>Naididae</i>	5				5	20
Tubificidae						
Nematoda						
Totals	1080	850	757		2687	10439



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Table A14. Macroinvertebrate data collected from site CR-7.4 on 19 Sept. 2024.

Colorado River						
CR-7.4		Sample				
19 September 2024	1	2	3		Total	Estimated #/m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella</i> sp.	2	3	5		10	39
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	35	27	29		91	353
<i>Dipheter hageni</i>	2				2	8
<i>Attenella margarita</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>						
<i>Drunella grandis</i>	5	1	1		7	28
<i>Ephemerella dorothea infrequens</i>	146	238	225		609	2361
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus albertae</i>						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>	9	1	4		14	55
<i>Heptagenia</i> sp.	1				1	4
<i>Rhithrogena</i> sp.	25	21	20		66	256
<i>Tricorythodes explicatus</i>	5	6			11	43
<i>Paraleptophlebia</i> sp.	50	22	27		99	384
Plecoptera (stoneflies)						
Capniidae						
<i>Paracapnia angulata</i>		2	1		3	12
Chloroperlidae	1	11	9		21	82
<i>Sweltsa</i> sp.						
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i>						
<i>Claassenia sabulosa</i>	7	2	5		14	55
<i>Hesperoperla pacifica</i>			1		1	4
Periodidae (<i>Cultus</i> sp.)		6	4		10	39
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.	5	12	13		30	117
<i>Isoperla fulva</i>		2			2	8
<i>Megarcys signata</i>						
<i>Skwala americana</i>	1	4	1		6	24
<i>Pteronarcella badia</i>		1			1	4
<i>Pteronarcys californica</i>			1		1	4
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	6	19	21		46	179
<i>Brachycentrus occidentalis</i>			1		1	4
<i>Micrasema bactro</i>						
<i>Culoptila</i> sp.	2	1	1		4	16
<i>Glossosoma</i> sp.	2	4	1		7	28
<i>Protoptila</i> sp.	19	31	2		52	202
<i>Helicopsyche borealis</i>	1				1	4
<i>Arctopsyche grandis</i>		1	1		2	8
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.	1		1		2	8
<i>Hydropsyche</i> sp.	7	8	8		23	90
<i>Hydropsyche cockerelli</i>	4	7	9		20	78
<i>Hydropsyche occidentalis</i>	1	2	8		11	43
<i>Hydropsyche oslari</i>	12	12	14		38	148
<i>Hydroptila</i> sp.	1	1			2	8
<i>Ochrotrichia</i> sp.						
<i>Lepidostoma</i> sp.	88	134	16		238	923
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.	1				1	4
<i>Dolophilodes</i> sp.						
<i>Psychomyia</i> sp.						
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>						
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



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Table A14. cont. Macroinvertebrate data collected from CR-7.4 on 19 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.			21	21	82
<i>Cricotopus nostocicola</i>		1	1	2	8
<i>Cricotopus/Orthocladius</i> sp.	115	116	195	426	1652
<i>Cryptochironomus</i> sp.					
<i>Damesa</i> sp.					
<i>Dicrotendipes</i> sp.					
<i>Eukiefferiella</i> sp.	24	28	86	138	535
<i>Lopescladius</i> sp.		1		1	4
<i>Microspectral/Tanytarsus</i> sp.	1	2		3	12
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.	5			5	20
<i>Paqastia</i> sp.	1	3	3	7	28
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.	5	2	2	9	35
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.		2		2	8
<i>Potthastia</i> sp.					
<i>Potthastia qaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.		2	1	3	12
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.			1	1	4
<i>Thienemanniella</i> sp.	4			4	16
<i>Thienemannimyia</i> group	2			2	8
<i>Tvetenia</i> sp.	22	34	42	98	380
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.	2		1	3	12
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
<i>Simulium</i> sp.	2		23	25	97
Tipulidae					
<i>Antocha</i> sp.					
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.	1			1	4
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
<i>Cleptelmis</i> sp.					
<i>Heterolimnius</i> sp.					
<i>Microcylloepus</i> sp.					
<i>Optioservus</i> sp.	54	113	81	248	962
<i>Zaitzevia parvula</i>		9	6	15	59
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.	1			1	4
<i>Hygrobates</i> sp.					
<i>Lebertia</i> sp.		1	1	2	8
<i>Protzia</i> sp.	3	7	1	11	43
<i>Sperchon</i> sp.	1	4	2	7	28
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.	1	1		2	8
<i>Ferrissia</i> sp.					
Lymnaeidae					
<i>Physa</i> sp.	1	1		2	8
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>	1			1	4
<i>Crangonyx</i> sp.					
Gammarus lacustris					
Erpobdellidae					
Enchytraeidae					
Lumbricidae					
<i>Naididae</i>	3			3	12
<i>Tubificidae</i>		1		1	4
Nematoda					
Totals	688	907	897	2492	9684

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Table A15. Macroinvertebrate data collected from site CR-1.7 on 19 Sept. 2024.

Colorado River					
CR-1.7		Sample			
19 September 2024	1	2	3	Total	Estimated #/m ²
Ephemeroptera (mayflies)					
<i>Ameletus</i> sp.					
<i>Acentrella</i> sp.	2	23	20	45	175
<i>Baetis flavistriga</i>					
<i>Baetis (tricaudatus)</i>	7	48	86	141	547
<i>Dipheter hageni</i>					
<i>Attenella margarita</i>			1	1	4
<i>Drunella coloradensis</i>					
<i>Drunella doddsii</i>					
<i>Drunella grandis</i>	2	8	2	12	47
<i>Ephemerella dorothea infrequens</i>	12	26	14	52	202
<i>Serratella tibialis</i>					
<i>Cinygmula</i> sp.					
<i>Epeorus albertae</i>					
<i>Epeorus deceptivus</i>					
<i>Epeorus longimanus</i>		1	2	3	12
<i>Heptagenia</i> sp.		5	1	6	24
<i>Rhithrogena</i> sp.	1	16	6	23	90
<i>Tricorythodes explicatus</i>					
<i>Paraleptophlebia</i> sp.	1	29	25	55	214
Plecoptera (stoneflies)					
Capniidae					
<i>Paracapnia angulata</i>	1	4	3	8	32
Chloroperlidae					
		2	2	4	16
<i>Sweltsa</i> sp.					
<i>Zapada cinctipes</i>					
<i>Zapada oregonensis</i>					
<i>Claassenia sabulosa</i>		2	4	6	24
<i>Hesperoperla pacifica</i>					
Perlodidae (<i>Cultus</i> sp.)	2	3	9	14	55
<i>Diura knowltoni</i>					
<i>Isoperla</i> sp.		5	8	13	51
<i>Isoperla fulva</i>		1		1	4
<i>Megarcys signata</i>					
<i>Skwala americana</i>		3	2	5	20
<i>Pteronarcella badia</i>		5	3	8	32
<i>Pteronarcys californica</i>					
<i>Taenionema</i> sp.					
Trichoptera (caddisflies)					
<i>Brachycentrus americanus</i>	2	2		4	16
<i>Brachycentrus occidentalis</i>					
<i>Micrasema bacro</i>					
<i>Culoptila</i> sp.					
<i>Glossosoma</i> sp.					
<i>Proptila</i> sp.					
<i>Helicopsyche borealis</i>					
<i>Arctopsyche grandis</i>					
<i>Ceratopsyche morosa</i> group					
<i>Cheumatopsyche</i> sp.	3	8		11	43
<i>Hydropsyche</i> sp.	2	8	4	14	55
<i>Hydropsyche cockerelli</i>	1	6		7	28
<i>Hydropsyche occidentalis</i>	2	8	3	13	51
<i>Hydropsyche oslari</i>	11	19	5	35	136
<i>Hydroptila</i> sp.		1		1	4
<i>Ochrotrichia</i> sp.					
<i>Lepidostoma</i> sp.		14	32	46	179
<i>Ceraclea</i> sp.					
<i>Oecetis</i> sp.					
<i>Dolophilodes</i> sp.					
<i>Psychomyia</i> sp.					
<i>Rhyacophila brunnea</i>					
<i>Rhyacophila coloradensis</i>					
<i>Rhyacophila sibirica</i> group					
<i>Oligophlebodes</i> sp.					



Table A15. cont. Macroinvertebrate data collected from CR-1.7 on 19 Sept. 2024.

Diptera (true flies)					
Chironomidae (chironomids)					
<i>Cardiocladius</i> sp.					
<i>Cricotopus nostocicola</i>					
	39	64	51	154	597
<i>Cricotopus/Orthocladius</i> sp.					
<i>Cryptochironomus</i> sp.					
<i>Diamesa</i> sp.					
<i>Dicrotendipes</i> sp.					
	5	15	15	35	136
<i>Eukiefferiella</i> sp.					
<i>Lopescladius</i> sp.					
<i>Microspectral/Tanytarsus</i> sp.					
<i>Microtendipes</i> sp.					
<i>Nanocladius</i> sp.					
<i>Paqastia</i> sp.					
	1	6	1	8	32
<i>Parakiefferiella</i> sp.					
<i>Parametrioicnemus</i> sp.					
	1	5	1	7	28
<i>Paratanytarsus</i> sp.					
<i>Phaenopsectra</i> sp.					
<i>Polypedilum</i> sp.					
	1	2		3	12
<i>Potthastia</i> sp.					
<i>Potthastia gaedii</i>					
<i>Procladius</i> sp.					
<i>Rheotanytarsus</i> sp.					
<i>Sublettea</i> sp.					
<i>Synorthocladius</i> sp.					
<i>Thienemanniella</i> sp.					
	3		2	5	20
<i>Thienemannimyia</i> group					
	17	22	17	56	218
Other Diptera (true flies)					
<i>Atherix pachypus</i>					
Ceratopogoninae					
<i>Chelifera/Neoplasta</i> sp.					
<i>Hemerodromia</i> sp.					
<i>Wiedemannia</i> sp.					
<i>Lispoides</i> sp.					
<i>Pericoma</i> sp.					
	6	38	25	69	268
Tipulidae					
<i>Antocha</i> sp.					
<i>Dicranota</i> sp.					
<i>Hexatoma</i> sp.					
<i>Pedicia</i> sp.					
<i>Tipula</i> sp.					
Coleoptera (beetles)					
<i>Liodessus</i> sp.					
		1	1	2	8
<i>Cleptelmis</i> sp.					
	1			1	4
<i>Heterlimnius</i> sp.					
<i>Microcylloepus</i> sp.					
		3		3	12
<i>Optioservus</i> sp.					
	24	371	180	575	2229
<i>Zaitzevia parvula</i>					
	1	50	19	70	272
<i>Brychius</i> sp.					
Miscellaneous					
<i>Atractides</i> sp.					
<i>Hygrobates</i> sp.					
			1	1	4
<i>Lebertia</i> sp.					
<i>Protzia</i> sp.					
<i>Sperchon</i> sp.					
	3		1	4	16
<i>Torrenticola</i> sp.					
<i>Caecidotea</i> sp.					
<i>Ferrissia</i> sp.					
		2	3	5	20
Lymnaeidae					
<i>Physa</i> sp.					
			7	7	28
<i>Gyraulus</i> sp.					
<i>Polycelis coronata</i>					
		1		1	4
<i>Crangonyx</i> sp.					
<i>Gammarus lacustris</i>					
Erpobdellidae					
		2	3	5	20
Enchytraeidae					
Lumbricidae					
Naididae					
	43	12	33	88	342
Tubificidae					
		1		1	4
Nematoda					
Totals	194	844	596	1634	6359

Appendix B

Northern Water

Benthic Macroinvertebrate Data – Fall 2024

Table B1. Macroinvertebrate data collected from site CR-31.0 on 17 Sept. 2024.

Colorado River						
CR-31.0 (WGU)		Sample				Estimated Total/m ²
17 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>						
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	14	7	12		33	128
<i>Dipheter hageni</i>	3		1		4	16
<i>Attenella margarita</i>			1		1	4
<i>Drunella grandis</i>	3	3	1		7	28
<i>Ephemerella dorothea infrequens</i>	32	36	55		123	477
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	8		3		11	43
<i>Heptagenia sp.</i>						
<i>Rhithrogena sp.</i>						
<i>Tricorythodes explicatus</i>	1		1		2	8
<i>Paraleptophlebia sp.</i>		1	10		11	43
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>	3	1	10		14	55
Chloroperlidae	1	2	4		7	28
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>		1			1	4
<i>Hesperoperla pacifica</i>						
Perlodidae (<i>Cultus sp.</i>)	1		3		4	16
<i>Isoperla sp.</i>	1		2		3	12
<i>Isoperla fulva</i>						
<i>Skwala americana</i>	10	4	7		21	82
<i>Pteronarcys californica</i>						
Trichoptera						
<i>Brachycentrus americanus</i>	35	17	13		65	252
<i>Brachycentrus occidentalis</i>	10	11	29		50	194
<i>Micrasema bactro</i>						
<i>Culoptila sp.</i>						
<i>Glossosoma sp.</i>	2	26	31		59	229
<i>Protoptila sp.</i>						
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	18	12	31		61	237
<i>Ceratopsyche morosa</i> group	17	1	1		19	74
<i>Cheumatopsyche sp.</i>	2		2		4	16
<i>Hydropsyche sp.</i>						
<i>Hydropsyche (cockerelli)</i>	22	23	31		76	295
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	15	5	16		36	140
<i>Hydroptila sp.</i>						
<i>Lepidostoma sp.</i>	29	46	134		209	811
<i>Ceraclea sp.</i>						
<i>Oecetis sp.</i>						
Limnephilidae			2		2	8
<i>Psychomyia flavida</i>						
<i>Rhyacophila brunnea</i>	1				1	4
<i>Rhyacophila coloradensis</i>						

Table B1. cont. Macroinvertebrate data collected from site CR-31.0 on 17 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.		1			1	4
<i>Cladotanytarsus</i> sp.			1		1	4
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>		4	1		5	20
<i>Cricotopus/Orthocladius</i> sp.	104	138	97		339	1314
<i>Cryptochironomus</i> sp.		1			1	4
<i>Diamesa</i> sp.	1				1	4
<i>Eukiefferiella</i> sp.	22	35	12		69	268
<i>Lopescladius</i> sp.						
<i>Micropsectra/Tanytarsus</i> sp.	8	6	6		20	78
<i>Microtendipes</i> sp.	1	2	7		10	39
<i>Nanocladius</i> sp.			1		1	4
<i>Pagastia</i> sp.	4	8	7		19	74
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.	3		2		5	20
<i>Parametriocnemus</i> sp.	3	1	6		10	39
<i>Polypedilum</i> sp.	1	23	7		31	121
<i>Potthastia</i> sp.	1	4			5	20
<i>Potthastia gaedii</i>		1	1		2	8
<i>Rheotanytarsus</i> sp.	1				1	4
<i>Synorthocladius</i> sp.	2	2	1		5	20
<i>Thienemanniella</i> sp.		2			2	8
<i>Thienemannimyia</i> group	4	4	9		17	66
<i>Tvetenia</i> sp.	38	66	54		158	613
Other Diptera						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	1		2		3	12
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	1	3			4	16
<i>Antocha</i> sp.	1	1			2	8
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	16	24	22		62	241
<i>Zaitzevia parvula</i>						
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.		1	1		2	8
<i>Lebertia</i> sp.	1	1	5		7	28
<i>Protzia</i> sp.		1			1	4
<i>Sperchon</i> sp.			1		1	4
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.	31	6	5		42	163
<i>Polycelis coronata</i>	51	61	203		315	1221
<i>Physa</i> sp.		1			1	4
Lumbricidae						
Naididae		8	9		17	66
Tubificidae w/o hair chaetae						
Totals	523	601	860		1984	7711

Table B2. Macroinvertebrate data collected from site CR-28.7 on 17 Sept. 2024.

Colorado River						
CR-28.7 (WGD)		Sample				Estimated Total/m ²
17 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>	4	7	4		15	59
<i>Baetis flavistriga</i>		2			2	8
<i>Baetis (tricaudatus)</i>	63	89	125		277	1074
<i>Dipheter hageni</i>	2		2		4	16
<i>Attenella margarita</i>						
<i>Drunella grandis</i>	2	1			3	12
<i>Ephemerella dorothea infrequens</i>	233	322	326		881	3415
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	11	9	17		37	144
<i>Heptagenia sp.</i>						
<i>Rhithrogena sp.</i>		2			2	8
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia sp.</i>	15	8	27		50	194
Plecoptera						
Capniidae		1			1	4
<i>Paracapnia angulata</i>	2	2			4	16
Chloroperlidae	4	9	24		37	144
<i>Zapada cinctipes</i>		1			1	4
<i>Claassenia sabulosa</i>	2	4	5		11	43
<i>Hesperoperla pacifica</i>						
Perlodidae (<i>Cultus sp.</i>)		1	2		3	12
<i>Isoperla sp.</i>	1	4	4		9	35
<i>Isoperla fulva</i>			2		2	8
<i>Skwala americana</i>		1	1		2	8
<i>Pteronarcys californica</i>						
Trichoptera						
<i>Brachycentrus americanus</i>	34	33	45		112	435
<i>Brachycentrus occidentalis</i>	9	4	4		17	66
<i>Micrasema bactro</i>	1				1	4
<i>Culoptila sp.</i>		1	2		3	12
<i>Glossosoma sp.</i>	2	5	5		12	47
<i>Protoptila sp.</i>	1				1	4
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	1	12	9		22	86
<i>Ceratopsyche morosa</i> group		1	4		5	20
<i>Cheumatopsyche sp.</i>						
<i>Hydropsyche sp.</i>		20	31		51	198
<i>Hydropsyche (cockerelli)</i>	70	120	210		400	1551
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	130	219	337		686	2659
<i>Hydroptila sp.</i>			1		1	4
<i>Lepidostoma sp.</i>	27	20	17		64	249
<i>Ceraclea sp.</i>		1			1	4
<i>Oecetis sp.</i>						
Limnephilidae						
<i>Psychomyia flavida</i>	3	1	1		5	20
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>						

Table B2. cont. Macroinvertebrate data collected from site CR-28.7 on 17 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.						
<i>Cladotanytarsus</i> sp.						
<i>Corynoneura</i> sp.		1			1	4
<i>Cricotopus nostocicola</i>						
<i>Cricotopus/Orthocladius</i> sp.	25	39	29		93	361
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.						
<i>Eukiefferiella</i> sp.	33	28	44		105	407
<i>Lopescladius</i> sp.						
<i>Micropsectra/Tanytarsus</i> sp.	1	1	1		3	12
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.	1	3			4	16
<i>Pagastia</i> sp.						
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.						
<i>Parametriocnemus</i> sp.	4	9	2		15	59
<i>Polypedilum</i> sp.	2	5			7	28
<i>Potthastia</i> sp.						
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.	1				1	4
<i>Synorthocladius</i> sp.	4	3			7	28
<i>Thienemanniella</i> sp.		2			2	8
<i>Thienemannimyia</i> group	1	4	6		11	43
<i>Tvetenia</i> sp.	54	80	86		220	853
Other Diptera						
<i>Atherix pachypus</i>	34	35	40		109	423
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	1	1	2		4	16
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	1	8			9	35
<i>Antocha</i> sp.	1	2	1		4	16
Coleoptera						
<i>Microcylloepus</i> sp.			1		1	4
<i>Optioservus</i> sp.	56	99	47		202	783
<i>Zaitzevia parvula</i>	1	1	7		9	35
Miscellaneous						
<i>Atractides</i> sp.	1	4	1		6	24
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.						
<i>Protzia</i> sp.	1		1		2	8
<i>Sperchon</i> sp.	3	2	4		9	35
<i>Torrenticola</i> sp.		1			1	4
<i>Caecidotea</i> sp.						
<i>Polycelis coronata</i>	1	1			2	8
<i>Physa</i> sp.			1		1	4
Lumbricidae			1		1	4
Naididae			2		2	8
Tubificidae w/o hair chaetae						
Totals	843	1229	1481		3553	13793

Table B3. Macroinvertebrate data collected from site CR-22.1 on 19 Sept. 2024.

Colorado River						
CR-22.1 (HSPP)		Sample				Estimated Total/m ²
19 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>	4	11	7		22	86
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	222	76	134		432	1675
<i>Dipheter hageni</i>	2	2	9		13	51
<i>Attenella margarita</i>						
<i>Drunella grandis</i>		1			1	4
<i>Ephemerella dorothea infrequens</i>	577	411	664		1652	6404
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	22	18	17		57	221
<i>Heptagenia sp.</i>						
<i>Rhithrogena sp.</i>	9	14	17		40	156
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia sp.</i>	10	5	27		42	163
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>			1		1	4
Chloroperlidae			5		5	20
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>	2	4	5		11	43
<i>Hesperoperla pacifica</i>						
Perlidae (<i>Cultus sp.</i>)	3	6	15		24	94
<i>Isoperla sp.</i>	3	11	22		36	140
<i>Isoperla fulva</i>		1			1	4
<i>Skwala americana</i>			2		2	8
<i>Pteronarcys californica</i>						
Trichoptera						
<i>Brachycentrus americanus</i>	2	3	5		10	39
<i>Brachycentrus occidentalis</i>			1		1	4
<i>Micrasema bactro</i>						
<i>Culoptila sp.</i>	16	31	3		50	194
<i>Glossosoma sp.</i>	11	13	1		25	97
<i>Proptila sp.</i>	11	9	1		21	82
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	1	7	12		20	78
<i>Ceratopsyche morosa</i> group	1	1			2	8
<i>Cheumatopsyche sp.</i>	2	4	2		8	32
<i>Hydropsyche sp.</i>	3	7			10	39
<i>Hydropsyche (cockerelli)</i>	17	18	27		62	241
<i>Hydropsyche occidentalis</i>	1	3	3		7	28
<i>Hydropsyche oslari</i>	44	46	124		214	830
<i>Hydroptila sp.</i>	2	2	2		6	24
<i>Lepidostoma sp.</i>	44	31	8		83	322
<i>Ceraclea sp.</i>						
<i>Oecetis sp.</i>						
Limnephilidae						
<i>Psychomyia flavida</i>	1	1	3		5	20
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>						

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Table B3. cont. Macroinvertebrate data collected from site CR-22.1 on 19 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.	2	4			6	24
<i>Cladotanytarsus</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>						
<i>Cricotopus/Orthocladius</i> sp.	111	89	88		288	1117
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.						
<i>Eukiefferiella</i> sp.	82	42	63		187	725
<i>Lopescladius</i> sp.						
<i>Micropsectra/Tanytarsus</i> sp.	3	1	1		5	20
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Pagastia</i> sp.						
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.						
<i>Parametriocnemus</i> sp.	3	4	4		11	43
<i>Polypedilum</i> sp.	2	1	2		5	20
<i>Potthastia</i> sp.		2			2	8
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.						
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.		1			1	4
<i>Thienemannimyia</i> group	1	4	9		14	55
<i>Tvetenia</i> sp.	87	56	91		234	907
Other Diptera						
<i>Atherix pachypus</i>						
Ceratopogoninae			1		1	4
<i>Chelifera/Neoplasta</i> sp.						
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	33	9	23		65	252
<i>Antocha</i> sp.						
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	23	33	21		77	299
<i>Zaitzevia parvula</i>	3	3	1		7	28
Miscellaneous						
<i>Atractides</i> sp.	1				1	4
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.						
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.		1	1		2	8
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Polycelis coronata</i>		1			1	4
<i>Physa</i> sp.						
Lumbricidae			4		4	16
Naididae	36	2			38	148
Tubificidae w/o hair chaetae			6		6	24
Totals	1397	989	1432		3818	14821

Table B4. Macroinvertebrate data collected from site CR-16.7 on 19 Sept. 2024.

Colorado River						
CR-16.7 (WFU)		Sample				Estimated Total/m ²
19 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>	4	1			5	20
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	118	39	92		249	966
<i>Dipheter hageni</i>	1				1	4
<i>Attenella margarita</i>						
<i>Drunella grandis</i>	5	3	2		10	39
<i>Ephemerella dorothea infrequens</i>	233	139	234		606	2349
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	8	2	4		14	55
<i>Heptagenia</i> sp.	1	1			2	8
<i>Rhithrogena</i> sp.	1	5	8		14	55
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia</i> sp.	3	5	2		10	39
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>		1			1	4
Chloroperlidae		2			2	8
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>	1	2			3	12
<i>Hesperoperla pacifica</i>		1	3		4	16
Perlodidae (<i>Cultus</i> sp.)	1	4	4		9	35
<i>Isoperla</i> sp.	1	5	3		9	35
<i>Isoperla fulva</i>						
<i>Skwala americana</i>		1			1	4
<i>Pteronarcys californica</i>	2	1	1		4	16
Trichoptera						
<i>Brachycentrus americanus</i>	7	12	22		41	159
<i>Brachycentrus occidentalis</i>	4	6	6		16	63
<i>Micrasema bactro</i>						
<i>Culoptila</i> sp.	11	43	65		119	462
<i>Glossosoma</i> sp.		3	6		9	35
<i>Protophila</i> sp.	5	20	17		42	163
<i>Helicopsyche borealis</i>	1		1		2	8
<i>Arctopsyche grandis</i>	2	7	5		14	55
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche</i> sp.	1	3			4	16
<i>Hydropsyche</i> sp.	1		2		3	12
<i>Hydropsyche (cockerelli)</i>	17	32	80		129	500
<i>Hydropsyche occidentalis</i>			9		9	35
<i>Hydropsyche oslari</i>	10	26	107		143	555
<i>Hydroptila</i> sp.	3				3	12
<i>Lepidostoma</i> sp.	8	18	11		37	144
<i>Ceraclea</i> sp.						
<i>Oecetis</i> sp.						
Limnephilidae						
<i>Psychomyia flavida</i>	5	3	2		10	39
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>			1		1	4

Table B4. cont. Macroinvertebrate data collected from site CR-16.7 on 19 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.			1		1	4
<i>Cladotanytarsus</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>		3			3	12
<i>Cricotopus/Orthocladius</i> sp.	48	4	3		55	214
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.	1				1	4
<i>Eukiefferiella</i> sp.	78	43	61		182	706
<i>Lopescladius</i> sp.	7	2	5		14	55
<i>Micropsectra/Tanytarsus</i> sp.						
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Pagastia</i> sp.			2		2	8
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.						
<i>Parametriocnemus</i> sp.	8	9	9		26	101
<i>Polypedilum</i> sp.			3		3	12
<i>Potthastia</i> sp.	2				2	8
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.						
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.	3				3	12
<i>Thienemannimyia</i> group			1		1	4
<i>Tvetenia</i> sp.	12	3	14		29	113
Other Diptera						
<i>Atherix pachypus</i>	1		1		2	8
Ceratopogoninae		1			1	4
<i>Chelifera/Neoplasta</i> sp.						
<i>Hemerodromia</i> sp.		1			1	4
<i>Simulium</i> sp.	1	2	30		33	128
<i>Antocha</i> sp.						
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	13	19	10		42	163
<i>Zaitzevia parvula</i>	4	3	7		14	55
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.		1	1		2	8
<i>Protzia</i> sp.	1				1	4
<i>Sperchon</i> sp.	3	6			9	35
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Polycelis coronata</i>	3	21	11		35	136
<i>Physa</i> sp.						
Lumbricidae						
Naididae	20		1		21	82
Tubificidae w/o hair chaetae	1	2	1		4	16
Totals	660	505	848		2013	7823

Table B5. Macroinvertebrate data collected from site CR-bWF on 19 Sept. 2024.

Colorado River						
CR-bWF		Sample				Estimated Total/m ²
19 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>	2	17	14		33	128
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	30	39	11		80	311
<i>Dipheter hageni</i>		1	1		2	8
<i>Attenella margarita</i>						
<i>Drunella grandis</i>	5	5	3		13	51
<i>Ephemerella dorothea infrequens</i>	84	97	100		281	1090
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	3	18	13		34	132
<i>Heptagenia sp.</i>						
<i>Rhithrogena sp.</i>	3	2	3		8	32
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia sp.</i>	1	5	5		11	43
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>						
Chloroperlidae						
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>						
<i>Hesperoperla pacifica</i>			1		1	4
Perlodidae (<i>Cultus sp.</i>)			1		1	4
<i>Isoperla sp.</i>						
<i>Isoperla fulva</i>						
<i>Skwala americana</i>	1		1		2	8
<i>Pteronarcys californica</i>			1		1	4
Trichoptera						
<i>Brachycentrus americanus</i>	334	330	578		1242	4814
<i>Brachycentrus occidentalis</i>	5	7	4		16	63
<i>Micrasema bactro</i>						
<i>Culoptila sp.</i>	22	39	21		82	318
<i>Glossosoma sp.</i>	9	5	3		17	66
<i>Protophila sp.</i>		3	2		5	20
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	8	4	5		17	66
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche sp.</i>						
<i>Hydropsyche sp.</i>	10	10	14		34	132
<i>Hydropsyche (cockerelli)</i>	3	4	1		8	32
<i>Hydropsyche occidentalis</i>	5	6	1		12	47
<i>Hydropsyche oslari</i>	110	80	69		259	1004
<i>Hydroptila sp.</i>						
<i>Lepidostoma sp.</i>	85	175	259		519	2012
<i>Ceraclea sp.</i>						
<i>Oecetis sp.</i>						
Limnephilidae						
<i>Psychomyia flavida</i>						
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>		1			1	4

Table B5. cont. Macroinvertebrate data collected from site CR-bWF on 19 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.		2			2	8
<i>Cladotanytarsus</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>	7	4	2		13	51
<i>Cricotopus/Orthocladius</i> sp.	12	13	17		42	163
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.						
<i>Eukiefferiella</i> sp.	15	7	8		30	117
<i>Lopescladius</i> sp.						
<i>Micropsectra/Tanytarsus</i> sp.						
<i>Microtendipes</i> sp.		1	1		2	8
<i>Nanocladius</i> sp.	1				1	4
<i>Pagastia</i> sp.	2	4			6	24
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.						
<i>Parametriocnemus</i> sp.	3	1			4	16
<i>Polypedilum</i> sp.	4	1	1		6	24
<i>Potthastia</i> sp.	1				1	4
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.						
<i>Synorthocladius</i> sp.		1			1	4
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	4		1		5	20
Other Diptera						
<i>Atherix pachypus</i>						
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	2				2	8
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	3				3	12
<i>Antocha</i> sp.	6	8	14		28	109
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	20	20	22		62	241
<i>Zaitzevia parvula</i>	3	2	7		12	47
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.						
<i>Protzia</i> sp.	1				1	4
<i>Sperchon</i> sp.			1		1	4
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.			5		5	20
<i>Polycelis coronata</i>	97	90	111		298	1156
<i>Physa</i> sp.			3		3	12
Lumbricidae						
Naididae	11	1	4		16	63
Tubificidae w/o hair chaetae	2				2	8
Totals	914	1003	1308		3225	12520

Table B6. Macroinvertebrate data collected from site CR-R3 on 19 Sept. 2024.

Colorado River						
CR-R3		Sample				Estimated Total/m ²
19 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>			1		1	4
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	52	31	63		146	566
<i>Dipheter hageni</i>						
<i>Attenella margarita</i>						
<i>Drunella grandis</i>	4	3	4		11	43
<i>Ephemerella dorothea infrequens</i>	467	248	460		1175	4555
<i>Serratella (micheneri)</i>	1				1	4
<i>Epeorus longimanus</i>	3	1			4	16
<i>Heptagenia sp.</i>						
<i>Rhithrogena sp.</i>	8	8	5		21	82
<i>Tricorythodes explicatus</i>	1				1	4
<i>Paraleptophlebia sp.</i>	9	1	5		15	59
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>	2				2	8
Chloroperlidae	7	1	1		9	35
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>	6	6	7		19	74
<i>Hesperoperla pacifica</i>						
Perlodidae (<i>Cultus sp.</i>)	3	5	22		30	117
<i>Isoperla sp.</i>	16	3	8		27	105
<i>Isoperla fulva</i>		2			2	8
<i>Skwala americana</i>	6	3	1		10	39
<i>Pteronarcys californica</i>						
Trichoptera						
<i>Brachycentrus americanus</i>	226	72	119		417	1617
<i>Brachycentrus occidentalis</i>		1			1	4
<i>Micrasema bactro</i>						
<i>Culoptila sp.</i>	2				2	8
<i>Glossosoma sp.</i>	173	205	494		872	3380
<i>Protophila sp.</i>	2	1	2		5	20
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>		4	1		5	20
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche sp.</i>						
<i>Hydropsyche sp.</i>						
<i>Hydropsyche (cockerelli)</i>	31	50	87		168	652
<i>Hydropsyche occidentalis</i>						
<i>Hydropsyche oslari</i>	31	27	45		103	400
<i>Hydroptila sp.</i>			1		1	4
<i>Lepidostoma sp.</i>	103	20	40		163	632
<i>Ceraclea sp.</i>						
<i>Oecetis sp.</i>						
Limnephilidae						
<i>Psychomyia flavida</i>						
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>						

Table B6. cont. Macroinvertebrate data collected from site CR-R3 on 19 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.		1	1		2	8
<i>Cladotanytarsus</i> sp.	1				1	4
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>	2				2	8
<i>Cricotopus/Orthocladius</i> sp.	36	13	20		69	268
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.		1			1	4
<i>Eukiefferiella</i> sp.	7	4	8		19	74
<i>Lopescladius</i> sp.	9				9	35
<i>Micropsectral Tanytarsus</i> sp.	1		3		4	16
<i>Microtendipes</i> sp.	1				1	4
<i>Nanocladius</i> sp.						
<i>Paqastia</i> sp.	18	15	22		55	214
<i>Paracladopelma</i> sp.			1		1	4
<i>Parakiefferiella</i> sp.	1				1	4
<i>Parametricnemus</i> sp.	1	1	3		5	20
<i>Polypedilum</i> sp.	3				3	12
<i>Potthastia</i> sp.	1	1	1		3	12
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.						
<i>Synorthocladius</i> sp.	1				1	4
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	11	9	14		34	132
Other Diptera						
<i>Atherix pachypus</i>	1				1	4
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.						
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	2	40	23		65	252
<i>Antocha</i> sp.	6	3	13		22	86
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	33	8	32		73	283
<i>Zaitzevia parvula</i>	4		1		5	20
Miscellaneous						
<i>Atractides</i> sp.						
<i>Hygrobates</i> sp.	1				1	4
<i>Lebertia</i> sp.	3				3	12
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	5		1		6	24
<i>Torrenticola</i> sp.						
Caecidotea sp.						
<i>Polycelis coronata</i>	17	7	11		35	136
<i>Physa</i> sp.						
Lumbricidae			1		1	4
Naididae	4	3	5		12	47
Tubificidae w/o hair chaetae						
Totals	1322	798	1526		3646	14151

Table B7. Macroinvertebrate data collected from site CR-R4 on 19 Sept. 2024.

Colorado River						
CR-R4		Sample				Estimated Total/m ²
19 Sept. 2024	1	2	3		Total	
Ephemeroptera						
<i>Acentrella turbida</i>	1	4			5	20
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	24	62	22		108	419
<i>Dipheter hageni</i>	1				1	4
<i>Attenella margarita</i>						
<i>Drunella grandis</i>	4	13	5		22	86
<i>Ephemerella dorothea infrequens</i>	521	527	211		1259	4880
<i>Serratella (micheneri)</i>						
<i>Epeorus longimanus</i>	6	7	2		15	59
<i>Heptagenia sp.</i>	1				1	4
<i>Rhithrogena sp.</i>	17	8	2		27	105
<i>Tricorythodes explicatus</i>						
<i>Paraleptophlebia sp.</i>	20	4	3		27	105
Plecoptera						
Capniidae						
<i>Paracapnia angulata</i>	1	1			2	8
Chloroperlidae	1				1	4
<i>Zapada cinctipes</i>						
<i>Claassenia sabulosa</i>	1	2			3	12
<i>Hesperoperla pacifica</i>						
Perlodidae (<i>Cultus sp.</i>)	9	7	7		23	90
<i>Isoperla sp.</i>	3	2	1		6	24
<i>Isoperla fulva</i>	1		1		2	8
<i>Skwala americana</i>	6	2	3		11	43
<i>Pteronarcys californica</i>	1				1	4
Trichoptera						
<i>Brachycentrus americanus</i>	86	119	57		262	1016
<i>Brachycentrus occidentalis</i>	3	4	5		12	47
<i>Micrasema bactro</i>	1				1	4
<i>Culoptila sp.</i>	4	1			5	20
<i>Glossosoma sp.</i>	243	162	39		444	1721
<i>Protophila sp.</i>	6	1			7	28
<i>Helicopsyche borealis</i>						
<i>Arctopsyche grandis</i>	2	6	1		9	35
<i>Ceratopsyche morosa</i> group						
<i>Cheumatopsyche sp.</i>						
<i>Hydropsyche sp.</i>	1	1	1		3	12
<i>Hydropsyche (cockerelli)</i>	64	81	35		180	698
<i>Hydropsyche occidentalis</i>	1		1		2	8
<i>Hydropsyche oslari</i>	79	100	52		231	896
<i>Hydroptila sp.</i>						
<i>Lepidostoma sp.</i>	77	17	13		107	415
<i>Ceraclea sp.</i>	2				2	8
<i>Oecetis sp.</i>			1		1	4
Limnephilidae						
<i>Psychomyia flava</i>		1			1	4
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>						

Table B7. cont. Macroinvertebrate data collected from site CR-R4 on 19 Sept. 2024.

Diptera						
Chironomidae						
<i>Cardiocladius</i> sp.						
<i>Cladotanytarsus</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus nostocicola</i>	1				1	4
<i>Cricotopus/Orthocladius</i> sp.	30	17	23		70	272
<i>Cryptochironomus</i> sp.						
<i>Diamesa</i> sp.		1			1	4
<i>Eukiefferiella</i> sp.	11	17	8		36	140
<i>Lopescladius</i> sp.						
<i>Micropsectral Tanytarsus</i> sp.	3		1		4	16
<i>Microtendipes</i> sp.						
<i>Nanocladius</i> sp.						
<i>Paqastia</i> sp.	10	7	12		29	113
<i>Paracladopelma</i> sp.						
<i>Parakiefferiella</i> sp.						
<i>Parametrioctenemus</i> sp.	2		1		3	12
<i>Polypedilum</i> sp.	3	1	2		6	24
<i>Potthastia</i> sp.	2		1		3	12
<i>Potthastia gaedii</i>						
<i>Rheotanytarsus</i> sp.						
<i>Synorthocladius</i> sp.			1		1	4
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	17	26	13		56	218
Other Diptera						
<i>Atherix pachypus</i>		1			1	4
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.	2				2	8
<i>Hemerodromia</i> sp.						
<i>Simulium</i> sp.	1	1	1		3	12
<i>Antocha</i> sp.	18	10	5		33	128
Coleoptera						
<i>Microcylloepus</i> sp.						
<i>Optioservus</i> sp.	16	2	5		23	90
<i>Zaitzevia parvula</i>	2		2		4	16
Miscellaneous						
<i>Atractides</i> sp.	1				1	4
<i>Hygrobates</i> sp.						
<i>Lebertia</i> sp.	2		1		3	12
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	1	1			2	8
<i>Torrenticola</i> sp.						
<i>Caecidotea</i> sp.						
<i>Polycelis coronata</i>	59	10	1		70	272
<i>Physa</i> sp.						
Lumbricidae						
Naididae	2		1		3	12
Tubificidae w/o hair chaetae	1				1	4
Totals	1371	1226	540		3137	12180

Appendix C

Denver Water

Benthic Macroinvertebrate Data – Fall 2024

Table C1. Macroinvertebrate data collected from site FR-23.2 on 16 Sept. 2024.

Fraser River						
FR-abvWPSD (FR-23.2)		Sample				Estimated Total # /m ²
16 Sept. 2024	1	2	3		Total	
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.	1	1			2	8
<i>Acentrella turbida</i>	3	4	3		10	39
<i>Baetis alius</i>		2			2	8
<i>Baetis flavistriga</i>			3		3	12
<i>Baetis (tricaudatus)</i>	8	13	8		29	113
<i>Diphetero hageni</i>						
<i>Drunella coloradensis</i>		1			1	4
<i>Drunella doddsii</i>	12	39	27		78	303
<i>Drunella grandis</i>		1			1	4
<i>Ephemerella dorothea infrequens</i>	3	3	8		14	55
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.	1	1	3		5	20
<i>Epeorus deceptivus</i>	2	7	2		11	43
<i>Epeorus longimanus</i>						
<i>Rhithrogena</i> sp.	1				1	4
<i>Paraleptophlebia</i> sp.						
<i>Paraleptophlebia packii</i>						
Plecoptera (stoneflies)						
Capniidae						
Chloroperlidae						
<i>Sweltsa</i> sp.		2	2		4	16
<i>Prostoia besametsa</i>	2	3			5	20
<i>Zapada cinctipes</i>		1			1	4
<i>Zapada oregonensis</i> group		2			2	8
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.	7	5	8		20	78
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>			3		3	12
<i>Skwala americana</i>						
<i>Taenionema</i> sp.	1	8	1		10	39
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	7	7	1		15	59
<i>Micrasema bactro</i>						
<i>Anagapetus debilis</i>						
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.		2	2		4	16
<i>Arctopsyche grandis</i>	1	2	2		5	20
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche oslari</i>						
<i>Lepidostoma</i> sp.						
<i>Rhyacophila brunnea</i>	3	2	1		6	24
<i>Rhyacophila coloradensis</i>		2			2	8
<i>Rhyacophila sibirica</i> group	1	2	1		4	16
<i>Oligophlebodes</i> sp.	1	7	6		14	55



Table C1. cont. Macroinvertebrate data collected from site FR-23.2 on 16 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Brillia</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus/Orthocladius</i> sp.	19	42	38		99	384
<i>Diamesa</i> sp.	1	5	6		12	47
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	9	18	14		41	159
<i>Micropsectra/Tanytarsus</i> sp.		2	4		6	24
<i>Pagastia</i> sp.	3	6	11		20	78
<i>Parakiefferiella</i> sp.						
<i>Polypedilum</i> sp.						
<i>Pothastia</i> sp.						
<i>Pseudorthocladius</i> sp.						
<i>Rheocricotopus</i> sp.	1	2			3	12
<i>Stempellina</i> sp.						
<i>Synorthocladius</i> sp.	1				1	4
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	7	3	1		11	43
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae		8	3		11	43
<i>Chelifera/Neoplasta</i> sp.						
<i>Pericoma</i> sp.		3	1		4	16
<i>Simulium</i> sp.	2	1			3	12
<i>Antocha</i> sp.						
<i>Dicranota</i> sp.		1			1	4
Coleoptera (beetles)						
<i>Cleptelmis</i> sp.						
<i>Heterlimnius</i> sp.	2	11	10		23	90
<i>Optioservus</i> sp.						
<i>Zaitzevia parvula</i>						
Miscellaneous						
<i>Lebertia</i> sp.	4	5	12		21	82
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	4	5	15		24	94
<i>Torrenticola</i> sp.						
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	1	3			4	16
Enchytraeidae		1			1	4
Lumbricidae		3			3	12
Naididae	3	5	2		10	39
Nematoda		1			1	4
Totals	111	242	198		551	2155

Table C2. Macroinvertebrate data collected from site VC-WP on 16 Sept. 2024.

Vasquez Creek						
VC-WP (VC-0)		Sample				
16 Sept. 2024	1	2	3		Total	Estimated Total # /m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.		1			1	4
<i>Acentrella turbida</i>	3	7	1		11	43
<i>Baetis alius</i>						
<i>Baetis flavistriga</i>		8	2		10	39
<i>Baetis (tricaudatus)</i>	5	8	25		38	148
<i>Dipheter hageni</i>		1			1	4
<i>Drunella coloradensis</i>	3	1	4		8	32
<i>Drunella doddsii</i>	12	15	15		42	163
<i>Drunella grandis</i>	1	3			4	16
<i>Ephemerella dorothea infrequens</i>			3		3	12
<i>Serratella tibialis</i>	3	2	4		9	35
<i>Cinygmula</i> sp.	8	6	17		31	121
<i>Epeorus deceptivus</i>	10	6	3		19	74
<i>Epeorus longimanus</i>						
<i>Rhithrogena</i> sp.						
<i>Paraleptophlebia</i> sp.						
<i>Paraleptophlebia packii</i>						
Plecoptera (stoneflies)						
Capniidae	1	1	2		4	16
Chloroperlidae						
<i>Sweltsa</i> sp.	5	4	9		18	70
<i>Prostoia besametsa</i>		2	15		17	66
<i>Zapada cinctipes</i>	1	3			4	16
<i>Zapada oregonensis</i> group	2	4	10		16	63
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.	3	4	7		14	55
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>						
<i>Skwala americana</i>						
<i>Taenionema</i> sp.	2	1	2		5	20
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	1	4	10		15	59
<i>Micrasema bactro</i>			3		3	12
<i>Anagapetus debilis</i>	1	1			2	8
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.						
<i>Arctopsyche grandis</i>	2		1		3	12
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche oslari</i>						
<i>Lepidostoma</i> sp.			2		2	8
<i>Rhyacophila brunnea</i>	4	11	7		22	86
<i>Rhyacophila coloradensis</i>		1	2		3	12
<i>Rhyacophila sibirica</i> group	7	7	2		16	63
<i>Oligophlebodes</i> sp.	43	140	97		280	1086



Table C2. cont. Macroinvertebrate data collected from site VC-WP on 16 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Brillia</i> sp.			1		1	4
<i>Corynoneura</i> sp.	1	1			2	8
<i>Cricotopus/Orthocladius</i> sp.	14	25	32		71	276
<i>Diamesa</i> sp.	2	1			3	12
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	11	22	35		68	264
<i>Micropsectra/Tanytarsus</i> sp.						
<i>Pagastia</i> sp.	1	2			3	12
<i>Parakiefferiella</i> sp.			1		1	4
<i>Polypedilum</i> sp.						
<i>Potthastia</i> sp.			1		1	4
<i>Pseudorthocladius</i> sp.						
<i>Rheocricotopus</i> sp.			3		3	12
<i>Stempellina</i> sp.			1		1	4
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.		2	5		7	28
Other Diptera (true flies)						
<i>Atherix pachypus</i>						
Ceratopogoninae		4	7		11	43
<i>Chelifera/Neoplasta</i> sp.	1				1	4
<i>Pericoma</i> sp.	12	26	97		135	524
<i>Simulium</i> sp.	2		2		4	16
<i>Antocha</i> sp.						
<i>Dicranota</i> sp.			1		1	4
Coleoptera (beetles)						
<i>Cleptelmis</i> sp.			1		1	4
<i>Heterlimnius</i> sp.	61	211	205		477	1849
<i>Optioservus</i> sp.						
<i>Zaitzevia parvula</i>						
Miscellaneous						
<i>Lebertia</i> sp.	5	12	39		56	218
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	4	2	5		11	43
<i>Torrenticola</i> sp.		1			1	4
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	36	55	78		169	656
Enchytraeidae	7	44	7		58	225
Lumbricidae						
Naididae		3			3	12
Nematoda						
Totals	274	652	764		1690	6573

Table C3. Macroinvertebrate data collected from site FR-20 on 16 Sept. 2024.

Fraser River						
FR-Rendezvous (FR-20)		Sample				Estimated
16 Sept. 2024	1	2	3		Total	Total # /m ²
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella turbida</i>	7	7	1		15	59
<i>Baetis alius</i>						
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	40	68	52		160	621
<i>Dipheter hageni</i>		1			1	4
<i>Drunella coloradensis</i>		1			1	4
<i>Drunella doddsii</i>	17	21	29		67	260
<i>Drunella grandis</i>	2	3	1		6	24
<i>Ephemerella dorothea infrequens</i>	1	1			2	8
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.		2	3		5	20
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>						
<i>Rhithrogena</i> sp.						
<i>Paraleptophlebia</i> sp.						
<i>Paraleptophlebia packii</i>						
Plecoptera (stoneflies)						
Capniidae						
Chloroperlidae						
<i>Sweltsa</i> sp.	5	9	10		24	94
<i>Prostoia besametsa</i>	4	5	4		13	51
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i> group						
<i>Diura knowltoni</i>			1		1	4
<i>Isoperla</i> sp.		1	4		5	20
<i>Isoperla fulva</i>						
<i>Megarcys signata</i>	1	3	1		5	20
<i>Skwala americana</i>		3	3		6	24
<i>Taenionema</i> sp.	1	2	1		4	16
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	20	78	52		150	582
<i>Micrasema bactro</i>		1			1	4
<i>Anagapetus debilis</i>						
<i>Culoptila</i> sp.						
<i>Glossosoma</i> sp.	2	4	6		12	47
<i>Arctopsyche grandis</i>	4	13	5		22	86
<i>Cheumatopsyche</i> sp.						
<i>Hydropsyche cockerelli</i>						
<i>Hydropsyche oslari</i>			1		1	4
<i>Lepidostoma</i> sp.		2	1		3	12
<i>Rhyacophila brunnea</i>	1	1			2	8
<i>Rhyacophila coloradensis</i>						
<i>Rhyacophila sibirica</i> group	1	1			2	8
<i>Oligophlebodes</i> sp.	53	136	73		262	1016



Table C3. cont. Macroinvertebrate data collected from site FR-20 on 16 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Brillia</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus/Orthocladius</i> sp.	275	253	229		757	2935
<i>Diamesa</i> sp.	3	5	3		11	43
<i>Dicrotendipes</i> sp.						
<i>Eukiefferiella</i> sp.	64	63	32		159	617
<i>Micropsectral/Tanytarsus</i> sp.		2	4		6	24
<i>Pagastia</i> sp.	28	16	27		71	276
<i>Parakiefferiella</i> sp.						
<i>Polypedilum</i> sp.	2	7	4		13	51
<i>Potthastia</i> sp.						
<i>Pseudorthocladius</i> sp.		1			1	4
<i>Rheocricotopus</i> sp.						
<i>Stempellina</i> sp.		2	1		3	12
<i>Synorthocladius</i> sp.						
<i>Thienemanniella</i> sp.		1			1	4
<i>Thienemannimyia</i> group						
<i>Tvetenia</i> sp.	2	11	6		19	74
Other Diptera (true flies)						
<i>Atherix pachypus</i>	1				1	4
Ceratopogoninae	1	2	1		4	16
<i>Chelifera/Neoplasta</i> sp.	1				1	4
<i>Pericoma</i> sp.	89	112	77		278	1078
<i>Simulium</i> sp.	1	1	3		5	20
<i>Antocha</i> sp.	2		1		3	12
<i>Dicranota</i> sp.		1			1	4
Coleoptera (beetles)						
<i>Cleptelmis</i> sp.						
<i>Heterlimnius</i> sp.	120	100	128		348	1349
<i>Optioservus</i> sp.		1			1	4
<i>Zaitzevia parvula</i>						
Miscellaneous						
<i>Lebertia</i> sp.	13	40	16		69	268
<i>Protzia</i> sp.		1			1	4
<i>Sperchon</i> sp.	7	11	8		26	101
<i>Torrenticola</i> sp.						
<i>Gyraulus</i> sp.						
<i>Polycelis coronata</i>	9	53	36		98	380
Enchytraeidae			1		1	4
Lumbricidae						
Naididae						
Nematoda		1			1	4
Totals	777	1047	825		2649	10288

Table C4. Macroinvertebrate data collected from site FR-14 on 16 Sept. 2024.

Fraser River						
FR-CR83 (FR-14)		Sample				Estimated Total # /m ²
16 Sept. 2024	1	2	3		Total	
Ephemeroptera (mayflies)						
<i>Ameletus</i> sp.						
<i>Acentrella turbida</i>	3	1			4	16
<i>Baetis alius</i>						
<i>Baetis flavistriga</i>						
<i>Baetis (tricaudatus)</i>	28	32	17		77	299
<i>Dipheter hageni</i>						
<i>Drunella coloradensis</i>						
<i>Drunella doddsii</i>						
<i>Drunella grandis</i>	28	26	41		95	369
<i>Ephemerella dorothea infrequens</i>	16	35	52		103	400
<i>Serratella tibialis</i>						
<i>Cinygmula</i> sp.						
<i>Epeorus deceptivus</i>						
<i>Epeorus longimanus</i>			2		2	8
<i>Rhithrogena</i> sp.	1				1	4
<i>Paraleptophlebia</i> sp.	1	5	2		8	32
<i>Paraleptophlebia packii</i>		3			3	12
Plecoptera (stoneflies)						
Capniidae						
Chloroperlidae		1			1	4
<i>Sweltsa</i> sp.	1				1	4
<i>Prostoia besametsa</i>						
<i>Zapada cinctipes</i>						
<i>Zapada oregonensis</i> group						
<i>Diura knowltoni</i>						
<i>Isoperla</i> sp.						
<i>Isoperla fulva</i>	5	5	4		14	55
<i>Megarcys signata</i>						
<i>Skwala americana</i>	1				1	4
<i>Taenionema</i> sp.						
Trichoptera (caddisflies)						
<i>Brachycentrus americanus</i>	6	6	16		28	109
<i>Micrasema bactro</i>	1				1	4
<i>Anagapetus debilis</i>						
<i>Culoptila</i> sp.		3	4		7	28
<i>Glossosoma</i> sp.	10	25	145		180	698
<i>Arctopsyche grandis</i>	1	7	6		14	55
<i>Cheumatopsyche</i> sp.			1		1	4
<i>Hydropsyche cockerelli</i>	69	46	59		174	675
<i>Hydropsyche oslari</i>	4	3	10		17	66
<i>Lepidostoma</i> sp.	10	14	8		32	125
<i>Rhyacophila brunnea</i>						
<i>Rhyacophila coloradensis</i>	5	4	3		12	47
<i>Rhyacophila sibirica</i> group						
<i>Oligophlebodes</i> sp.						



Table C4. cont. Macroinvertebrate data collected from site FR-14 on 16 Sept. 2024.

Diptera (true flies)						
Chironomidae (chironomids)						
<i>Brillia</i> sp.						
<i>Corynoneura</i> sp.						
<i>Cricotopus/Orthocladius</i> sp.	105	128	54	287	1113	
<i>Diamesa</i> sp.	8	10		18	70	
<i>Dicrotendipes</i> sp.			1	1	4	
<i>Eukiefferiella</i> sp.	61	32	17	110	427	
<i>Micropsectral/Tanytarsus</i> sp.			1	1	4	
<i>Pagastia</i> sp.	8	6	5	19	74	
<i>Parakiefferiella</i> sp.						
<i>Polypedilum</i> sp.			2	2	8	
<i>Potthastia</i> sp.						
<i>Pseudorthocladius</i> sp.						
<i>Rheocricotopus</i> sp.						
<i>Stempellina</i> sp.						
<i>Synorthocladius</i> sp.	1	1		2	8	
<i>Thienemanniella</i> sp.						
<i>Thienemannimyia</i> group		4	1	5	20	
<i>Tvetenia</i> sp.	9	7	5	21	82	
Other Diptera (true flies)						
<i>Atherix pachypus</i>		3	1	4	16	
Ceratopogoninae						
<i>Chelifera/Neoplasta</i> sp.		1	2	3	12	
<i>Pericoma</i> sp.	1			1	4	
<i>Simulium</i> sp.	2	2		4	16	
<i>Antocha</i> sp.	3	6	6	15	59	
<i>Dicranota</i> sp.						
Coleoptera (beetles)						
<i>Cleptelmis</i> sp.						
<i>Heterlimnius</i> sp.		1		1	4	
<i>Optioservus</i> sp.	22	58	30	110	427	
<i>Zaitzevia parvula</i>	1			1	4	
Miscellaneous						
<i>Lebertia</i> sp.	1			1	4	
<i>Protzia</i> sp.						
<i>Sperchon</i> sp.	1	3	3	7	28	
<i>Torrenticola</i> sp.						
<i>Gyraulus</i> sp.	2			2	8	
<i>Polycelis coronata</i>						
Enchytraeidae						
Lumbricidae						
Naididae	3	3	2	8	32	
Nematoda						
Totals	418	481	500	1399	5442	

Appendix D

Learning By Doing

Historical MMI v4 and Individual Metric Results – 2017-2023

Table D1. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2017 using the MMI v4 subsampling.

Metric	Station ID							
	FR-23.2	FR-20	FR-15	FR-14	RC-1.1	FR-12.4	FR-1.9	CR-9.1
EPT Taxa	50.0	45.8	58.3	62.5	66.7	75.0	100.0	93.2
% Non-Insect Individuals	70.4	55.6	92.7	94.1	80.6	86.2	94.6	83.1
% EPT Individuals-no Baetidae	19.6	15.0	29.1	61.7	53.5	81.3	79.4	68.1
% Coleoptera Individuals	16.2	9.5	4.6	31.6	44.8	47.4	54.8	52.3
% Intolerant Taxa	76.5	82.0	71.7	72.3	71.5	72.9	100.0	89.0
% Increasers, Mid-Elevation	70.9	58.9	87.7	95.5	91.2	85.5	95.3	92.9
Clinger Taxa	43.3	43.3	72.1	76.9	72.1	62.5	100.0	97.4
Predator/Shredder Taxa	85.7	92.9	71.4	100.0	92.9	100.0	100.0	78.6
MMI v4	54.1	50.4	61.0	74.3	71.6	76.3	90.5	81.8
	Auxiliary Metrics							
Diversity	3.44	3.08	3.49	3.95	3.98	3.49	4.41	4.23
HBI	4.50	3.95	4.66	3.64	3.57	2.68	3.23	3.09
Sediment Region	SR2	SR2	SR2	SR2	SR2			
TIV	6.39	5.88	6.31	5.64	5.56	--	--	--

Table D2. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2018. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID									
	FR-27.2	SLC-0	FR-15	RC-1.1	WF-13.1	WF-5.5	WF-2.0	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	65.3	66.7	45.8	70.8	75.0	45.8	29.2	84.8	100.0	52.1
% EPT, no Baetidae	100.0	35.6	72.1	90.6	85.0	62.1	4.3	50.9	58.0	24.9
Clinger Taxa	65.0	81.7	67.3	67.3	72.1	57.7	33.7	100.0	100.0	57.8
Total Taxa	59.5	--	--	--	--	--	--	--	--	--
Intolerant Taxa	81.0	--	--	--	--	--	--	--	--	--
% Increases, Mountains	63.9	--	--	--	--	--	--	--	--	--
Predator Taxa	61.5	--	--	--	--	--	--	--	--	--
% Scraper Individuals	100.0	--	--	--	--	--	--	--	--	--
% Non-Insect Individuals	--	70.4	82.2	74.3	86.5	66.6	92.3	76.7	81.7	30.4
% Coleoptera Individuals	--	62.6	70.5	46.6	6.2	66.5	0.8	89.4	73.1	67.9
% Intolerant Taxa	--	65.6	62.2	76.8	94.4	43.4	51.8	79.0	94.9	55.0
% Increases, Mid-Elev.	--	49.7	85.3	87.8	84.2	87.3	98.7	83.5	88.7	0.0
Predator/Shredder Taxa	--	100.0	57.1	100.0	100.0	78.6	42.9	71.4	92.9	57.1
MMI	74.5	66.5	67.8	76.8	75.4	63.5	44.2	79.5	86.2	43.2
	Auxiliary Metrics									
Diversity	2.98	3.87	3.25	3.66	3.61	3.58	2.64	4.13	4.02	3.54
HBI	2.16	4.05	3.15	2.85	3.23	3.42	4.69	3.42	3.46	5.08
Sediment Region	SR1	SR2	SR2	SR2	SR2					
TIV	2.28	6.20	4.79	4.59	4.25	--	--	--	--	--

Table D3. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2019 based on the MMI v4 subsampling.

Metric	Station ID									
	FR-25.1	FR-15	FR-1.9	RC-1.1	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	73.5	66.7	100.0	87.5	83.3	41.6	35.6	93.2	100.0	85.3
% EPT, no Baetidae	45.8	45.6	78.9	83.1	81.5	15.1	17.9	68.3	72.9	80.6
Clinger Taxa	70.0	62.5	96.1	76.9	76.9	52.9	35.3	92.6	100.0	84.1
Total Taxa	71.4	--	--	--	--	--	--	--	--	--
Intolerant Taxa	81.0	--	--	--	--	--	--	--	--	--
% Increases, Mountains	41.3	--	--	--	--	--	--	--	--	--
Predator Taxa	76.9	--	--	--	--	--	--	--	--	--
% Scraper Individuals	56.2	--	--	--	--	--	--	--	--	--
% Non-Insect Individuals	--	88.3	95.8	84.5	90.1	47.0	58.9	78.1	86.0	71.8
% Coleoptera Individuals	--	53.4	58.5	34.8	41.8	1.0	0.0	25.8	33.1	33.1
% Intolerant Taxa	--	74.9	92.4	82.0	77.7	60.7	76.0	75.1	95.2	67.8
% Increases, Mid-Elev.	--	91.1	97.2	90.5	88.6	93.4	94.5	88.2	80.1	46.7
Predator/Shredder Taxa	--	78.6	64.3	100.0	100.0	71.4	50.0	64.3	57.1	64.3
MMI	64.5	70.1	85.4	79.9	80.0	47.9	46.0	73.2	78.1	66.7
	Auxiliary Metrics									
Diversity	4.11	3.69	4.18	4.08	3.73	3.25	2.66	4.30	4.05	2.92
HBI	3.60	3.91	2.85	3.22	3.13	3.74	4.07	3.10	3.40	3.27
Sediment Region	SR1	SR2		SR2						
TIV	4.92	5.69	--	5.20	--	--	--	--	--	--

Table D4. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2020. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID									
	FR-25.1	FR-15	FR-12.4	RC-1.1	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	81.6	54.2	75.0	70.8	58.3	41.6	44.6	89.0	100.0	71.1
% EPT, no Baetidae	32.5	100.0	100.0	92.9	59.1	6.1	8.4	75.1	60.6	32.7
Clinger Taxa	70.0	52.9	67.3	67.3	57.7	48.1	45.4	92.6	100.0	73.6
Total Taxa	92.9	--	--	--	--	--	--	--	--	--
Intolerant Taxa	100.0	--	--	--	--	--	--	--	--	--
% Increases, Mountains	26.4	--	--	--	--	--	--	--	--	--
Predator Taxa	92.3	--	--	--	--	--	--	--	--	--
% Scraper individuals	33.9	--	--	--	--	--	--	--	--	--
% Non-Insect individuals	--	96.2	95.8	80.0	95.8	88.6	93.6	59.6	92.2	76.7
% Coleoptera individuals	--	10.4	17.7	20.5	15.0	0.0	0.8	32.8	50.6	21.6
% Intolerant Taxa	--	64.4	84.3	77.1	71.7	89.5	99.0	74.2	100.0	70.9
% Increases, Mid-Elev.	--	97.4	97.2	91.0	98.6	98.6	100.0	68.4	93.4	58.4
Predator/Shredder taxa	--	71.4	64.3	78.6	71.4	50.0	28.6	57.1	71.4	64.3
MMI	66.2	68.4	75.2	72.3	66.0	52.8	52.5	68.6	83.5	58.7
	Auxiliary Metrics									
Diversity	3.82	2.40	3.46	3.80	3.78	2.89	2.26	4.29	4.29	3.54
HBI	4.53	1.93	2.13	2.47	3.61	5.43	5.05	2.86	3.36	4.97
Sediment Region	SR1	SR2		SR2						
TIV	5.44	3.93	--	4.69	--	--	--	--	--	--

Table D5. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2021. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID										
	FR-25.1	FR-15	RC-1.1	FR-1.9	WF-13.1	WF-5.5 (mod)	WF-2 (mod)	WF-0.5	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	65.3	66.7	70.8	100.0	70.8	58.3	33.3	53.5	67.8	100.0	23.7
% EPT, no Baetidae	38.4	80.3	100.0	63.8	79.7	58.4	3.4	17.9	39.1	47.2	5.5
Clinger Taxa	70.0	67.3	67.3	100.0	72.1	52.9	38.5	45.4	77.9	84.4	21.0
Total Taxa	64.3	--	--	--	--	--	--	--	--	--	--
Intolerant Taxa	85.7	--	--	--	--	--	--	--	--	--	--
% Increasers, Mountains	41.2	--	--	--	--	--	--	--	--	--	--
Predator Taxa	69.2	--	--	--	--	--	--	--	--	--	--
% Scraper individuals	39.3	--	--	--	--	--	--	--	--	--	--
% Non-Insect individuals	--	92.5	93.4	95.2	88.4	87.1	77.8	70.5	10.1	85.9	15.4
% Coleoptera individuals	--	12.8	27.7	95.9	28.5	96.2	0.8	0.0	22.2	46.7	70.1
% Intolerant Taxa	--	82.0	79.1	100.0	100.0	60.9	77.7	85.5	74.9	68.5	16.1
% Increasers, Mid-Elev.	--	91.7	100.0	97.6	100.0	84.4	92.3	91.3	0.0	82.0	0.0
Predator/Shredder taxa	--	64.3	57.1	71.4	78.6	71.4	35.7	57.1	50.0	78.6	35.7
MMI	59.2	69.7	74.4	90.5	77.3	71.2	44.9	52.7	42.8	74.2	23.4
	Auxiliary Metrics										
Diversity	3.23	3.65	3.75	3.63	3.39	3.18	2.40	3.20	3.96	3.91	2.77
HBI	4.01	2.27	2.25	3.05	2.28	3.76	4.31	4.19	4.02	4.29	6.02
Sediment Region	SR1	SR2	SR2		SR2						
TIV	4.54	4.58	4.47	--	4.54	--	--	--	--	--	--

Table D6. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2022. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID											
	FR-27.2	SLC-0	RC-1.1	WC-BHU	WC-CRU	CR-24.9	WF-5.5 (mod)	WF-2 (mod)	WF-0.5	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	69.4	91.7	79.2	39.8	38.4	70.8	58.3	37.4	49.0	72.0	82.4	66.4
% EPT, no Baetidae	93.5	91.1	100.0	19.9	57.3	82.3	56.5	5.0	9.6	26.5	41.2	30.2
Clinger Taxa	60.0	91.3	81.7	45.1	44.1	76.9	52.9	43.3	40.3	68.2	60.3	68.3
Total Taxa	76.2	--	--	--	--	--	--	--	--	--	--	--
Intolerant Taxa	76.2	--	--	--	--	--	--	--	--	--	--	--
% Increasers, Mountains	82.6	--	--	--	--	--	--	--	--	--	--	--
Predator Taxa	76.9	--	--	--	--	--	--	--	--	--	--	--
% Scraper individuals	70.6	--	--	--	--	--	--	--	--	--	--	--
% Non-Insect individuals	--	92.2	92.5	16.8	74.6	86.7	95.1	36.1	44.3	38.6	64.3	78.4
% Coleoptera individuals	--	37.5	17.2	22.0	13.0	27.9	24.5	0.0	0.0	7.7	22.0	50.5
% Intolerant Taxa	--	95.6	91.6	50.4	66.7	54.6	57.9	78.1	89.6	56.8	38.7	40.0
% Increasers, Mid-Elev.	--	94.3	100.0	0.0	71.1	86.6	96.3	93.8	98.5	8.1	36.4	64.1
Predator/Shredder taxa	--	78.6	64.3	50.0	35.7	78.6	64.3	42.9	57.1	64.3	42.9	57.1
MMI	75.7	84.0	78.3	30.5	50.1	70.6	63.2	42.1	48.6	42.8	48.5	56.9
	Auxiliary Metrics											
Diversity	4.09	3.92	3.97	3.34	3.19	3.72	3.82	2.67	2.84	3.81	3.81	3.70
HBI	2.39	2.55	2.48	5.87	3.97	3.07	3.87	3.51	3.26	5.26	4.95	4.84
Sediment Region	SR1	SR2	SR2									
TIV	3.55	5.02	4.68	--	--	--	--	--	--	--	--	--

Table D7. Individual component metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Learning By Doing study area during the fall of 2023. All metric scores are based on the MMI v4 subsampling process.

Metric	Station ID													
	RC-5.3	RC-1.1	FR-12.4	FR-KP	FR-1.9	WC-2.3	WC-0.5	CR-24.9	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
EPT Taxa	79.2	79.2	79.2	100.0	100.0	44.2	68.3	83.3	45.8	25.0	40.1	89.0	100.0	75.8
% Non-Insect individuals	98.6	96.4	89.4	98.5	95.0	23.4	89.2	93.3	95.2	57.5	78.4	85.8	92.2	79.4
% EPT, no Baetidae	46.3	98.5	48.6	98.9	64.8	47.6	87.7	72.3	44.0	5.0	11.3	65.4	50.6	25.3
% Coleoptera individuals	22.6	24.8	22.7	37.7	79.4	6.7	29.5	6.5	34.0	0.9	0.0	16.2	15.1	55.9
% Intolerant Taxa	84.5	97.3	77.9	98.4	96.5	45.4	78.4	82.0	54.6	60.4	100.0	71.1	75.6	48.4
% Increasesers, Mid-Elev.	100.0	98.5	97.5	98.5	97.4	0.0	91.0	91.0	95.8	87.5	95.3	93.2	87.1	63.3
Clinger Taxa	76.9	86.5	86.5	100.0	100.0	50.1	68.6	81.7	52.9	33.7	40.3	97.4	100.0	73.6
Predator/Shredder taxa	92.9	64.3	85.7	78.6	78.6	57.1	64.3	64.3	85.7	42.9	42.9	78.6	64.3	64.3
MMI	75.1	80.7	73.4	88.8	89.0	34.3	72.1	71.8	63.5	39.1	51.0	74.6	73.1	60.7
	Auxiliary Metrics													
Diversity	3.81	4.31	4.24	4.08	4.27	3.25	3.23	3.83	3.85	2.83	2.29	4.18	4.03	4.02
HBI	3.81	2.10	3.56	3.54	3.20	5.55	3.48	3.57	4.05	4.19	4.59	3.31	3.93	5.14
Sediment Region	SR2													
TIV	5.94	4.73	5.42	--	--	--	--	--	--	--	--	--	--	--

Table D8. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2017. All additional metric values are based on full count Hess samples.

Metric	FR-23.2	FR-20	FR-15	FR-14	RC-1.1	FR-12.4	FR-1.9	CR-9.1
Density (mean #/m ²)	3,866	10,789	8,284	8,908	9,388	11,725	7,934	8,618
Taxa Richness	34	39	42	47	43	53	50	49
EPT	15	14	16	22	19	24	28	25
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0	0	0	4	4
% EPT-excluding Baetidae	14.49%	10.36%	22.50%	46.51%	40.28%	55.51%	57.79%	48.42%
% Chironomidae	48.99%	47.45%	48.57%	25.33%	25.89%	15.01%	11.56%	17.00%
% Hydropsychidae	31.91%	9.32%	31.33%	72.59%	19.77%	21.38%	49.66%	17.14%
% Tolerant Taxa	17.65%	15.38%	19.05%	14.89%	23.26%	20.75%	18.00%	24.49%
% Intolerant Taxa	44.12%	43.59%	33.33%	36.17%	44.19%	37.74%	50.00%	42.86%

Table D9. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2018. All additional metric values are based on full count Hess samples.

Metric	FR-27.2	SLC-0	FR-15	RC-1.1	WF-13.1	WF-5.5	WF-2.0	CR-9.1	CR-7.4	CR-1.7
Density (mean #/m ²)	3,862	3,524	8,770	8,566	3,231	6,429	8,755	7,037	7,384	6,197
Taxa Richness	33	46	42	42	37	45	25	55	56	42
EPT	19	22	16	22	20	12	9	28	28	15
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0	0	0	0	19	0	0
% EPT-excluding Baetidae	78.85%	28.73%	54.32%	64.10%	61.93%	46.34%	2.62%	35.23%	43.58%	17.68%
% Chironomidae	2.01%	5.75%	6.02%	2.77%	23.25%	1.57%	74.34%	12.09%	10.16%	11.72%
% Hydropsychidae	0.00%	16.42%	86.99%	35.47%	47.22%	26.01%	6.06%	19.45%	19.81%	9.91%
% Tolerant Taxa	12.12%	15.22%	19.05%	23.81%	13.51%	31.11%	16.00%	16.36%	23.21%	28.57%
% Intolerant Taxa	57.58%	41.30%	35.71%	42.86%	54.05%	28.89%	28.00%	43.64%	39.29%	21.43%

Table D10. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2019. All additional metric values are based on full count Hess samples.

Metric	FR-25.1	FR-15	FR-1.9	RC-1.1	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
Density (mean #/m ²)	1,087	8,521	5,528	7,180	10,328	7,264	1,801	10,060	12,549	8,758
Taxa Richness	31	52	48	49	56	33	20	53	58	49
EPT Taxa	19	24	25	24	23	15	8	27	29	23
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0	0	0	0	0	0	0
% EPT-excluding Baetidae	36.33%	34.64%	57.78%	57.68%	57.11%	8.39%	14.90%	49.54%	53.00%	57.36%
% Chironomidae	18.71%	27.71%	7.18%	15.91%	3.46%	17.85%	6.70%	17.49%	6.47%	4.96%
% Hydropsychidae	9.52%	61.29%	21.48%	40.78%	37.60%	22.83%	3.28%	24.09%	14.98%	2.35%
% Tolerant Taxa	12.90%	17.31%	20.83%	26.53%	21.43%	18.18%	20.00%	20.75%	22.41%	30.61%
% Intolerant Taxa	54.84%	40.38%	39.58%	40.82%	39.29%	30.30%	35.00%	37.74%	37.93%	28.57%

Table D11. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2020. All additional metric values are based on full count Hess samples.

Metric	FR-25.1	FR-15	FR-12.4	RC-1.1	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
Density (mean #/m ²)	1,848	28,703	14,088	2,329	7,099	14,133	10,366	9,386	10,326	6,808
Taxa Richness	43	47	52	37	47	36	28	53	55	45
EPT Taxa	23	19	25	18	21	18	14	28	29	21
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0	0	0	0	0	0	0
% EPT-excluding Baetidae	28.33%	78.30%	76.52%	66.00%	38.26%	2.91%	4.79%	52.63%	46.56%	24.14%
% Chironomidae	6.13%	11.73%	8.16%	15.58%	20.63%	47.87%	10.63%	8.32%	11.92%	14.16%
% Hydropsychidae	6.25%	55.37%	38.15%	5.02%	24.43%	20.00%	5.88%	14.16%	24.59%	47.88%
% Tolerant Taxa	11.63%	17.02%	23.08%	21.62%	14.89%	16.67%	14.29%	18.87%	18.18%	24.44%
% Intolerant Taxa	53.49%	31.91%	44.23%	43.24%	38.30%	38.89%	46.43%	37.74%	40.00%	31.11%

Table D12. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2021. All additional metric values are based on full count Hess samples.

Metric	FR-25.1	FR-15	RC-1.1	FR-1.9	WF-13.1	WF-5.5 (mod)	WF-2 (mod)	WF-0.5	CR-9.1	CR-7.4	CR-1.7
Density (#/m ²)	1,795	6,993	3,436	4,871	3,539	4,211	8,597	9,909	11,520	8,184	2,924
Taxa Richness	33	42	33	46	31	41	25	28	47	54	30
EPT	19	19	21	26	20	16	12	14	22	27	8
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	4	0	0	0	0	4	0	0
% EPT excluding Baetidae	27.61%	59.58%	79.75%	46.77%	56.26%	41.74%	2.17%	9.79%	27.26%	33.13%	3.46%
% Chironomidae	13.70%	27.37%	5.20%	3.43%	2.97%	2.95%	40.34%	23.61%	7.04%	15.99%	14.49%
% Hydropsychidae	10.00%	23.63%	31.37%	33.19%	3.01%	64.18%	25.00%	0.00%	14.88%	76.66%	0.00%
% Tolerant Taxa	12.12%	14.29%	21.21%	21.74%	3.23%	26.83%	24.00%	17.86%	19.15%	20.37%	43.33%
% Intolerant Taxa	57.58%	45.24%	45.45%	50.00%	61.29%	29.27%	44.00%	42.86%	38.30%	35.19%	6.67%

Table D13. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2022. All additional metric values are based on full count Hess samples.

Metric	FR-27.2	SLC-0	RC-1.1	WC-BHU	WC-CRU	CR-24.9	WF-5.5 (mod)	WF-2 (mod)	WF-0.5	CR-9.1	CR-7.4	CR-1.7
Density (#/m²)	3,604	4,364	7,320	5,495	8,611	19,913	6,886	13,889	13,031	9,741	5,767	10,550
Taxa Richness	37	49	47	34	28	56	45	28	30	54	45	58
EPT	20	27	24	11	10	25	14	11	16	23	17	26
Density of <i>Pteronarcys californica</i> (#/m²)	0	0	0	0	0	12	0	0	0	0	0	0
% EPT excluding Baetidae	72.35%	65.57%	80.00%	14.13%	39.03%	58.05%	40.91%	2.37%	7.62%	18.94%	25.47%	17.56%
% Chironomidae	7.78%	2.50%	6.84%	5.72%	2.03%	8.98%	29.68%	15.72%	20.24%	17.86%	34.43%	17.34%
% Hydropsychidae	0.00%	29.04%	31.40%	48.72%	27.55%	13.69%	87.37%	6.38%	3.08%	24.04%	20.57%	9.21%
% Tolerant Taxa	16.22%	18.37%	17.02%	38.24%	32.14%	25.00%	26.67%	28.57%	20.00%	24.07%	28.89%	29.31%
% Intolerant Taxa	54.05%	51.02%	51.06%	26.47%	28.57%	33.93%	26.67%	39.29%	33.33%	31.48%	17.78%	24.14%

Table D14. Additional individual metrics and comparative values for macroinvertebrate samples collected from the Learning By Doing study area in the fall of 2023. All additional metric values are based on full count Hess samples.

Metric	RC-5.3	RC-1.1	FR-12.4	FR-KP	FR-1.9	WC-2.3	WC-0.5	CR-24.9	WF-5.5	WF-2.0	WF-0.5	CR-9.1	CR-7.4	CR-1.7
Estimated Density (#/m²)	13,293	9,259	15,911	5,400	6,560	5,987	13,150	4,452	6,256	10,538	20,039	11,358	11,233	6,712
Taxa Richness	58	51	68	52	53	44	53	41	49	30	34	60	47	45
EPT	24	28	33	31	27	15	22	22	16	11	17	28	25	24
Density of <i>Pteronarcys californica</i> (#/m²)	0	0	0	8	0	0	0	0	0	0	0	0	0	0
% EPT excluding Baetidae	37.65%	75.17%	36.58%	70.48%	47.01%	33.42%	62.86%	53.89%	35.96%	3.68%	6.10%	52.55%	38.16%	18.69%
%Chironomidae	30.17%	8.81%	28.33%	2.66%	4.80%	16.68%	5.70%	5.59%	17.58%	27.61%	6.14%	9.26%	22.05%	21.41%
%Hydropsychidae	23.50%	23.72%	60.10%	75.76%	39.38%	73.05%	61.62%	48.90%	63.80%	3.33%	1.33%	7.98%	29.98%	73.22%
%Tolerant Taxa	18.97%	17.65%	23.53%	17.31%	18.87%	31.82%	22.64%	19.51%	20.41%	26.67%	23.53%	26.67%	21.28%	17.78%
% Intolerant Taxa	39.66%	50.98%	41.18%	48.08%	43.40%	31.82%	41.51%	41.46%	26.53%	36.67%	38.24%	31.67%	38.30%	28.89%

Appendix E

Northern Water (WGFP) and Denver Water

Metric Results from the fall of 2023

Table E1. Individual metrics and MMI v4 scores from benthic macroinvertebrate samples collected from Northern Water sampling sites on the Colorado River on 19 September 2023. All scores are based on the MMI v4 subsampling and 'impairment' is shown in red.

Metric	Station ID			
	CR-WGU	CR-WGD	CR-HSPP	CR-WFU
EPT Taxa	75.0	91.7	62.5	100.0
% Non-Insect Individuals	33.3	96.1	44.5	78.3
% EPT Individuals, no Baetidae	22.3	100.0	47.0	76.0
% Coleoptera Individuals	11.2	9.0	5.7	14.0
% Intolerant Taxa	69.0	84.1	70.3	65.6
% Increaser Individuals, Mid-Elevation	21.7	96.1	0.0	86.2
Clinger Taxa	72.1	86.5	72.1	100.0
Predator/Shredder Taxa	64.3	64.3	64.3	64.3
MMI v4	46.1	78.5	45.8	73.0
Auxiliary Metrics				
Diversity	3.71	3.59	3.48	4.38
HBI	4.80	3.13	5.18	3.35
TIV (Sediment Region 2)	N/A	5.44	N/A	4.99

Table E2. Additional metrics and comparative values for macroinvertebrate samples collected from Northern Water sampling sites on the Colorado River on 19 September 2023. All metrics are based on full count Hess samples.

Metric	CR-WGU	CR-WGD	CR-HSPP	CR-WFU
EPT	23	26	22	30
Evenness	0.646	0.623	0.652	0.719
DAT	36.4	34.8	24.7	34.2
Insect Taxa	45	46	34	48
Total Taxa	54	56	42	59
% Shredders and Scrapers	8.72%	10.24%	12.41%	19.78%
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	4
% EPT (excluding Baetidae)	15.55%	72.43%	32.11%	56.25%
Density (mean #/m ²)	13,006	8,047	7,415	7,518
% Chironomidae	39.01%	7.39%	8.22%	14.72%
% Hydropsychidae	17.37%	62.64%	36.75%	49.85%
% Tolerant Taxa	18.52%	21.43%	23.81%	18.64%
% Intolerant Taxa	35.19%	41.07%	38.10%	35.59%

Table E3. Individual metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Denver Water study area (Fraser River and Vasquez Creek) during fall of 2023. MMI v4 scores indicating ‘impairment’ would be provided in red.

Metric	Station ID			
	FR-abvWPSD	VC-WP	FR-Rendezvous	FR-CR83
EPT Taxa	91.7	95.6	95.8	70.8
% Non-Insect Individuals	58.5	32.9	85.1	92.8
% EPT Individuals, no Baetidae	26.7	36.2	37.7	80.2
% Coleoptera Individuals	35.1	62.3	30.4	53.0
% Intolerant Taxa	98.4	93.1	100.0	67.5
% Increasers Mid-Elevation	63.7	81.0	91.4	92.7
Clinger Taxa	76.9	79.3	76.9	81.7
Predator/Shredder Taxa	100.0	100.0	92.9	64.3
MMI	68.9	72.6	76.3	75.4
	Auxiliary Metrics			
Diversity	3.81	3.93	3.67	3.87
HBI	3.75	2.94	2.88	2.60
TIV (Sediment Region 2)	6.28	5.80	6.38	4.83

Table E4. Additional metrics and comparative values for macroinvertebrate samples collected from the Denver Water study area (Fraser River and Vasquez Creek) in fall of 2023. All additional metric values are based on full count Hess samples.

	FR-abvWPSD	VC-WP	FR-Rendezvous	FR-CR83
Density (#/m ²)	3579	2370	8897	8991
Taxa Richness	41	45	53	56
EPT	25	27	30	27
Density of <i>Pteronarcys californica</i> (#/m ²)	0	0	0	0
% EPT excluding Baetidae	18.48%	24.18%	24.44%	58.88%
% Chironomidae	37.07%	10.69%	45.35%	15.21%
Evenness	0.704	0.690	0.609	0.637
DAT Index	24.8	24.7	30.0	31.9
% Hydropsychidae	3.33%	4.65%	5.31%	46.29%
% Tolerant Taxa	14.63%	17.78%	11.32%	17.86%
% Intolerant Taxa	60.98%	55.56%	52.83%	39.29%

Appendix F

Learning By Doing, Northern Water (WGFP) and Denver Water

Additional Metric Figures

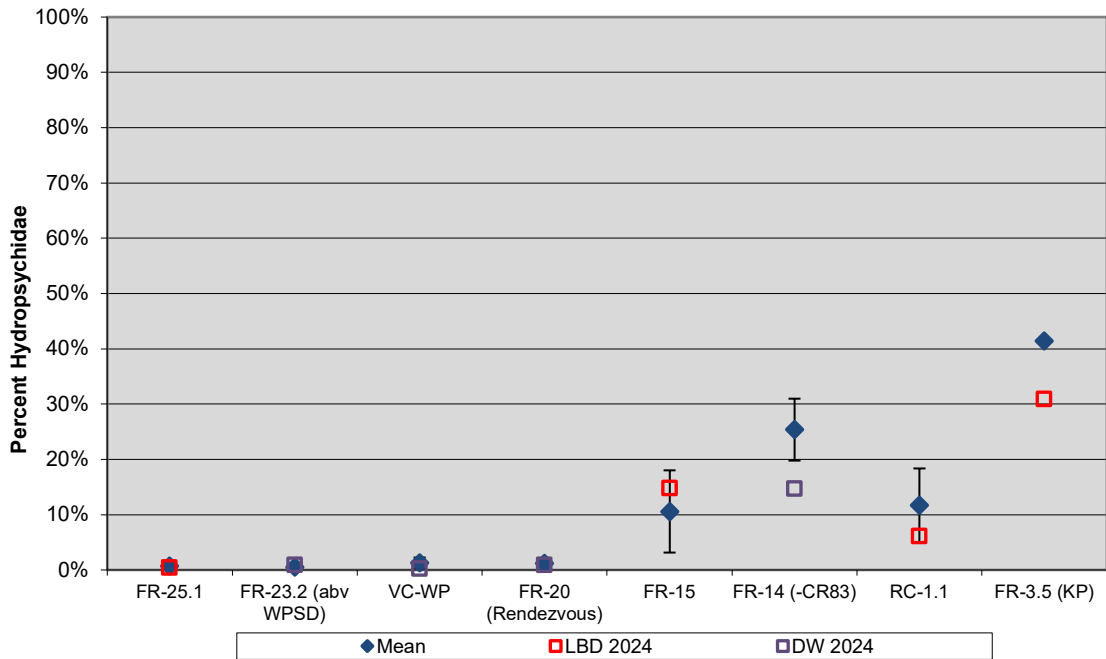


Figure F1. Percent Hydropsychidae values from study sites in the Fraser River study area from fall 2024 and historical mean values (± 1 SD).

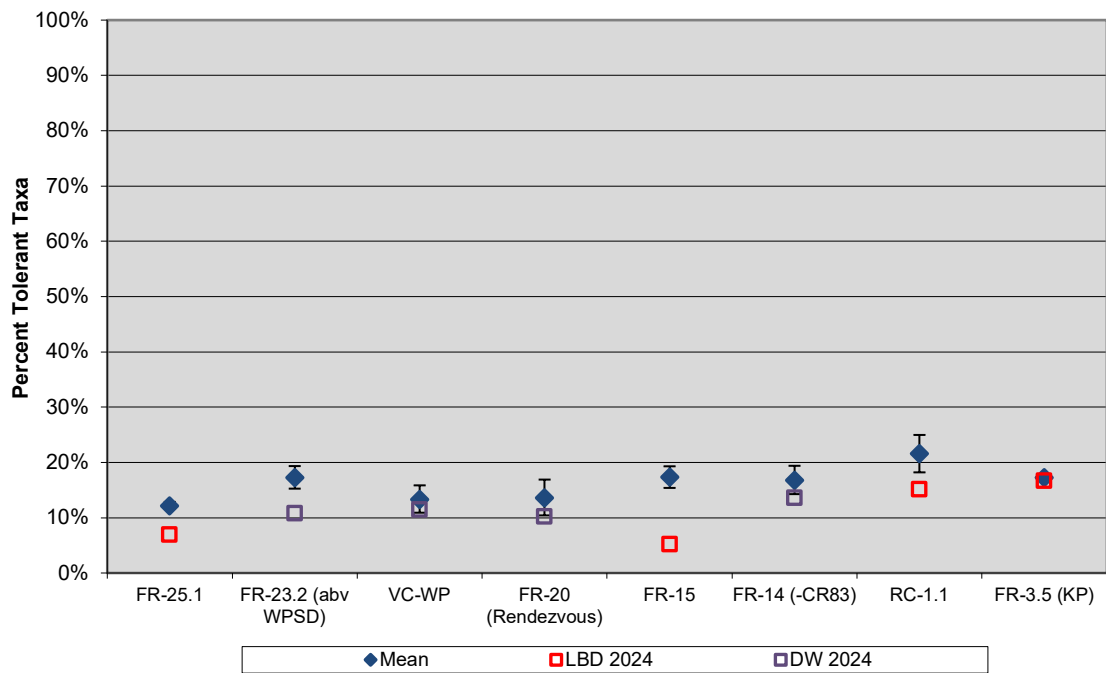


Figure F2. Percent Tolerant Taxa values from the Fraser River study area from fall 2024 and historical mean values (± 1 SD).

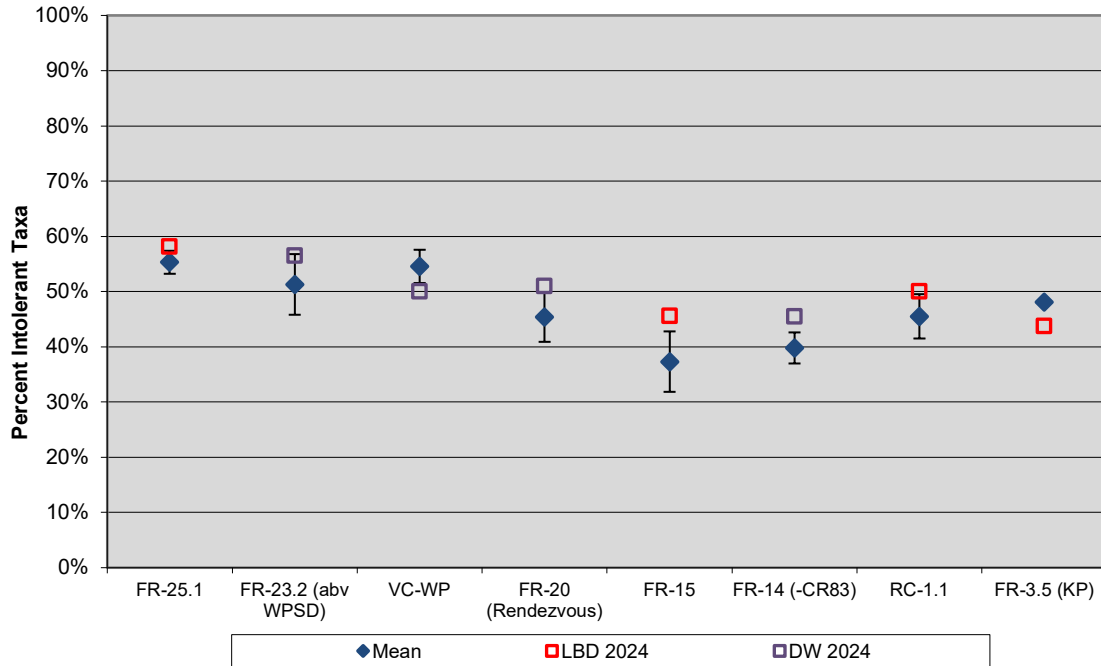


Figure F3. Percent Intolerant Taxa values from study sites in the Fraser River study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

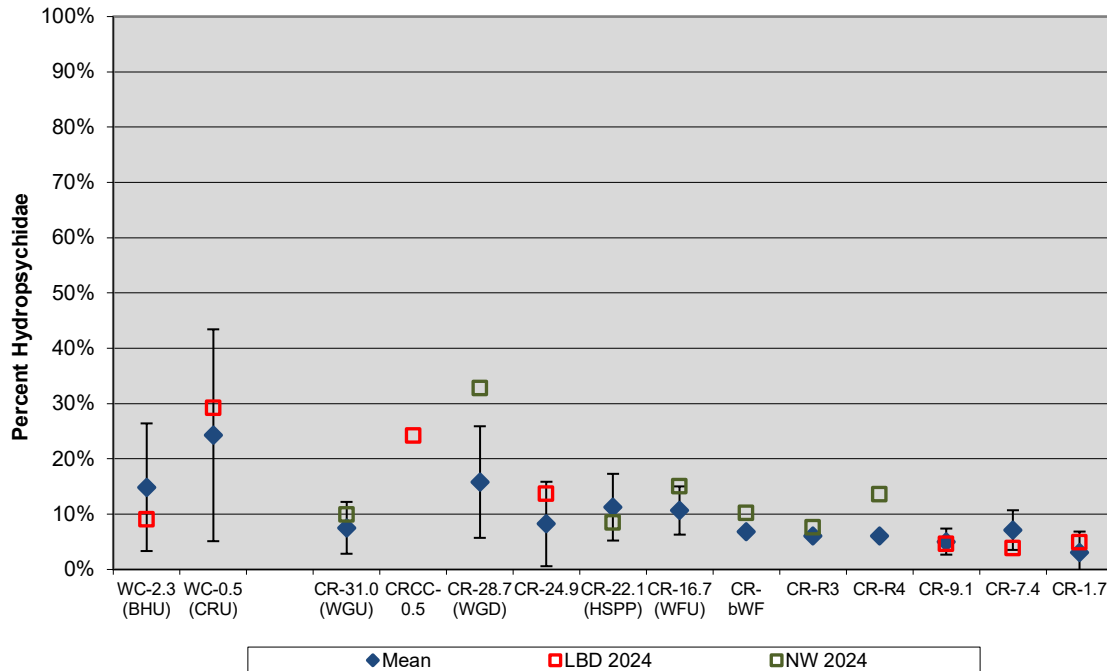


Figure F4. Percent Hydropsychidae values from study sites in the Colorado River study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

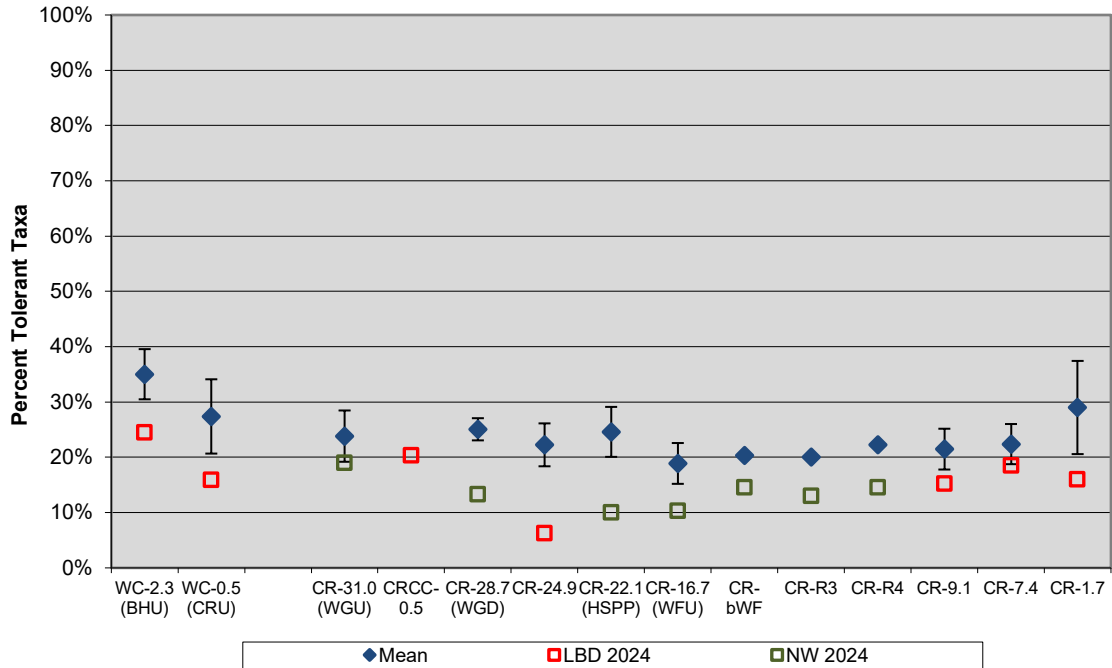


Figure F5. Percent Tolerant Taxa values from study sites in the Colorado River study area from fall 2024 and mean values (±1 SD) from previous sampling events.

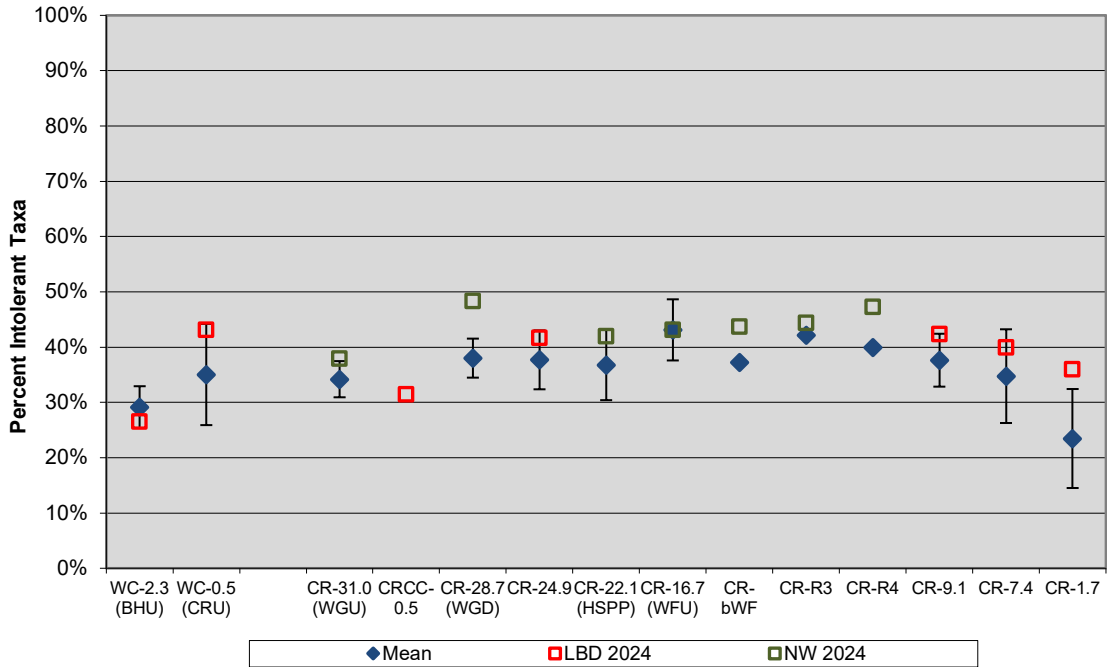


Figure F6. Percent Intolerant Taxa values from study sites in the Colorado River study area from fall 2024 and mean values (±1 SD) from previous sampling events.

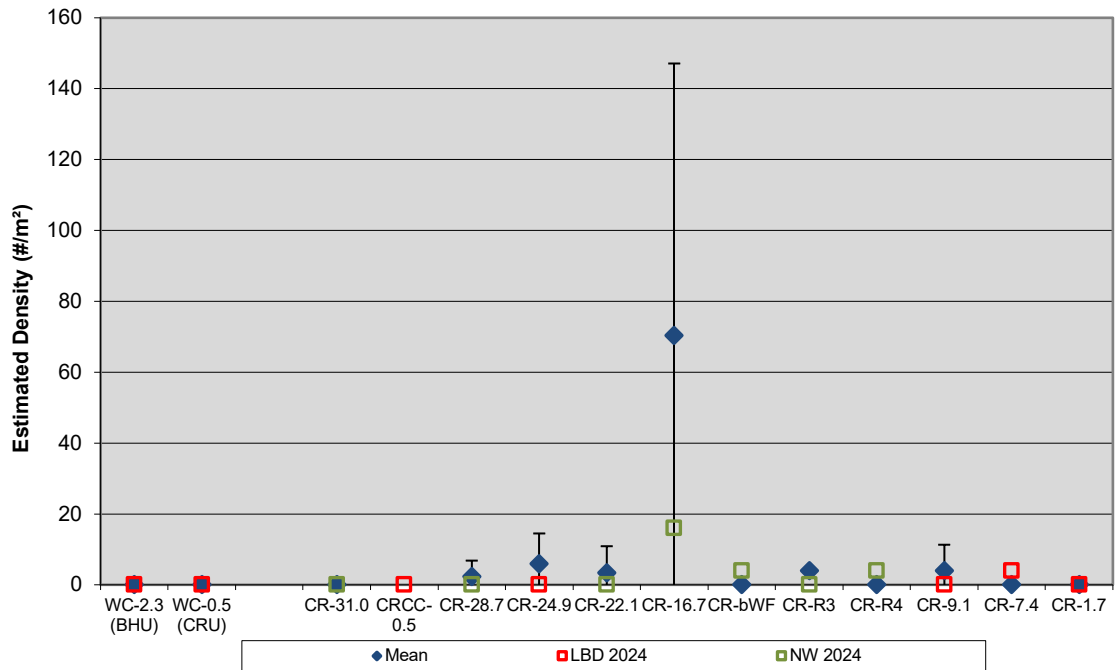


Figure F7. Density of *Pteronarcys californica* in the Colorado River study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

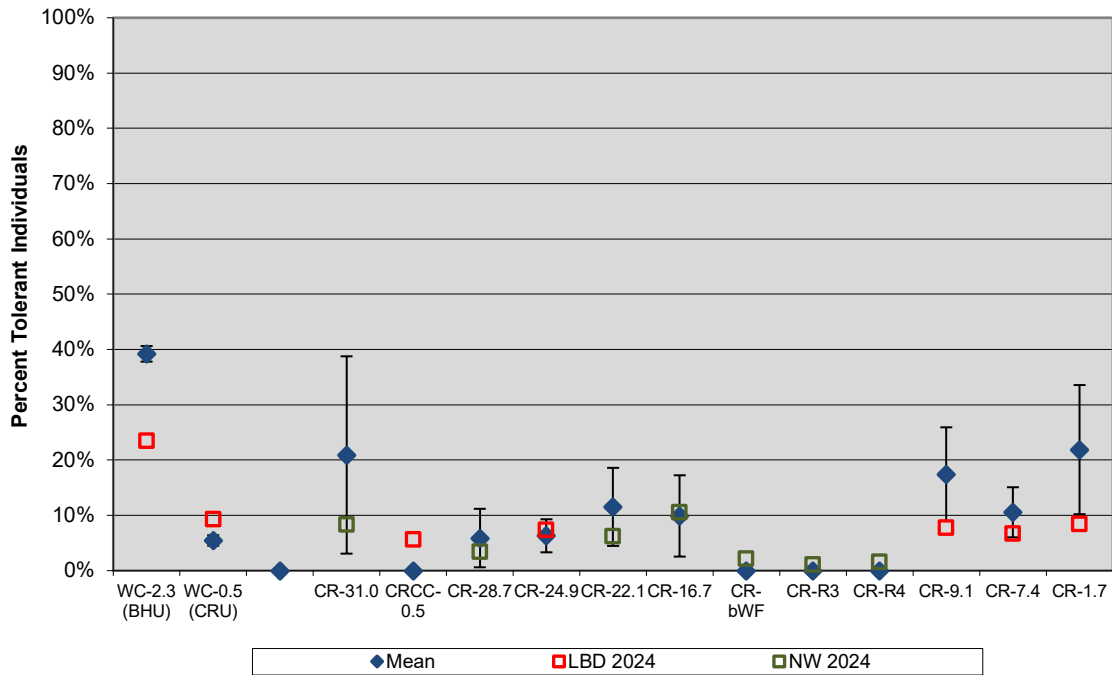


Figure F8. Percent Tolerant Individuals values in the Colorado River study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

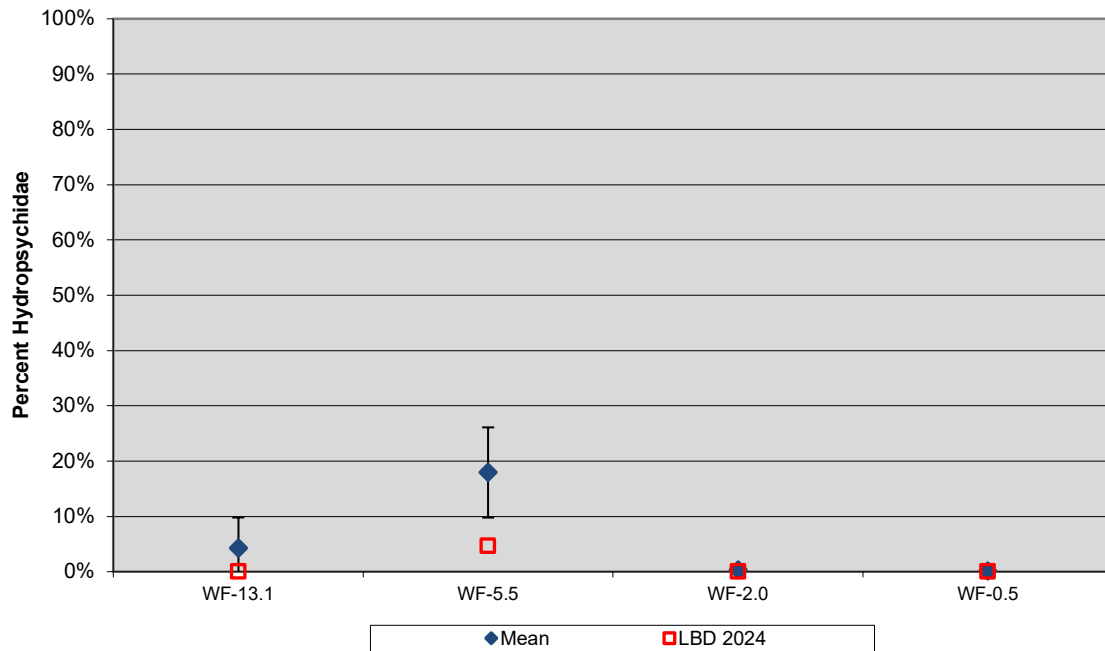


Figure F9. Percent Hydropsychidae values from study sites in the Williams Fork study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

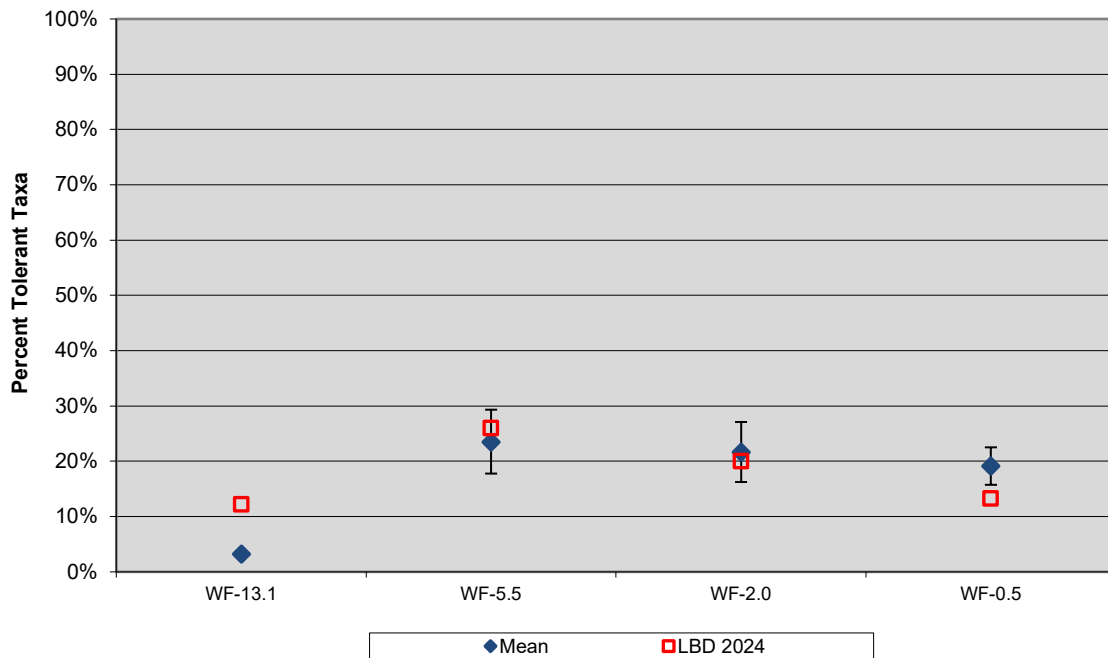


Figure F10. Percent Tolerant Taxa values from study sites in the Williams Fork study area from fall 2024 and mean values (± 1 SD) from previous sampling events.

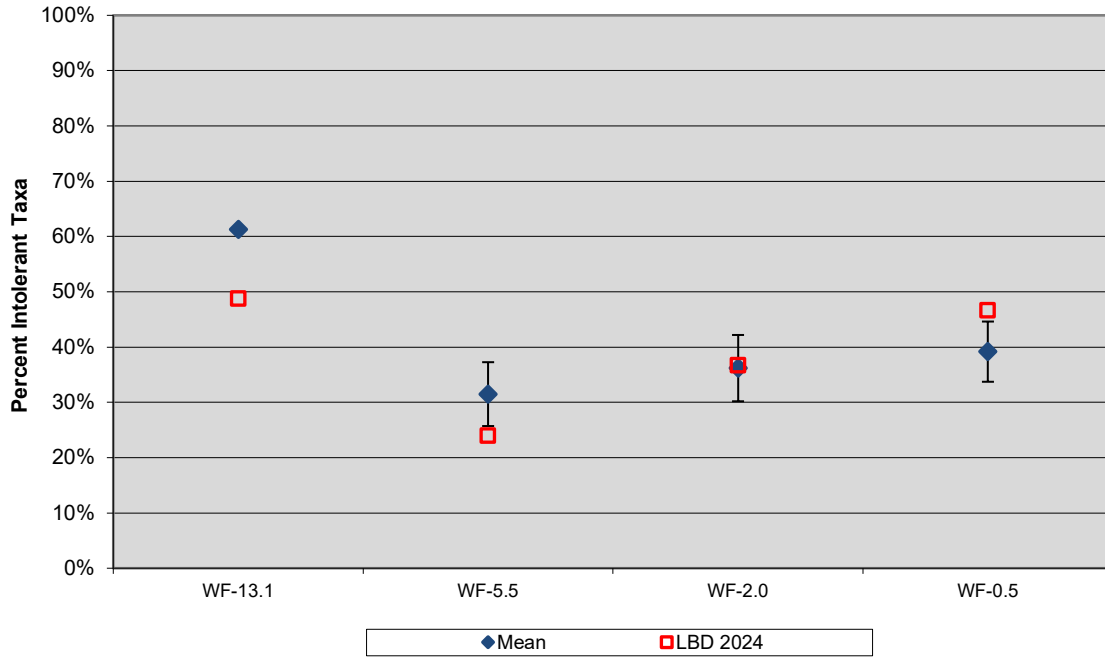


Figure F11. Percent Intolerant Taxa values from study sites in the Williams Fork study area from fall 2024 and mean values (± 1 SD) from previous sampling events.