BIOLOGICAL ASSESSMENT OF STREAM SITES IN THE CITY OF BELLEVUE, WASHINGTON: AQUATIC INVERTEBRATE ASSEMBLAGES

2011

Report to the City of Bellevue, Washington
Utilities Department
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INTRODUCTION

This report summarizes and interprets aquatic macroinvertebrate data collected in August 2011 at stream sites in the City of Bellevue, King County, Washington. The objectives of this study include using the invertebrate biota to detect impairment to biological health, using 2 assessment tools: the B-IBI (Benthic Index of Biological Integrity) (Kleindl 1995, Fore et al. 1996, Karr and Chu 1999), which is a battery of 10 biological metrics calibrated for streams of the Pacific Northwest, and a predictive model (RIVPACS – the River InVertebrate Prediction and Classification System) developed by the Washington Department of Ecology (WADOE). RIVPACS compares the occurrence of taxa at a site with the taxa expected at a similar site with minimal human influence, and yields a score that summarizes the comparison. These assessment tools provide a summary score of biological condition, and the B-IBI can be translated into biological health condition classes (i.e., excellent, good, fair, poor, and very poor) based on ranking criteria used by King County (King County 2008). In addition, this report identifies probable stressors which may account for diminished stream health, basing these observations on demonstrated and expected associations between patterns of response of B-IBI metrics and other metric expressions, as well as the taxonomic and functional composition of the benthic assemblages. The analysis examines common stressors associated with urbanization: water quality degradation, changes to natural thermal regimes, loss and impairment of instream habitats due to sediment deposition and altered flow regimes, and disturbance to reach scale habitat features such as streambanks, channel morphology, and riparian zone integrity.

METHODS

Sampling

The City of Bellevue provided oversight for the collection of 13 aquatic invertebrate samples from 5 sites. Samples were processed and invertebrates identified by Rhithron Associates, Missoula, Montana.

Sample processing

In the laboratory, standard sorting protocols were applied to achieve representative subsamples of aquatic organisms. Caton sub-sampling devices (Caton 1991), divided into 30 grids, each approximately 5 cm by 6 cm were used. Each individual sample was thoroughly mixed in its jar(s), poured out and evenly spread into the Caton tray, and individual grids were randomly selected. The contents of each grid were examined under stereoscopic microscopes using 10x-30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in 95% ethanol for subsequent identification. The final selected grid was completely sorted of all organisms. All unsorted sample fractions were retained and stored at the Rhithron laboratory.

Organisms were individually examined by certified taxonomists, using 10x – 80x stereoscopic dissecting scopes (Leica S8E and S6E) and identified to target taxonomic levels consistent with B-IBI for Puget Sound Lowlands streams protocols, using appropriate published taxonomic references and keys. Midges (Diptera: Chironomidae) were identified to genus/species group/species and Oligochaetes were identified to genus/species. Identification, counts, life stages, and information about the condition of specimens were recorded on bench sheets. To obtain accuracy in richness measures, organisms that could not be identified to the target level specified were designated as "not unique" if other specimens from the same group could be taken to target levels. Organisms designated as "unique" were those that could be definitively distinguished from other organisms in the sample. Identified organisms were preserved in 95% ethanol in labeled vials, and archived at the Rhithron laboratory.

Midges and worms were carefully morphotyped using 10x – 80x stereoscopic dissecting microscopes (Leica S8E and S6E) and representative specimens were slide mounted and examined at 200x – 1000x magnification using an Olympus BX 51 compound microscope with Hoffman contrast. Slide mounted organisms were archived at the Rhithron laboratory.

Quality control procedures

Quality control procedures for initial sample processing and subsampling involved checking sorting efficiency. These checks were conducted on 100% of the samples by independent observers who microscopically re-examined 20% of sorted substrate from each sample. All organisms that were missed were counted and this number was added to the total number obtained in the original sort. Sorting efficiency was evaluated by applying the following calculation:

$$SE = \frac{n_1}{n_{1+2}} \times 100$$

where: SE is the sorting efficiency, expressed as a percentage, n_1 is the total number of specimens in the first sort, and n_2 is the total number of specimens expected in the second sort, based on the results of the re-sorted 20%.

Quality control procedures for taxonomic determinations of invertebrates involved checking accuracy, precision and enumeration. Two samples were randomly selected and all organisms re-identified and counted by an independent taxonomist. Taxa lists and enumerations were compared by calculating a Bray-Curtis similarity statistic (Bray and Curtis 1957) for each selected sample. Routinely, discrepancies between the original identifications and the QC identifications are discussed among the taxonomists, and necessary rectifications to the data are made. Discrepancies that cannot be rectified by discussions are routinely sent out to taxonomic specialists for identification. For this project, confidence in identifications was high, and discrepancies involved only minor enumeration inaccuracies: no verifications from outside specialists were necessary.

Data analysis

A database application (RAILIS v. 1.2 – Rhithron Associates, Inc.) was used to calculate all B-IBI metrics and scores. RIVPACS scores were obtained by entering data into a web-based application maintained by the Utah State University's Western Center for Monitoring and Assessment of Freshwater Ecosystems. Related applications on this website produce a taxa list from each sample by a random re-sampling routine that standardizes sample sizes. Some taxa are excluded from the analysis. Output from the RIVPACS applications provide a RIVPACS score for each replicate.

Metric and taxonomic signals for sediment deposition, thermal stress, water quality (including the presence of possible metals contamination), and habitat indicators were investigated and described in narrative interpretations. These interpretations of the taxonomic and functional composition of invertebrate assemblages are based on demonstrated associations between assemblage components and habitat and water quality variables gleaned from the published literature, the writer's own research and professional judgment, and those of other expert sources (e.g. Wisseman 1998). These interpretations are not intended to replace canonical procedures for stressor identification, since such procedures require substantial surveys of habitat, and historical and current data related to water quality, land use, point and non-point source influences, soils, hydrology, geology, and other resources that were not readily available for this study. Instead, attributes of invertebrate taxa that are well-substantiated in diverse literature, published and unpublished research, and that are generally accepted by regional aquatic ecologists, are combined into descriptions of probable water quality and instream and reach-scale habitat conditions. The approach to this analysis uses some assemblage attributes that are interpreted as evidence of water quality and other attributes that are interpreted as evidence of habitat integrity. To arrive at impairment classifications, attributes are considered individually, so information is maximized by not relying on a single cumulative score, which may mask stress on the biota.

Water quality variables are estimated by examining mayfly taxa richness and the Hilsenhoff Biotic Index (HBI) value. Other indications of water quality include the richness and abundance of hemoglobin-bearing taxa and the richness of sensitive taxa. Mayfly taxa richness has been demonstrated to be significantly correlated with chemical measures of dissolved oxygen, pH, and conductivity (e.g. Bollman 1998, Fore et al. 1996, Wisseman 1998). The Hilsenhoff Biotic Index (HBI) (Hilsenhoff 1987) has a long history of use and validation (Cairns and Pratt 1993). The index uses the relative abundance of taxa and the tolerance values associated with them to calculate a score representative of the tolerance of a benthic invertebrate assemblage. Higher HBI scores indicate more tolerant assemblages. In one study, the HBI was demonstrated to be significantly associated with conductivity, pH, water temperature, sediment deposition, and the presence of filamentous algae (Bollman 1998). Crops of filamentous algae are also suspected when macroinvertebrates associated or dependent on it (e.g. LeSage and Harrison 1980, Anderson 1976) are abundant. Nutrient enrichment in streams often results in large crops of filamentous algae (Watson 1988). Hemoglobin-bearing taxa are very tolerant of environments with low oxygen concentrations, since the hemoglobin in their circulating fluids enables them to carry more oxygen than organisms without it. Low oxygen concentrations are often a result of nutrient enrichment in situations where enrichment has encouraged excessive plant growth; nocturnal respiration by these plants creates hypoxic conditions. Sensitive taxa exhibit intolerance to a wide range of stressors (e.g. Wisseman 1998, Hellawell 1986, Barbour et al. 1999), including nutrient enrichment, acidification, thermal stress, sediment deposition, habitat disruption, and other causes of degraded ecosystem health. These taxa are expected to be present in predictable numbers in functioning streams.

Thermal characteristics of the sampled site are predicted by the richness and abundance of cold stenotherm taxa (Clark 1997) which require low water temperatures, and by calculation of the predicted temperature preference of the macroinvertebrate assemblage (Brandt 2001). Hemoglobin-bearing taxa are also indicators of warm water temperatures (Walshe 1947). Dissolved oxygen is associated with water temperature (colder water can hold more dissolved oxygen) and can also vary with the degree of nutrient enrichment. Increased temperatures and high nutrient concentrations can, alone or in concert, create conditions favorable to hypoxic sediments, habitats preferred by hemoglobin-bearers.

Metals sensitivity for some groups, especially the heptageniid mayflies, is well-known (e.g. Clements 1999, Clements 2004, Fore 2003). In the present approach, the absence of these groups in environs where they are typically expected to occur is considered a signal of possible metals contamination, especially when these signals are combined with a measure of overall assemblage tolerance of metals. The Metals Tolerance Index (MTI) (McGuire 1998) ranks taxa according to their sensitivity to metals. Weighting taxa by their abundance in a sample, assemblage tolerance is estimated by averaging the tolerance of all sampled individuals. Higher values for the MTI indicate assemblages with greater tolerance to metals contamination.

The condition of instream and streamside habitats is also estimated by characteristics of the macroinvertebrate assemblages. Stress from sediment deposition is evaluated by caddisfly richness and by clinger richness (Kleindl 1995, Bollman 1998, Karr and Chu 1999). A newer tool, the Fine Sediment Biotic Index (FSBI) (Relyea et al. 2000) is also used. Similar to the HBI, tolerance values are assigned to taxa based on the substrate particle sizes with which the taxa are most frequently associated. Scores are determined by weighting these tolerance values by the relative abundance of taxa in a sample. Higher values of the FSBI indicate assemblages with greater fine sediment sensitivity. However, it appears that FSBI values may be influenced by the presence of other deposited material, such as large organic material, including leaves and woody debris.

The functional characteristics of macroinvertebrate assemblages are based on the morphology and behaviors associated with feeding, and are interpreted in terms of the River Continuum Concept (Vannote et al. 1980) in the narratives. Alterations from predicted patterns may be interpreted as evidence of water quality or habitat disruption. For example, shredders and the microbes they depend on are sensitive to modifications of the riparian zone vegetation (Plafkin et al. 1989), and the abundance of invertebrate predators is likely to be related to the diversity of invertebrate prey species, and thus the complexity of instream habitats.

RESULTS

Quality Control Procedures

Results of quality control procedures for subsampling and taxonomy for 2011 samples are given in Table 1. Sorting efficiency averaged 98.8%, and taxonomic precision for identification and enumeration averaged 97.0% for the randomly selected QA samples. These similarity statistics fall within acceptable industry criteria (Stribling et al. 2003).

Data analysis

Taxa lists and counts, and values and scores for standard bioassessment metrics for composited replicate samples are given in the Appendix. Table 2 summarizes B-IBI and RIVPACS scores for sample replicates. B-IBI scores varied from 16 to 30 for City of Bellevue sample replicates collected in 2011. These scores indicated “poor” conditions for 9 of the replicates. Four replicates (Lewis/Ravine 1 and 3, and Vasa 1 and 2) were rated “fair”. B-IBI site scores are graphed in Figure 1. B-IBI site scores are calculated as totaled scores for averaged metric values calculated for each replicate.

RIVPACS scores varied from 0.24 to 0.88. These scores indicated impaired biological conditions in 2011 for 7 sample replicates; the other 6 replicates were scored as unimpaired. RIVPACS scores for replicates were averaged to achieve site scores, which are graphed in Figure 2.

B-IBI scores and RIVPACS results were strongly correlated with each other for the 13 replicates in this study ($r = 0.826$, $p = 0.001$). Figure 3 illustrates this relationship.

Table 1. Results of internal quality control procedures for subsampling and taxonomy. City of Bellevue, 2011.

RAI Sample ID	Station name and replicate number	Alternate station name	Sorting efficiency (%)	Bray-Curtis similarity (%)
CB11LD001	Lewis Creek US/Ravine Rep 1	Lewis/Ravine 1	96.55	
CB11LD002	Lewis Creek US/Ravine Rep 2	Lewis/Ravine 2	100	
CB11LD003	Lewis Creek US/Ravine Rep 3	Lewis/Ravine 3	98.34	95.07
CB11LD004	Vasa Creek at Tribble Rep 1	Vasa 1	96.69	
CB11LD005	Vasa Creek at Tribble Rep 2	Vasa 2	100	
CB11LD006	Vasa Creek at Tribble Rep 3	Vasa 3	100	
CB11LD007	Lewis Creek Elliott Rep 1	Lewis/Elliott 1	99.12	
CB11LD008	Lewis Creek Elliott Rep 2	Lewis/Elliott 2	96.55	98.87
CB11LD009	Lewis Creek Elliott Rep 3	Lewis/Elliott 3	100	
CB11LD010	Sunset/Richards Rep 1	Sunset 1	98.24	
CB11LD011	Sunset/Richards Rep 2	Sunset 2	100	
CB11LD012	Sunset/Richards Rep 3	Sunset 3	99.83	
CB11LD013	Phantom Creek	Phantom	99.13	

Table 2. B-IBI scores for replicates, B-IBI site scores and RIVPACS scores for sample replicates. City of Bellevue, 2011.

RAI Sample ID	Station name and replicate number	Alternate station name	B-IBI replicate score	B-IBI site score	RIVPACS replicate score	RIVPACS site score
CB11LD001	Lewis Creek US/Ravine Rep 1	Lewis/Ravine 1	26	28	0.70	0.73
CB11LD002	Lewis Creek US/Ravine Rep 2	Lewis/Ravine 2	24		0.62	
CB11LD003	Lewis Creek US/Ravine Rep 3	Lewis/Ravine 3	30		0.86	
CB11LD004	Vasa Creek at Tribble Rep 1	Vasa 1	26	24	0.86	0.81
CB11LD005	Vasa Creek at Tribble Rep 2	Vasa 2	30		0.78	
CB11LD006	Vasa Creek at Tribble Rep 3	Vasa 3	24		0.78	
CB11LD007	Lewis Creek Elliott Rep 1	Lewis/Elliott 1	24	24	0.80	0.80
CB11LD008	Lewis Creek Elliott Rep 2	Lewis/Elliott 2	20		0.72	
CB11LD009	Lewis Creek Elliott Rep 3	Lewis/Elliott 3	24		0.88	
CB11LD010	Sunset/Richards Rep 1	Sunset 1	18	16	0.40	0.32
CB11LD011	Sunset/Richards Rep 2	Sunset 2	16		0.24	
CB11LD012	Sunset/Richards Rep 3	Sunset 3	16		0.32	
CB11LD013	Phantom Creek	Phantom	24	24	0.56	0.56

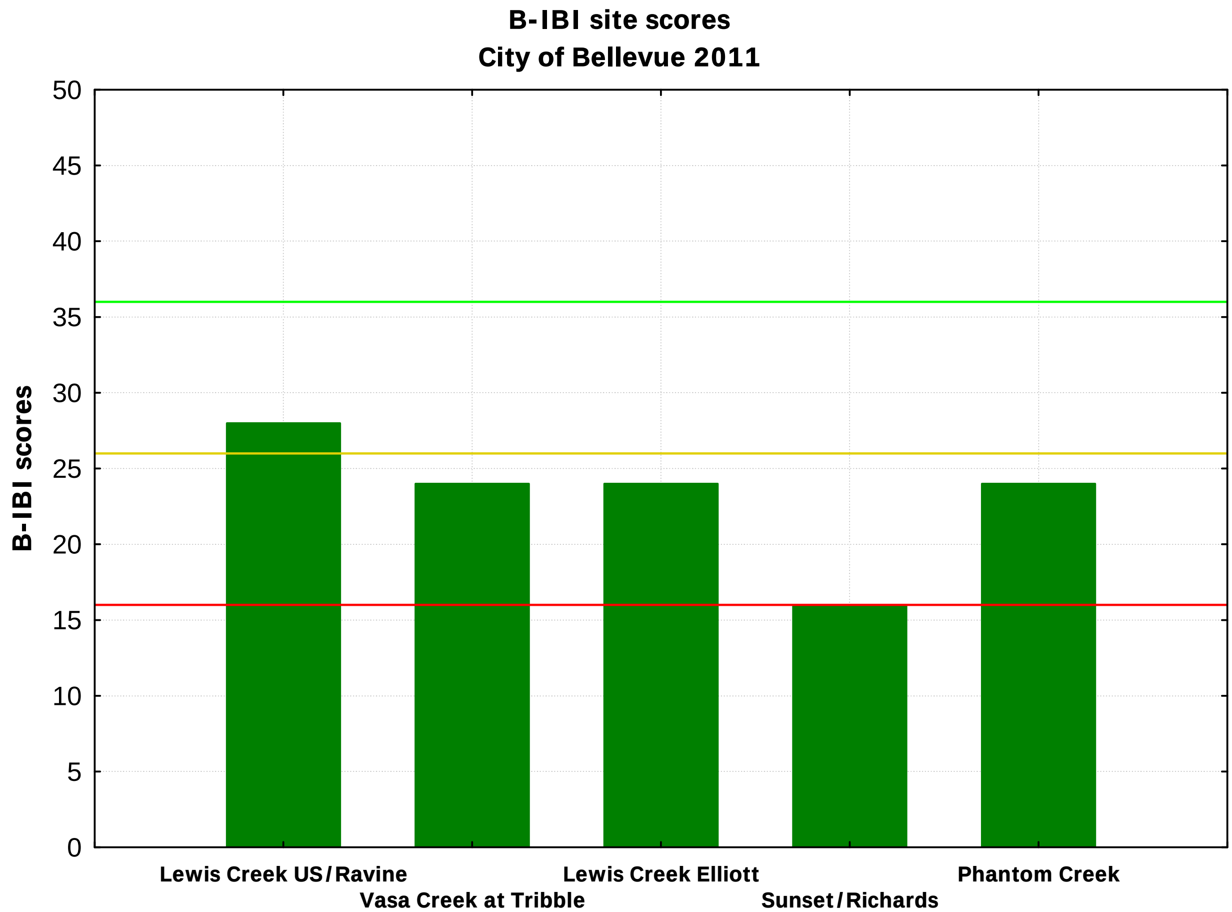

Figure 1. B-IBI site scores for stream sites in the City of Bellevue, 2011. The green line indicates the threshold (B-IBI = 36) for "good" conditions, set by WADOE. Scores below the threshold indicate impaired conditions. The yellow line is the threshold (B-IBI = 26) for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line (B-IBI = 16) indicate "very poor" conditions.

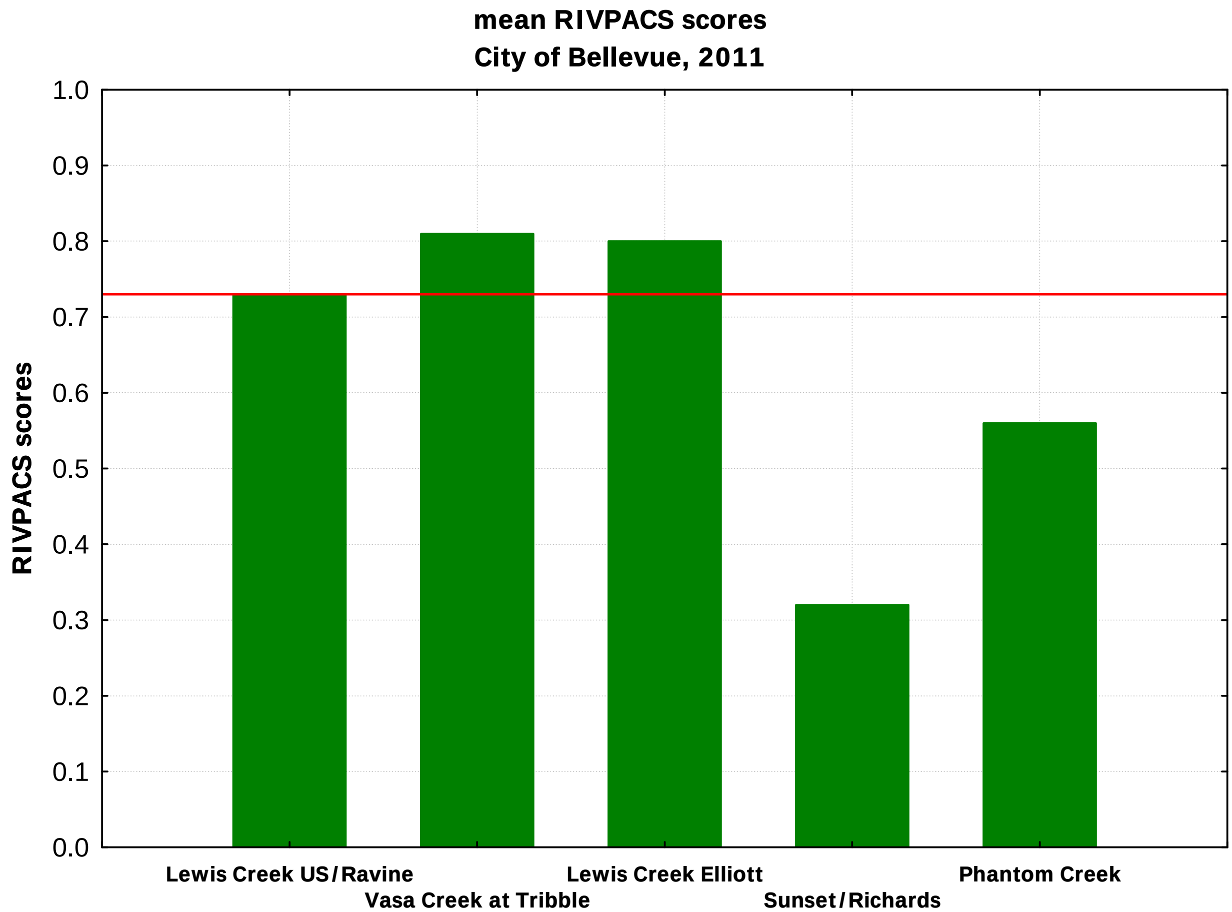

Figure 2. RIVPACS scores for stream sites in the City of Bellevue, 2011. The red line indicates the threshold (RIVPACS = 0.73) for "unimpaired" conditions, set by WADOE. Scores below the threshold indicate impaired conditions.

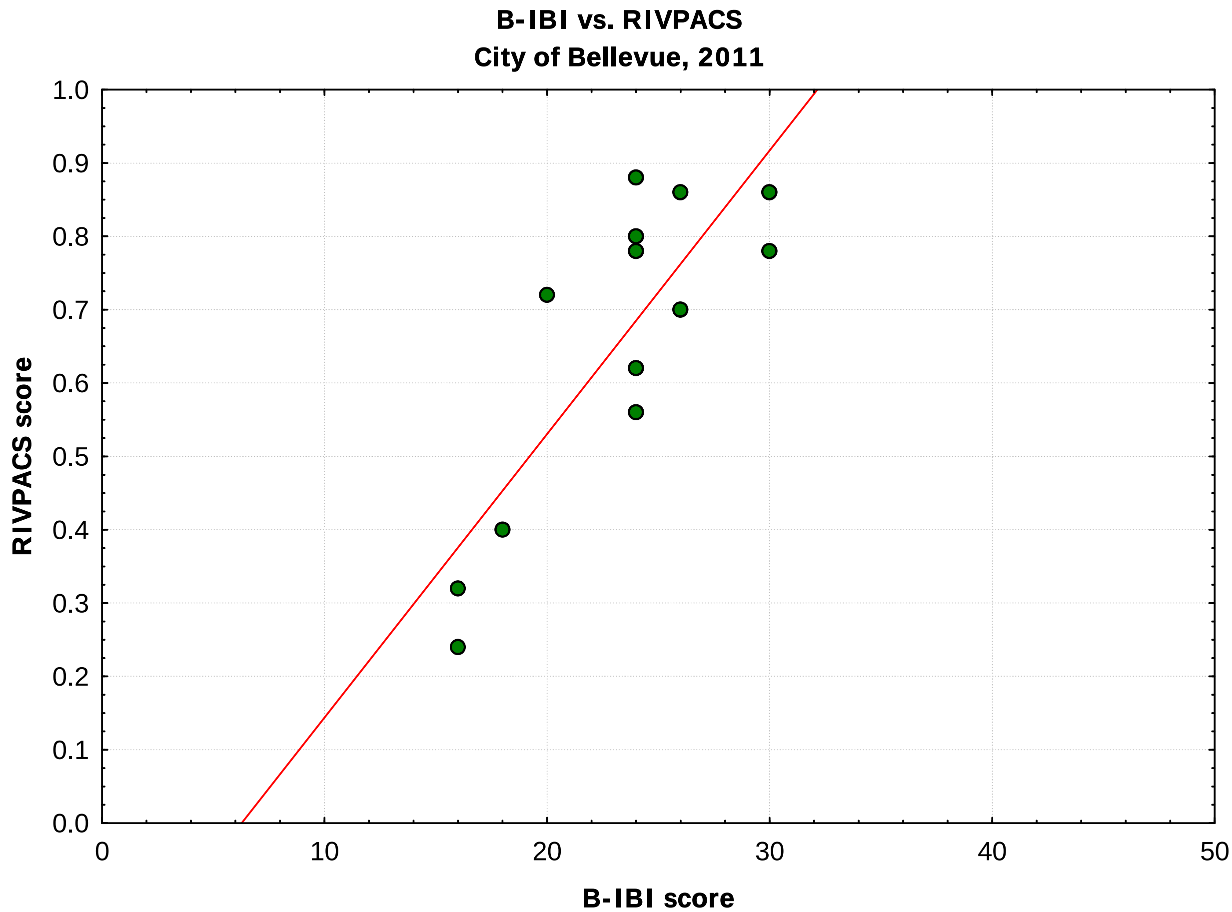

Figure 3. Correlation between B-IBI scores and RIVPACS scores for sites in the City of Bellevue, 2011. The relationship is significant: r= 0.826, p = 0.001.

Aquatic invertebrate assemblage characteristics

Lewis Creek US/Ravine

- **Bioassessment scores: 2011**

The B-IBI site score (28) indicated “fair” biological conditions. The average RIVPACS score (0.73) for sample replicates fell exactly at the lower limit of "unimpaired" conditions.

- **Indicators of ecological condition: 2011**

a. Water quality

The mayfly fauna at this site consisted of 2 taxa: the ubiquitous *Baetis tricaudatus* was abundant; the other taxon, the baetid *Diphetor hageni* was represented by 2 specimens. The biotic index value (3.49) was relatively low, suggesting a sensitive benthic assemblage. However, overall abundance in these samples was low, and midges were the most numerous taxonomic group, accounting for 30% of sampled animals. The hemoglobin-bearing taxon *Polypedilum* sp. was more common than expected, suggesting some areas of hypoxic substrates. Mild nutrient enrichment may be indicated. Several specimens of the turbellarian flatworm *Polycelis coronata* were counted in samples, suggesting that groundwater inputs influenced surface flow here. Although no heptageniid mayflies were collected, the metals tolerance index value (2.75) was low, suggesting that metals contamination did not influence the composition of the benthic assemblage.

b. Thermal condition

No cold stenotherm taxa were collected at this site in 2011. The thermal preference estimated for the invertebrate assemblage was 13.8ºC.

c. Sediment deposition

At least 18 "clinger" taxa were supported in the reach, and caddisflies were diverse (8 taxa). These findings suggest that colonization of stony substrate habitats was not appreciably compromised by fine sediment deposition. The presence of the chloroperlid *Paraperla* sp., which utilizes the hyporheic zone, suggests clean interstitial spaces in the benthic substrates. However, the FSBI value (3.30) indicated a sediment-tolerant assemblage. Abundant nemourid stoneflies (especially *Malenka* sp.) along with 5 other shredder taxa suggest that leafy and woody debris may have littered the benthic substrate.

d. Habitat diversity and integrity

Overall taxa richness (54) was high at this site, which may reflect diverse instream habitat. Six stonefly taxa were collected in 2011; high taxa richness in this group may be related to intact riparian function, unaltered channel morphology, and/or stable streambanks. Samples yielded 3 semivoltine taxa, and none of these was abundant. The site may have been subjected to periodic scour, thermal stress, toxic pollutants or other catastrophes that would interrupt long life cycles. Shredder taxa, especially the nemourid stonefly *Malenka* sp. and the midges *Brillia* sp. and *Polypedilum* spp., were abundant, suggesting that a significant component of the substrate may have been composed of large organic material such as leaves and woody debris. Scrapers were rare, suggesting dense shading of the channel. However, the scarcity of scrapers may also be a reflection of the nature of the benthic substrate: dense cover of stony surfaces by leaf litter or sediment. Gatherers dominated the functional composition of the assemblage.

Vasa Creek at Tribble

- **Bioassessment scores: 2011**

The B-IBI site score for this site was 24, indicating "poor" conditions. In contrast, the RIVPACS result (0.81) indicated unimpaired conditions.

- **Indicators of ecological condition: 2011**

a. Water quality

A single mayfly taxon was collected at the Vasa Creek site in 2011: this was the ubiquitous taxon *Baetis tricaudatus*. Although low mayfly taxa richness suggests impaired water quality, the biotic index value (3.87) was not different from expectations for a Puget Sound Lowlands stream. The moderately-sensitive benthic fauna suggests that water quality was good in this reach. The presence of relatively sensitive taxa such as the stonefly *Sweltsa* sp. and the caddisfly *Glossosoma* sp. also suggest good water quality. The metals tolerance index value (3.79) indicates that metals contamination probably did not influence the biota.

b. Thermal condition

The composition of the benthic fauna suggested cool water temperatures: the calculated preference for the assemblage was 13.7ºC. Cold stenotherm taxa were not well-represented in the samples collected in this reach.

c. Sediment deposition

Fifteen "clinger" taxa and 6 caddisfly taxa were collected: it seems likely that colonization of benthic substrates was not limited by sediment deposition. The FSBI value (4.17) indicated a moderately sediment-tolerant assemblage. The nemourid stonefly *Zapada cinctipes* was abundant, suggesting that leafy and woody debris may have littered the channel floor.

d. Habitat diversity and integrity

Taxa richness (39) was relatively high, suggesting diverse instream habitats. The site supported at least 4 stonefly taxa: high richness in this group may be related to stable streambanks, natural channel morphology, and functional riparian zones. Four semivoltine taxa were collected in 2011; several of these taxa were common in the samples, suggesting stable instream conditions. Scour, toxic inputs, and thermal extremes seem unlikely. The abundance of shredders and the scarcity of scrapers suggest that riparian inputs of leafy and woody debris were ample, and that the channel may have been shaded. All other expected functional components were present in proportions that seemed appropriate for a Puget Sound Lowlands stream.

Lewis Creek - Elliott

- **Bioassessment scores: 2011**

The B-IBI and RIVPACS assessment tools yielded conflicting results for this site. The B-IBI site score for Lewis Creek-Elliot was 24, indicating "poor" biological conditions. The RIVPACS score was 0.80, indicating unimpaired biological conditions.

- **Indicators of ecological condition: 2011**

a. Water quality

Low mayfly taxa richness (2) and elevated biotic index value (4.74) suggest that water quality was impaired in this reach. Large numbers of hemoglobin-bearing midges (*Polypedilum* sp.) were counted in samples, suggesting that hypoxic sediments were present. These findings could be related to warm water temperatures and nutrient enrichment. No sensitive taxa were encountered. The metals tolerance index value (4.04) and the abundance of tanytarsine midges (*Micropsectra* sp. and *Rheotanytarsus* sp.) suggest that metals contamination did not influence the biota here.

b. Thermal condition

Cool water temperatures were suggested by the absence of cold stenotherm taxa and the overall composition of the benthic fauna. The thermal preference calculated for the assemblage was 14.0ºC.

c. Sediment deposition

"Clingers" were represented by 19 taxa, and 7 caddisfly taxa were counted: these findings suggest that stony substrate habitats were probably not compromised by sediment deposition. The FSBI value (4.54) indicated a moderately sediment-tolerant assemblage.

d. Habitat diversity and integrity

Overall taxa richness (45) was high, suggesting that instream habitats were diverse. At least 5 stonefly taxa were supported at this site. High diversity in this group may be related to intact riparian zones, stable streambanks, and unaltered channel morphology. Five semivoltine taxa were collected, suggesting that catastrophic scour, thermal insults, or toxic pollutants did not influence the benthic assemblage. The functional composition of the assemblage was dominated by filterers (especially *Hydropsyche* sp. and *Simulium* sp.), which may be an indication of water quality impairment. Their abundance suggests that fine organic particulates were an important energy source in the reach. The absence of scrapers may be related to dense shading of the channel.

Sunset/Richards

- **Bioassessment scores: 2011**

By either bioassessment method, Sunset/Richards site is evaluated with the lowest scores of any site in this study. The B-IBI site score (16) corresponds to the "poor/very poor" threshold. The RIVPACS score (0.32) also indicated impairment.

- **Indicators of ecological condition: 2011**

a. Water quality

The sample collected at this site was dominated by the blackfly *Simulium* sp., which accounted for 41% of sampled animals. The tolerant amphipod *Crangonyx* sp. was also abundant. A single mayfly taxon was present; this was the ubiquitous *Baetis tricaudatus*. These findings, along with the elevated biotic index value (4.70), are evidence of water quality impairment. No sensitive taxa were present in the samples. The metals tolerance index value (3.97) was not higher than the biotic index value, implying that metals contamination was probably not influential. The functional composition of the assemblage suggests that nutrient enrichment could stress the benthic assemblage.

b. Thermal condition

No cold stenotherm taxa were encountered; some taxa in the sample prefer warmer water temperatures. These taxa include *Crangonyx* sp. and leeches in the family Erpobdellidae. The thermal preference of the assemblage was calculated at 14.0ºC.

c. Sediment deposition

Seven "clinger" taxa were collected, and caddisflies were represented by a single taxon. These findings suggest that there was limited access to stony substrate habitats, which could be due to sediment deposition. Nemourid stoneflies (*Malenka* sp.) were abundant; suggesting that leaf litter and other large organic material may have partially obliterated stony substrates. The FSBI value (3.15) indicated a sediment-tolerant assemblage.

d. Habitat diversity and integrity

Taxa richness (28) was lower than expected for a Puget Sound Lowlands stream, suggesting that instream habitats were limited. The stonefly fauna was limited to 2 taxa; this finding may be related to loss of streambank stability, disturbed riparian zones, or altered channel morphology. Long-lived taxa were poorly represented: a single specimen of the elmid *Narpus concolor* was collected. Catastrophes such as periodic dewatering, scouring sediment pulses, or intermittent inputs of toxic pollutants cannot be ruled out. The functional composition of the benthic assemblage was dominated by filterers (especially *Simulium* sp.) and gatherers. This pattern is sometimes interpreted as evidence of water quality impairment. Scrapers were absent.

Phantom Creek

- **Bioassessment scores: 2011**

A single sample was collected at this site in 2011. The B-IBI site score indicated "poor" biological conditions, and the RIVPACS score (0.56) also indicated impairment.

- **Indicators of ecological condition: 2011**

a. Water quality

The biotic index value (3.09) calculated for these samples was relatively low, implying a sensitive benthic assemblage. However, the mayfly fauna was limited to a single taxon, *Baetis tricaudatus*. The taxonomic composition of the sample suggests that water quality was good in this reach. The metals tolerance index value (3.26) indicates an assemblage that is not likely influenced by metals contamination.

b. Thermal condition

A single cold stenotherm taxon was present in the sample: several specimens of immature leuctrid stoneflies were counted. The thermal preference calculated for this assemblage was 12.4ºC.

c. Sediment deposition

Ten “clinger” taxa and 2 caddisfly taxa suggest that stony substrate habitats may have been degraded by sediment deposition. The nemourid stonefly *Zapada cinctipes* was the dominant taxon, indicating that leafy debris and woody material may account for a large proportion of benthic substrates. The FSBI value (3.52) indicated a moderately sediment-tolerant assemblage.

d. Habitat diversity and integrity

Taxa richness (28) was similar to expectations for a Puget Sound Lowlands stream, particularly considering that there was a single sample. Instream habitats may have been diverse here. At least 4 stonefly taxa were collected, suggesting that reach-scale habitat features such as riparian zones, channel morphology, and streambanks were undisrupted. Four semivoltine taxa were counted: periodic dewatering, scouring sediment pulses, or other catastrophes that would interrupt long life cycles can probably be ruled out. Shredders, mainly the nemourid stoneflies *Zapada cinctipes* and *Malenka* sp., dominated the functional composition of the sample. Scrapers were present, but were not abundant. These findings suggest that riparian shading was influential, and that riparian inputs of organic material were a major energy source in the reach.

DISCUSSION

Water quality perturbations and habitat disruption were indicated at some of the stream sites in the highly urbanized watersheds of the City of Bellevue. However, the benthic assemblage at Vasa Creek did not exhibit evidence of any specific stressors. Two of the 5 sites sampled in 2011 supported benthic invertebrate assemblages that suggested multiple sources of stress. Table 3 summarizes the stressors suggested by the analysis of the taxonomic and functional characteristics of the biotic assemblages. Water quality degradation was apparent at 3 sites, evidenced by low mayfly taxa richness and measures of assemblage tolerance. Mayfly taxa were limited at all Bellevue sites sampled in 2011: only 2 taxa, the ubiquitous *Baetis tricaudatus* and *Diphetor hageni*, were collected in 2011. Water quality problems probably included nutrient enrichment. Habitat disturbance was also suggested for 2 sites.

The B-IBI and RIVPACS tools gave conflicting impairment classifications for 3 of the 5 sites in the study, despite the strong correlation between numeric scores. While the B-IBI indicated impaired conditions at Lewis/Ravine, Vasa, and Lewis/Elliott, RIVPACS scores indicated unimpaired conditions at both Vasa and Lewis/Elliott. The RIVPACS score calculated for Lewis/Ravine fell exactly on the threshold between unimpaired and impaired designations. The ecological interpretations of the benthic assemblages at these sites appeared to support the RIVPACS determination for the Vasa site, while the B-IBI appeared to more correctly assess the Lewis/Ravine and Lewis/Elliott sites.

Table 3. Possible stressors, as suggested by the taxonomic and functional composition of invertebrate assemblages. City of Bellevue, 2011.

Site	water quality degradation	sediment deposition	thermal stress	habitat disruption
Lewis/Ravine	+		?	?
Vasa				
Lewis/Elliott	+			
Sunset/Richards	+	?	?	?
Phantom		?		

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APPENDIX

Taxa lists and metric summaries for composite samples

City of Bellevue, Washington

2011

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC001

RAI No.: CB11LDC001 Sta. Name: Lewis Creek US/Ravine Composite
Client ID:
Date Coll.: 8/2/2011 No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	5	0.76%	Yes	Unknown		5	PR
Nemata	4	0.61%	Yes	Unknown		5	UN
Lymnaeidae							
Pseudosuccinea columella	1	0.15%	Yes	Unknown		11	SC
Planariidae							
Polycelis coronata	8	1.22%	Yes	Unknown		1	OM
Planorbidae							
Planorbidae	2	0.30%	Yes	Immature		6	SC
Sphaeriidae							
Sphaeriidae	1	0.15%	Yes	Unknown		8	CF
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	8	1.22%	Yes	Unknown		4	CG
Fridericia sp.	20	3.04%	Yes	Unknown		11	CG
Mesenchytraeus sp.	2	0.30%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	19	2.89%	Yes	Unknown	Damaged	4	CG
Naididae							
Naididae (Tubificinae) - without capillary setae	1	0.15%	Yes	Immature		11	CG
Nais sp.	12	1.82%	Yes	Unknown		8	CG
Pristina sp.	9	1.37%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis sp.	16	2.43%	No	Larva	Damaged	5	CG
Baetis tricaudatus	58	8.81%	Yes	Larva		4	CG
Diphetor hageni	2	0.30%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Paraperla sp.	1	0.15%	Yes	Larva		1	CG
Sweltsa sp.	14	2.13%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	129	19.60%	Yes	Larva		1	SH
Nemouridae	1	0.15%	No	Larva	Damaged	2	SH
Zapada cinctipes	2	0.30%	Yes	Larva		3	SH
Perlodidae							
Perlodidae	2	0.30%	Yes	Larva	Early Instar	2	PR
Skwala sp.	13	1.98%	Yes	Larva		3	PR

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC001

RAI No.: CB11LDC001 Sta. Name: Lewis Creek US/Ravine Composite
Client ID:
Date Coll.: 8/2/2011 No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Trichoptera							
Glossosomatidae							
Glossosoma sp.	8	1.22%	Yes	Larva		0	SC
Hydropsychidae							
Hydropsyche sp.	10	1.52%	Yes	Larva		5	CF
Hydropsychidae	1	0.15%	No	Pupa		4	CF
Hydropsychidae	7	1.06%	No	Larva	Early Instar	4	CF
Parapsyche almota	3	0.46%	Yes	Larva		3	PR
Lepidostomatidae							
Lepidostoma sp.	4	0.61%	Yes	Larva		1	SH
Philopotamidae							
Wormaldia sp.	1	0.15%	Yes	Larva		0	CF
Rhyacophilidae							
Rhyacophila Betteni Gr.	1	0.15%	Yes	Larva		0	PR
Rhyacophila Brunnea Gr.	17	2.58%	Yes	Larva		2	PR
Rhyacophila narvae	5	0.76%	Yes	Larva		0	PR
Coleoptera							
Elmidae							
Heterlimnius sp.	2	0.30%	Yes	Larva		3	CG
Zaitzevia sp.	1	0.15%	Yes	Adult		5	CG
Diptera							
Ceratopogonidae							
Forcipomyiinae	5	0.76%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	6	0.91%	Yes	Larva		1	CG
Simuliidae							
Simuliidae	2	0.30%	No	Pupa	Damaged	6	CF
Simulium sp.	4	0.61%	No	Pupa		6	CF
Simulium sp.	34	5.17%	Yes	Larva		6	CF
Thaumaleidae							
Thaumaleidae	1	0.15%	Yes	Larva		11	SC
Tipulidae							
Dicranota sp.	16	2.43%	Yes	Larva		3	PR
Tipula sp.	2	0.30%	Yes	Larva		4	SH

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC001

RAI No.: CB11LDC001 | Sta. Name: Lewis Creek US/Ravine Composite
Client ID:
Date Coll.: 8/2/2011 | No. Jars: | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Chironomidae							
Chironomidae							
Boreochlus sp.	18	2.74%	Yes	Larva		1	CG
Brillia sp.	36	5.47%	Yes	Larva		4	SH
Brundiniella eumorpha	1	0.15%	Yes	Larva		8	PR
Corynoneura sp.	3	0.46%	Yes	Larva		7	CG
Eukiefferiella sp.	1	0.15%	Yes	Larva	Early Instar	8	CG
Eukiefferiella Claripennis Gr.	4	0.61%	Yes	Larva		8	CG
Krenosmittia sp.	3	0.46%	Yes	Larva		1	CG
Limnophyes sp.	1	0.15%	Yes	Larva		8	CG
Micropsectra sp.	49	7.45%	Yes	Larva		4	CG
Parametriocnemus sp.	16	2.43%	Yes	Larva		5	CG
Parametriocnemus sp.	1	0.15%	No	Pupa		5	CG
Polypedilum sp.	2	0.30%	No	Pupa		6	SH
Polypedilum sp.	32	4.86%	Yes	Larva		6	SH
Psilometriocnemus triannulatus	1	0.15%	Yes	Larva		11	CG
Reomyia sp.	5	0.76%	Yes	Larva		11	PR
Rheocricotopus sp.	1	0.15%	Yes	Larva		4	CG
Thienemannimyia Gr.	3	0.46%	Yes	Larva		5	PR
Tvetenia sp.	1	0.15%	No	Pupa		5	CG
Tvetenia Bavarica Gr.	17	2.58%	Yes	Larva		5	CG
Zavrelimyia sp.	3	0.46%	Yes	Larva		8	PR
Sample Count	658						

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC002

RAI No.: CB11LDC002 Sta. Name: Vasa Creek at Tribble Composite
Client ID:
Date Coll.: 8/3/2011 No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	13	0.86%	Yes	Unknown		5	PR
Amphipoda	3	0.20%	Yes	Unknown	Damaged	4	CG
Nemata	3	0.20%	Yes	Unknown		5	UN
Crangonyctidae							
Crangonyx sp.	4	0.27%	Yes	Unknown		6	CG
Planariidae							
Polycelis coronata	1	0.07%	Yes	Unknown		1	OM
Planorbidae							
Planorbidae	1	0.07%	Yes	Immature		6	SC
Sphaeriidae							
Sphaeriidae	1	0.07%	Yes	Unknown		8	CF
Oligochaeta							
Enchytraeidae							
Fridericia sp.	50	3.32%	Yes	Unknown		11	CG
Lumbriculidae							
Lumbriculidae	26	1.73%	No	Unknown	Damaged	4	CG
Lumbriculus sp.	2	0.13%	Yes	Unknown		4	CG
Stylodrilus sp.	1	0.07%	Yes	Unknown		4	CG
Ephemeroptera							
Baetidae							
Baetis sp.	23	1.53%	No	Larva	Early Instar	5	CG
Baetis tricaudatus	178	11.81%	Yes	Larva		4	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	23	1.53%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	38	2.52%	Yes	Larva		1	SH
Zapada cinctipes	261	17.32%	Yes	Larva		3	SH
Perlodidae							
Perlodidae	2	0.13%	No	Larva	Early Instar	2	PR
Skwala sp.	16	1.06%	Yes	Larva		3	PR
Trichoptera							
Glossosomatidae							
Glossosoma sp.	53	3.52%	Yes	Larva		0	SC
Glossosomatidae	15	1.00%	No	Pupa		0	SC
Hydropsychidae							
Hydropsyche sp.	330	21.90%	Yes	Larva		5	CF
Hydropsychidae	74	4.91%	No	Larva	Early Instar	4	CF
Hydropsychidae	3	0.20%	No	Pupa		4	CF
Parapsyche almota	22	1.46%	Yes	Larva		3	PR
Limnephilidae							
Dicosmoecus atripes	1	0.07%	Yes	Larva		1	SC
Rhyacophilidae							
Rhyacophila Betteni Gr.	4	0.27%	Yes	Larva		0	PR
Rhyacophila Brunnea Gr.	2	0.13%	Yes	Larva		2	PR

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC002

RAI No.: CB11LDC002 Sta. Name: Vasa Creek at Tribble Composite
Client ID:
Date Coll.: 8/3/2011 No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Coleoptera							
Elmidae							
Lara sp.	5	0.33%	Yes	Larva		1	SH
Narpus concolor	1	0.07%	Yes	Adult		2	CG
Narpus concolor	31	2.06%	No	Larva		2	CG
Diptera							
Empididae							
Clinocera sp.	1	0.07%	Yes	Larva		5	PR
Empididae	1	0.07%	Yes	Larva	Damaged	6	PR
Simuliidae							
Simuliidae	2	0.13%	No	Pupa	Damaged	6	CF
Simulium sp.	1	0.07%	No	Pupa		6	CF
Simulium sp.	66	4.38%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	1	0.07%	Yes	Larva		3	CG
Dicranota sp.	33	2.19%	Yes	Larva		3	PR
Tipula sp.	6	0.40%	Yes	Larva		4	SH
Chironomidae							
Chironomidae							
Apsectrotanypus sp.	2	0.13%	Yes	Larva		8	PR
Brillia sp.	43	2.85%	Yes	Larva		4	SH
Corynoneura sp.	5	0.33%	Yes	Larva		7	CG
Diplocladius cultriger	2	0.13%	Yes	Larva		8	CG
Eukiefferiella sp.	1	0.07%	No	Pupa		8	CG
Eukiefferiella Claripennis Gr.	3	0.20%	Yes	Larva		8	CG
Eukiefferiella tirolensis	7	0.46%	Yes	Larva		8	CG
Micropsectra sp.	20	1.33%	Yes	Larva		4	CG
Parametriocnemus sp.	44	2.92%	Yes	Larva		5	CG
Polypedilum sp.	1	0.07%	No	Pupa		6	SH
Polypedilum sp.	9	0.60%	Yes	Larva		6	SH
Tvetenia sp.	3	0.20%	No	Pupa		5	CG
Tvetenia Bavarica Gr.	69	4.58%	Yes	Larva		5	CG
Sample Count	1507						

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC003

RAI No.: CB11LDC003 | Sta. Name: Lewis Creek Elliott Composite
Client ID:
Date Coll.: 8/8/2011 | No. Jars: | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Nemata	2	0.12%	Yes	Unknown		5	UN
Crangonyctidae							
Crangonyx sp.	3	0.19%	Yes	Unknown		6	CG
Planariidae							
Polycelis coronata	2	0.12%	Yes	Unknown		1	OM
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	1	0.06%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	28	1.75%	Yes	Unknown	Damaged	4	CG
Naididae							
Naididae (Tubificinae) - without capillary setae	1	0.06%	Yes	Immature		11	CG
Nais sp.	43	2.68%	Yes	Unknown		8	CG
Ophidonais serpentina	2	0.12%	Yes	Unknown		6	CG
Pristina sp.	3	0.19%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis sp.	37	2.31%	No	Larva	Early Instar	5	CG
Baetis tricaudatus	265	16.52%	Yes	Larva		4	CG
Diphetor hageni	6	0.37%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	3	0.19%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	16	1.00%	Yes	Larva		1	SH
Nemouridae	1	0.06%	No	Larva	Damaged	2	SH
Zapada cinctipes	5	0.31%	Yes	Larva		3	SH
Perlodidae							
Skwala sp.	5	0.31%	Yes	Larva		3	PR
Trichoptera							
Glossosomatidae							
Glossosoma sp.	2	0.12%	Yes	Larva		0	SC
Glossosomatidae	1	0.06%	Yes	Pupa		0	SC
Hydropsychidae							
Hydropsyche sp.	294	18.33%	Yes	Larva		5	CF
Hydropsychidae	274	17.08%	No	Larva	Early Instar	4	CF
Lepidostomatidae							
Lepidostoma sp.	2	0.12%	Yes	Larva		1	SH
Rhyacophilidae							
Rhyacophila Betteni Gr.	14	0.87%	Yes	Larva		0	PR
Rhyacophila Brunnea Gr.	3	0.19%	Yes	Larva		2	PR
Rhyacophila narvae	1	0.06%	Yes	Larva		0	PR

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC003

RAI No.: CB11LDC003 | Sta. Name: Lewis Creek Elliott Composite
Client ID:
Date Coll.: 8/8/2011 | No. Jars: | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Coleoptera							
Elmidae							
Heterlimnius sp.	4	0.25%	Yes	Larva		3	CG
Narpus concolor	13	0.81%	Yes	Larva		2	CG
Zaitzevia sp.	1	0.06%	Yes	Adult		5	CG
Zaitzevia sp.	1	0.06%	Yes	Larva		5	CG
Psephenidae							
Psephenidae	1	0.06%	Yes	Larva	Early Instar	4	SC
Diptera							
Ceratopogonidae							
Ceratopogoninae	12	0.75%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	3	0.19%	Yes	Larva		1	CG
Empididae							
Clinocera sp.	1	0.06%	Yes	Larva		5	PR
Empididae	2	0.12%	No	Pupa		6	PR
Empididae	1	0.06%	Yes	Larva	Early Instar	6	PR
Simuliidae							
Simulium sp.	4	0.25%	No	Pupa		6	CF
Simulium sp.	137	8.54%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	14	0.87%	Yes	Larva		3	CG
Dicranota sp.	4	0.25%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Brillia sp.	9	0.56%	Yes	Larva		4	SH
Corynoneura sp.	2	0.12%	No	Pupa		7	CG
Corynoneura sp.	4	0.25%	Yes	Larva		7	CG
Eukiefferiella sp.	1	0.06%	No	Pupa		8	CG
Eukiefferiella Claripennis Gr.	11	0.69%	Yes	Larva		8	CG
Micropsectra sp.	88	5.49%	Yes	Larva		4	CG
Orthocladiinae	1	0.06%	Yes	Larva	Early Instar	6	CG
Parametriocnemus sp.	4	0.25%	Yes	Larva		5	CG
Polypedilum sp.	161	10.04%	Yes	Larva		6	SH
Polypedilum sp.	2	0.12%	No	Pupa		6	SH
Rheocricotopus sp.	1	0.06%	Yes	Larva		4	CG
Rheotanytarsus sp.	5	0.31%	No	Pupa		6	CF
Rheotanytarsus sp.	51	3.18%	Yes	Larva		6	CF
Tvetenia Bavarica Gr.	7	0.44%	Yes	Larva		5	CG
Sample Count	1559						

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC004

RAI No.: CB11LDC004   Sta. Name: Sunset/Richards Composite
Client ID:
Date Coll.: 8/9/2011   No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	15	0.88%	Yes	Unknown		5	PR
Amphipoda	42	2.45%	No	Unknown	Damaged	4	CG
Turbellaria	60	3.50%	Yes	Unknown		4	PR
Crangonyctidae							
Crangonyx sp.	215	12.55%	Yes	Unknown		6	CG
Erpobdellidae							
Erpobdellidae	1	0.06%	Yes	Unknown		8	PR
Planariidae							
Polycelis coronata	6	0.35%	Yes	Unknown		1	OM
Sphaeriidae							
Sphaeriidae	1	0.06%	Yes	Unknown		8	CF
Oligochaeta							
Enchytraeidae							
Enchytraeidae	5	0.29%	No	Unknown	Damaged	4	CG
Enchytraeus sp.	5	0.29%	Yes	Unknown		4	CG
Fridericia sp.	4	0.23%	Yes	Unknown		11	CG
Mesenchytraeus sp.	1	0.06%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	37	2.16%	Yes	Unknown	Damaged	4	CG
Naididae							
Naididae (Tubificinae) - without capillary setae	1	0.06%	Yes	Immature		11	CG
Ephemeroptera							
Baetidae							
Baetis sp.	64	3.74%	No	Larva	Early Instar	5	CG
Baetis tricaudatus	196	11.44%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	263	15.35%	Yes	Larva		1	SH
Nemouridae	5	0.29%	No	Larva	Damaged	2	SH
Zapada cinctipes	9	0.53%	Yes	Larva		3	SH
Trichoptera							
Hydropsychidae							
Hydropsychidae	9	0.53%	Yes	Larva	Early Instar	4	CF
Coleoptera							
Elmidae							
Narpus concolor	1	0.06%	Yes	Larva		2	CG

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC004

RAI No.: CB11LDC004 | Sta. Name: Sunset/Richards Composite
Client ID:
Date Coll.: 8/9/2011 | No. Jars: | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Empididae							
Empididae	1	0.06%	Yes	Larva	Early Instar	6	PR
Psychodidae							
Pericoma sp.	1	0.06%	Yes	Larva		4	CG
Simuliidae							
Simuliidae	10	0.58%	No	Pupa	Damaged	6	CF
Simulium sp.	35	2.04%	No	Pupa		6	CF
Simulium sp.	671	39.17%	Yes	Larva		6	CF
Tipulidae							
Dicranota sp.	6	0.35%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Brillia sp.	2	0.12%	Yes	Larva		4	SH
Eukiefferiella sp.	1	0.06%	No	Pupa		8	CG
Eukiefferiella Claripennis Gr.	10	0.58%	Yes	Larva		8	CG
Limnophyes sp.	1	0.06%	Yes	Larva		8	CG
Micropsectra sp.	3	0.18%	Yes	Larva		4	CG
Parametriocnemus sp.	4	0.23%	Yes	Larva		5	CG
Rheocricotopus sp.	1	0.06%	Yes	Larva		4	CG
Rheotanytarsus sp.	4	0.23%	Yes	Larva		6	CF
Tvetenia Bavarica Gr.	23	1.34%	Yes	Larva		5	CG
Sample Count	1713						

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC005

RAI No.: CB11LDC005 | Sta. Name: Phantom Creek Composite
Client ID:
Date Coll.: 8/10/2011 | No. Jars: | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	3	0.55%	Yes	Unknown		5	PR
Amphipoda	1	0.18%	Yes	Unknown	Damaged	4	CG
Turbellaria	1	0.18%	Yes	Unknown		4	PR
Physidae							
Physidae	5	0.92%	Yes	Unknown		8	SC
Planariidae							
Polycelis coronata	1	0.18%	Yes	Unknown		1	OM
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	1	0.18%	Yes	Unknown		4	CG
Fridericia sp.	1	0.18%	Yes	Unknown		11	CG
Lumbriculidae							
Lumbriculidae	8	1.48%	Yes	Unknown	Damaged	4	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	106	19.59%	Yes	Larva		4	CG
Plecoptera							
Chloroperlidae							
Chloroperlidae	2	0.37%	No	Larva	Early Instar	1	PR
Sweltsa sp.	16	2.96%	Yes	Larva		0	PR
Leuctridae							
Leuctridae	2	0.37%	Yes	Larva	Early Instar	0	SH
Nemouridae							
Malenka sp.	40	7.39%	Yes	Larva		1	SH
Nemouridae	13	2.40%	No	Larva	Damaged	2	SH
Zapada cinctipes	191	35.30%	Yes	Larva		3	SH
Trichoptera							
Glossosomatidae							
Glossosoma sp.	17	3.14%	Yes	Larva		0	SC
Glossosomatidae	6	1.11%	No	Pupa		0	SC
Hydropsychidae							
Parapsyche almota	30	5.55%	Yes	Larva		3	PR
Coleoptera							
Elmidae							
Lara sp.	3	0.55%	Yes	Larva		1	SH
Hydraenidae							
Hydraena sp.	1	0.18%	Yes	Adult		5	PR
Hydrophilidae							
Hydrophilidae	1	0.18%	Yes	Larva		5	PR

Taxa Listing

Project ID: CB11LDC
RAI No.: CB11LDC005

RAI No.: CB11LDC005 Sta. Name: Phantom Creek Composite
Client ID:
Date Coll.: 8/10/2011 No. Jars: STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Ceratopogonidae							
Forcipomyiinae	5	0.92%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	19	3.51%	Yes	Larva		1	CG
Simuliidae							
Simulium sp.	2	0.37%	No	Pupa		6	CF
Simulium sp.	10	1.85%	Yes	Larva		6	CF
Tipulidae							
Dicranota sp.	1	0.18%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Brillia sp.	6	1.11%	Yes	Larva		4	SH
Corynoneura sp.	2	0.37%	Yes	Larva		7	CG
Eukiefferiella Claripennis Gr.	4	0.74%	Yes	Larva		8	CG
Micropsectra sp.	9	1.66%	Yes	Larva		4	CG
Parametriocnemus sp.	4	0.74%	Yes	Larva		5	CG
Tvetenia Bavarica Gr.	30	5.55%	Yes	Larva		5	CG
Sample Count	541						

Metrics Report

Project ID: CB11LDC
RAI No.: CB11LDC001
Sta. Name: Lewis Creek US/Ravine Composite
Client ID:
STORET ID
Coll. Date: 8/2/2011

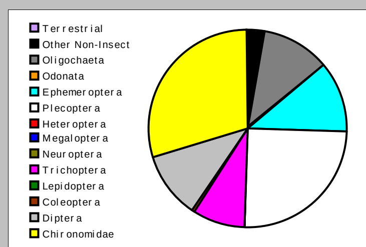
Abundance Measures

Sample Count: 658
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	6	21	3.19%
Oligochaeta	7	71	10.79%
Odonata			
Ephemeroptera	2	76	11.55%
Plecoptera	6	162	24.62%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	8	57	8.66%
Lepidoptera			
Coleoptera	2	3	0.46%
Diptera	6	70	10.64%
Chironomidae	17	198	30.09%

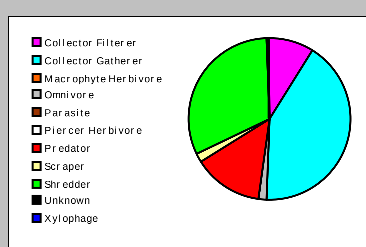


Dominant Taxa

Category	A	PRA
Malenka	129	19.60%
Baetis tricaudatus	58	8.81%
Micropsectra	49	7.45%
Simulium	38	5.78%
Brillia	36	5.47%
Polypedilum	34	5.17%
Fridericia	20	3.04%
Lumbriculidae	19	2.89%
Boreochlus	18	2.74%
Tvetenia Bavarica Gr.	17	2.58%
Rhyacophila Brunnea Gr.	17	2.58%
Parametriocnemus	17	2.58%
Dicranota	16	2.43%
Baetis	16	2.43%
Sweltsa	14	2.13%

Functional Composition

Category	R	A	PRA
Predator	14	93	14.13%
Parasite			
Collector Gatherer	24	273	41.49%
Collector Filterer	4	60	9.12%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	4	12	1.82%
Shredder	6	208	31.61%
Omnivore	1	8	1.22%
Unknown	1	4	0.61%

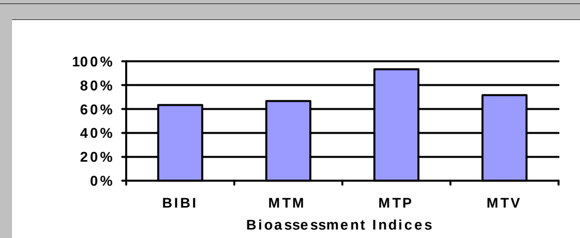


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	54	5	3		3
E Richness	2	1		1	
P Richness	6	3		3	
T Richness	8	3		3	
EPT Richness	16		3		1
EPT Percent	44.83%		2		1
All Non-Insect Abundance	92				
All Non-Insect Richness	13				
All Non-Insect Percent	13.98%				
Oligochaeta+Hirudinea Percent	10.79%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.368				
Dominance					
Dominant Taxon Percent	19.60%		3		3
Dominant Taxa (2) Percent	28.42%				
Dominant Taxa (3) Percent	35.87%	5			
Dominant Taxa (10) Percent	63.53%				
Diversity					
Shannon H (loge)	3.153				
Shannon H (log2)	4.549		3		
Margalef D	8.237				
Simpson D	0.074				
Evenness	0.041				
Function					
Predator Richness	14		3		
Predator Percent	14.13%	3			
Filterer Richness	4				
Filterer Percent	9.12%			2	
Collector Percent	50.61%		3		3
Scraper+Shredder Percent	33.43%		3		1
Scraper/Filterer	0.200				
Scraper/Scraper+Filterer	0.167				
Habit					
Burrower Richness	3				
Burrower Percent	8.66%				
Swimmer Richness	3				
Swimmer Percent	12.46%				
Clinger Richness	18	3			
Clinger Percent	46.81%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness	2				
Hemoglobin Bearer Percent	5.47%				
Air Breather Richness	2				
Air Breather Percent	2.74%				
Voltinism					
Univoltine Richness	25				
Semivoltine Richness	3	3			
Multivoltine Percent	43.92%		2		
Tolerance					
Sediment Tolerant Richness	4				
Sediment Tolerant Percent	5.93%				
Sediment Sensitive Richness	2				
Sediment Sensitive Percent	1.37%				
Metals Tolerance Index	2.754				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	1.06%	5		3	
Hilsenhoff Biotic Index	3.485		3		2
Intolerant Percent	33.13%				
Supertolerant Percent	4.86%				
CTQa	77.409				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	32	64.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	28	93.33%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	13	72.22%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	14	66.67%	Slight



Tuesday, March 06, 2012

Metrics Report

Project ID: CB11LDC
RAI No.: CB11LDC002
Sta. Name: Vasa Creek at Tribble Composite
Client ID:
STORET ID
Coll. Date: 8/3/2011

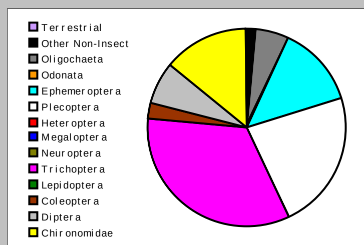
Abundance Measures

Sample Count: 1507
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	7	26	1.73%
Oligochaeta	3	79	5.24%
Odonata			
Ephemeroptera	1	201	13.34%
Plecoptera	4	340	22.56%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	6	504	33.44%
Lepidoptera			
Coleoptera	2	37	2.46%
Diptera	6	111	7.37%
Chironomidae	10	209	13.87%

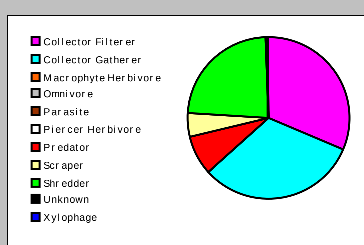


Dominant Taxa

Category	A	PRA
Hydropsyche	330	21.90%
Zapada cinctipes	261	17.32%
Baetis tricaudatus	178	11.81%
Hydropsychidae	77	5.11%
Tvetenia Bavarica Gr.	69	4.58%
Simulium	67	4.45%
Glossosoma	53	3.52%
Fridericia	50	3.32%
Parametriocnemus	44	2.92%
Brillia	43	2.85%
Malenka	38	2.52%
Dicranota	33	2.19%
Narpus concolor	32	2.12%
Lumbriculidae	26	1.73%
Baetis	23	1.53%

Functional Composition

Category	R	A	PRA
Predator	10	119	7.90%
Parasite			
Collector Gatherer	15	474	31.45%
Collector Filterer	3	477	31.65%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	3	70	4.64%
Shredder	6	363	24.09%
Omnivore	1	1	0.07%
Unknown	1	3	0.20%

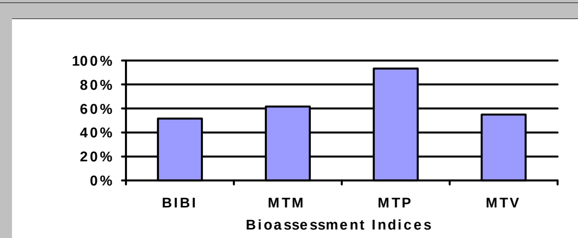


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	39	3	3		3
E Richness	1	1		0	
P Richness	4	3		3	
T Richness	6	3		3	
EPT Richness	11		3		0
EPT Percent	69.34%		3		2
All Non-Insect Abundance	105				
All Non-Insect Richness	10				
All Non-Insect Percent	6.97%				
Oligochaeta+Hirudinea Percent	5.24%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.851				
Dominance					
Dominant Taxon Percent	21.90%		3		3
Dominant Taxa (2) Percent	39.22%				
Dominant Taxa (3) Percent	51.03%	3			
Dominant Taxa (10) Percent	77.77%				
Diversity					
Shannon H (loge)	2.503				
Shannon H (log2)	3.611		3		
Margalef D	5.286				
Simpson D	0.131				
Evenness	0.062				
Function					
Predator Richness	10		3		
Predator Percent	7.90%	1			
Filterer Richness	3				
Filterer Percent	31.65%			0	
Collector Percent	63.11%		2		2
Scraper+Shredder Percent	28.73%		2		1
Scraper/Filterer	0.147				
Scraper/Scraper+Filterer	0.128				
Habit					
Burrower Richness	4				
Burrower Percent	5.24%				
Swimmer Richness	1				
Swimmer Percent	13.34%				
Clinger Richness	15	3			
Clinger Percent	64.43%				
Characteristics					
Cold Stenotherm Richness	1				
Cold Stenotherm Percent	0.07%				
Hemoglobin Bearer Richness	3				
Hemoglobin Bearer Percent	0.86%				
Air Breather Richness	3				
Air Breather Percent	2.65%				
Voltinism					
Univoltine Richness	18				
Semivoltine Richness	4	3			
Multivoltine Percent	28.33%		3		
Tolerance					
Sediment Tolerant Richness	4				
Sediment Tolerant Percent	4.45%				
Sediment Sensitive Richness	1				
Sediment Sensitive Percent	3.52%				
Metals Tolerance Index	3.786				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	0.07%	5		3	
Hilsenhoff Biotic Index	3.873		3		2
Intolerant Percent	11.68%				
Supertolerant Percent	1.06%				
CTQa	69.071				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	26	52.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	28	93.33%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	10	55.56%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	13	61.90%	Slight



Metrics Report

Project ID: CB11LDC
RAI No.: CB11LDC003
Sta. Name: Lewis Creek Elliott Composite
Client ID:
STORET ID
Coll. Date: 8/8/2011

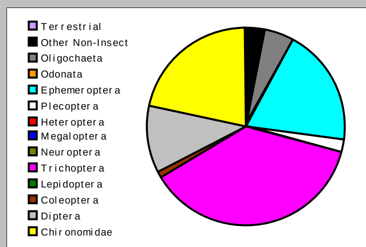
Abundance Measures

Sample Count: 1604
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	4	52	3.24%
Oligochaeta	6	78	4.86%
Odonata			
Ephemeroptera	2	308	19.20%
Plecoptera	4	30	1.87%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	7	591	36.85%
Lepidoptera			
Coleoptera	5	20	1.25%
Diptera	7	178	11.10%
Chironomidae	10	347	21.63%

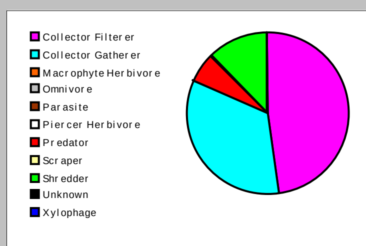


Dominant Taxa

Category	A	PRA
Hydropsyche	294	18.33%
Hydropsychidae	274	17.08%
Baetis tricaudatus	265	16.52%
Polypedilum	163	10.16%
Simulium	141	8.79%
Micropsectra	88	5.49%
Rheotanytarsus	56	3.49%
Acari	45	2.81%
Nais	43	2.68%
Baetis	37	2.31%
Lumbriculidae	28	1.75%
Malenka	16	1.00%
Rhyacophila Betteni Gr.	14	0.87%
Antocha	14	0.87%
Narpus concolor	13	0.81%

Functional Composition

Category	R	A	PRA
Predator	10	91	5.67%
Parasite			
Collector Gatherer	22	544	33.92%
Collector Filterer	3	765	47.69%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	3	4	0.25%
Shredder	5	196	12.22%
Omnivore	1	2	0.12%
Unknown	1	2	0.12%

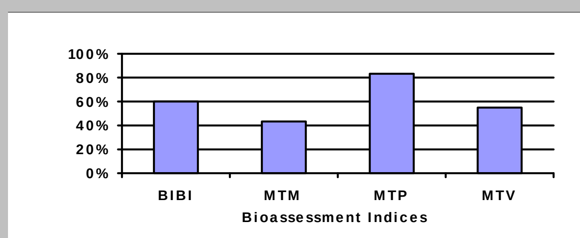


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	45	5	3		3
E Richness	2	1		1	
P Richness	4	3		3	
T Richness	7	3		3	
EPT Richness	13		3		0
EPT Percent	57.92%		3		2
All Non-Insect Abundance	130				
All Non-Insect Richness	10				
All Non-Insect Percent	8.10%				
Oligochaeta+Hirudinea Percent	4.86%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.961				
Dominance					
Dominant Taxon Percent	18.33%		3		3
Dominant Taxa (2) Percent	35.41%				
Dominant Taxa (3) Percent	51.93%	3			
Dominant Taxa (10) Percent	87.66%				
Diversity					
Shannon H (loge)	2.467				
Shannon H (log2)	3.559		3		
Margalef D	6.162				
Simpson D	0.133				
Evenness	0.062				
Function					
Predator Richness	10		3		
Predator Percent	5.67%	1			
Filterer Richness	3				
Filterer Percent	47.69%			0	
Collector Percent	81.61%		1		0
Scraper+Shredder Percent	12.47%		1		0
Scraper/Filterer	0.005				
Scraper/Scraper+Filterer	0.005				
Habit					
Burrower Richness	2				
Burrower Percent	2.31%				
Swimmer Richness	3				
Swimmer Percent	19.39%				
Clinger Richness	19	3			
Clinger Percent	58.48%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness	1				
Hemoglobin Bearer Percent	10.16%				
Air Breather Richness	2				
Air Breather Percent	1.12%				
Voltinism					
Univoltine Richness	23				
Semivoltine Richness	5	5			
Multivoltine Percent	43.89%		2		
Tolerance					
Sediment Tolerant Richness	3				
Sediment Tolerant Percent	2.87%				
Sediment Sensitive Richness	1				
Sediment Sensitive Percent	0.12%				
Metals Tolerance Index	4.043				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	0.12%	5		3	
Hilsenhoff Biotic Index	4.743		3		1
Intolerant Percent	3.80%				
Supertolerant Percent	3.62%				
CTQa	79.351				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	30	60.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	25	83.33%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	10	55.56%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	9	42.86%	Moderate



Metrics Report

Project ID: CB11LDC
RAI No.: CB11LDC004
Sta. Name: Sunset/Richards Composite
Client ID:
STORET ID
Coll. Date: 8/9/2011

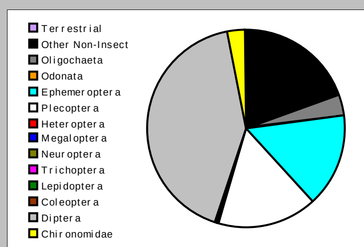
Abundance Measures

Sample Count: 1713
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	6	340	19.85%
Oligochaeta	5	53	3.09%
Odonata			
Ephemeroptera	1	260	15.18%
Plecoptera	2	277	16.17%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	1	9	0.53%
Lepidoptera			
Coleoptera	1	1	0.06%
Diptera	4	724	42.27%
Chironomidae	8	49	2.86%

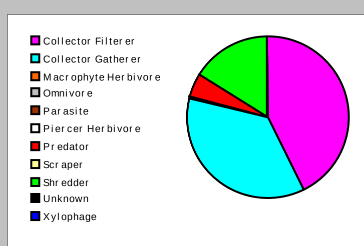


Dominant Taxa

Category	A	PRA
Simulium	706	41.21%
Malenka	263	15.35%
Crangonyx	215	12.55%
Baetis tricaudatus	196	11.44%
Baetis	64	3.74%
Turbellaria	60	3.50%
Amphipoda	42	2.45%
Lumbriculidae	37	2.16%
Tvetenia Bavarica Gr.	23	1.34%
Acari	15	0.88%
Simuliidae	10	0.58%
Eukiefferiella Claripennis Gr.	10	0.58%
Zapada cinctipes	9	0.53%
Hydropsychidae	9	0.53%
Polycelis coronata	6	0.35%

Functional Composition

Category	R	A	PRA
Predator	5	83	4.85%
Parasite			
Collector Gatherer	15	615	35.90%
Collector Filterer	4	730	42.62%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	3	279	16.29%
Omnivore	1	6	0.35%
Unknown			

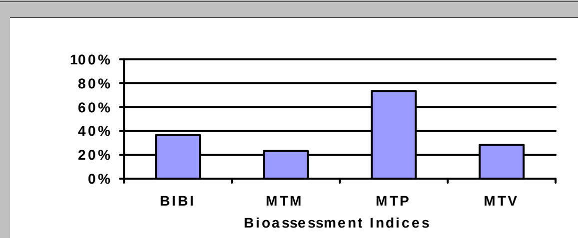


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	28	3	3		2
E Richness	1	1		0	
P Richness	2	1		2	
T Richness	1	1		0	
EPT Richness	4		1		0
EPT Percent	31.87%		2		0
All Non-Insect Abundance	393				
All Non-Insect Richness	11				
All Non-Insect Percent	22.94%				
Oligochaeta+Hirudinea Percent	3.15%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	1.000				
Dominance					
Dominant Taxon Percent	41.21%		2		1
Dominant Taxa (2) Percent	56.57%				
Dominant Taxa (3) Percent	69.12%	3			
Dominant Taxa (10) Percent	94.63%				
Diversity					
Shannon H (loge)	1.784				
Shannon H (log2)	2.574		2		
Margalef D	3.675				
Simpson D	0.253				
Evenness	0.086				
Function					
Predator Richness	5		2		
Predator Percent	4.85%	1			
Filterer Richness	4				
Filterer Percent	42.62%			0	
Collector Percent	78.52%		2		1
Scraper+Shredder Percent	16.29%		2		0
Scraper/Filterer	0.000				
Scraper/Scraper+Filterer	0.000				
Habit					
Burrower Richness	3				
Burrower Percent	2.34%				
Swimmer Richness	1				
Swimmer Percent	15.18%				
Clinger Richness	7	1			
Clinger Percent	58.96%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	2				
Air Breather Percent	0.41%				
Voltinism					
Univoltine Richness	12				
Semivoltine Richness	1	1			
Multivoltine Percent	22.77%		3		
Tolerance					
Sediment Tolerant Richness	2				
Sediment Tolerant Percent	2.51%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	3.974				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	0.06%	5		3	
Hilsenhoff Biotic Index	4.703		3		1
Intolerant Percent	16.05%				
Supertolerant Percent	0.82%				
CTQa	90.429				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	22	73.33%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	5	27.78%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	5	23.81%	Moderate



Tuesday, March 06, 2012

Metrics Report

Project ID: CB11LDC
RAI No.: CB11LDC005
Sta. Name: Phantom Creek Composite
Client ID:
STORET ID
Coll. Date: 8/10/2011

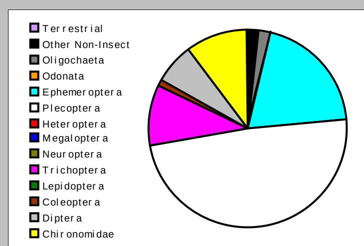
Abundance Measures

Sample Count: 541
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	11	2.03%
Oligochaeta	3	10	1.85%
Odonata			
Ephemeroptera	1	106	19.59%
Plecoptera	4	264	48.80%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	2	53	9.80%
Lepidoptera			
Coleoptera	3	5	0.92%
Diptera	4	37	6.84%
Chironomidae	6	55	10.17%

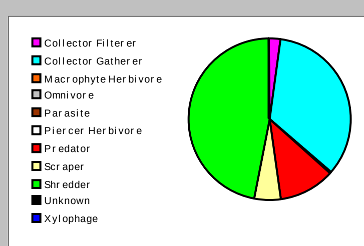


Dominant Taxa

Category	A	PRA
Zapada cinctipes	191	35.30%
Baetis tricaudatus	106	19.59%
Malenka	40	7.39%
Tvetenia Bavarica Gr.	30	5.55%
Parapsyche almota	30	5.55%
Dixa	19	3.51%
Glossosoma	17	3.14%
Sweltsa	16	2.96%
Nemouridae	13	2.40%
Simulium	12	2.22%
Micropsectra	9	1.66%
Lumbriculidae	8	1.48%
Glossosomatidae	6	1.11%
Brillia	6	1.11%
Physidae	5	0.92%

Functional Composition

Category	R	A	PRA
Predator	8	60	11.09%
Parasite			
Collector Gatherer	11	185	34.20%
Collector Filterer	1	12	2.22%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	28	5.18%
Shredder	5	255	47.13%
Omnivore	1	1	0.18%
Unknown			

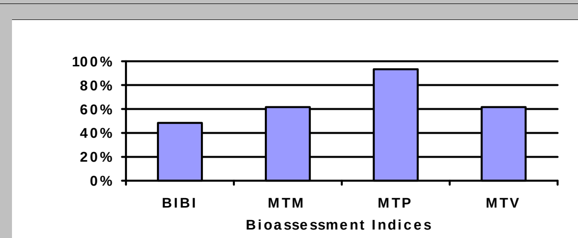


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	28	3	3		2
E Richness	1	1		0	
P Richness	4	3		3	
T Richness	2	1		1	
EPT Richness	7		2		0
EPT Percent	78.19%		3		3
All Non-Insect Abundance	21				
All Non-Insect Richness	8				
All Non-Insect Percent	3.88%				
Oligochaeta+Hirudinea Percent	1.85%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.566				
Dominance					
Dominant Taxon Percent	35.31%		2		1
Dominant Taxa (2) Percent	54.90%				
Dominant Taxa (3) Percent	62.29%	3			
Dominant Taxa (10) Percent	87.62%				
Diversity					
Shannon H (loge)	2.188				
Shannon H (log2)	3.156		3		
Margalef D	4.320				
Simpson D	0.194				
Evenness	0.076				
Function					
Predator Richness	8		3		
Predator Percent	11.09%	3			
Filterer Richness	1				
Filterer Percent	2.22%			3	
Collector Percent	36.41%		3		3
Scraper+Shredder Percent	52.31%		3		2
Scraper/Filterer	2.333				
Scraper/Scraper+Filterer	0.700				
Habit					
Burrower Richness	2				
Burrower Percent	2.59%				
Swimmer Richness	2				
Swimmer Percent	23.11%				
Clinger Richness	10	1			
Clinger Percent	63.22%				
Characteristics					
Cold Stenotherm Richness	1				
Cold Stenotherm Percent	0.37%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	2				
Air Breather Percent	0.37%				
Voltinism					
Univoltine Richness	13				
Semivoltine Richness	4	3			
Multivoltine Percent	30.68%		3		
Tolerance					
Sediment Tolerant Richness	2				
Sediment Tolerant Percent	1.66%				
Sediment Sensitive Richness	1				
Sediment Sensitive Percent	3.14%				
Metals Tolerance Index	3.261				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	0.92%	5		3	
Hilsenhoff Biotic Index	3.089		3		2
Intolerant Percent	22.00%				
Supertolerant Percent	1.66%				
CTQa	77.091				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	24	48.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	28	93.33%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	11	61.11%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	13	61.90%	Slight



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