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

2012

Report to the City of Bellevue, Washington
Utilities Department
Katie Jensen, Project Manager

Prepared by

Wease Bollman
Rhithron Associates, Inc.
Missoula, Montana
April 2013

INTRODUCTION

This report summarizes and interprets aquatic macroinvertebrate data collected in August 2012 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 and other agencies and organizations in the Puget Sound region (http://pugetsoundstreambenthos.org/). 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 11 aquatic invertebrate samples from 5 sites. Replicate samples (3) were collected at 3 sites, while single samples were collected at 2 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 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 assurance (QA) / quality control (QC) procedures

Quality control procedures for initial sample processing and subsampling involved checking sorting efficiency. These checks were conducted on all of the samples by independent observers who microscopically re-examined 25% of the 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 in the second sort. Target efficiency for these samples was 90%. Failure to achieve 90% sorting efficiency for any QC sample triggers the selection of an additional QC sample from the pool of samples sorted by the technician whose sample failed the QC test.

Quality assurance procedures for taxonomic determinations of invertebrates involved checking accuracy, precision and enumeration. Three samples were randomly selected and all organisms re-identified and counted by an independent taxonomist. Taxa lists and enumerations were compared by calculating the Percent Taxonomic Difference (PTD), the Percent Difference in Enumeration (PDE), and 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. However, taxonomic certainty for identifications in this project was high, and no external verifications 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 hypotheses, attributes are considered individually, so information is maximized by not relying on a single cumulative score, which may mask stress on the biota. When replicate samples were collected, data was compiled for the narrative analyses.

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). 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 2012 samples are given in Table 1. Sorting efficiency averaged 98.6%. PDE, PTD, and similarity statistics for the single sample processed for taxonomy QC met Rhithron's internal data quality criteria (Rhithron Associates 2013), and were all well within industry standards for taxonomy data quality (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 20 to 30 for City of Bellevue samples collected in 2012. These scores indicated "poor" conditions for 6 of the 11 samples. Five samples (Lewis RM 0.8 replicates 1, 2, and 3, Coal RM 4.0 replicate 1 and Coal RM 2.3 replicate 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. On the basis of site scores, 2 sites, Lewis RM 0.8 and Coal RM 4.0 were rated "fair". All other sites were rated "poor".

RIVPACS scores varied from 0.48 to 0.89. These scores indicated impaired biological conditions in 2012 for 5 of the 11 samples; the other 6 replicates were scored as unimpaired. RIVPACS scores for replicates were averaged to achieve site scores, which are graphed in Figure 2. Two sites, Lewis RM 0.8 and Coal RM 2.3 were rated as unimpaired on the basis of site scores. All other sites were rated impaired.

B-IBI scores and RIVPACS results were not correlated with each other for the 11 samples in this study ($r = 0.3539$, $p = 0.2856$). Figure 3 illustrates this relationship.

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

Station name and replicate number	Abbreviated station name	Sorting efficiency (%)			Bray-Curtis similarity (%)
Lewis I-90 Rep 1	LewisRM0.8_R1	95.79			
Lewis I-90 Rep 2	LewisRM0.8_R2	99.27			
Lewis I-90 Rep 3	LewisRM0.8_R3	98.41			
Coal Creek Below Parkway Rep 1	CoalRM1.8_R1	97.17			
Coal Creek Below Parkway Rep 2	CoalRM1.8_R2	100	2.82%	0.38%	97.54%
Coal Creek Below Parkway Rep 3	CoalRM1.8_R3	100			
Coal Creek Cindermines Rep 1	CoalRM4.0_R1	99.08			
Coal Creek Trailhead Rep 1	CoalRM2.3_R1	100			
Coal Creek Trailhead Rep 2	CoalRM2.3_R2	97.86			
Coal Creek Trailhead Rep 3	CoalRM2.3_R3	100			
Upper Vasa Creek Rep 1	VasaRM1.9_R1	97.21			

Table 2. B-IBI and RIVPACS scores for replicates and for sites. For sites with replication, B-IBI site scores were calculated by scoring averaged metric values, and RIVPACs site scores were obtained by averaging replicate scores. City of Bellevue, 2012.

Station name and replicate number	Abbreviated station name	B-IBI replicate score	B-IBI site score	RIVPACS replicate score	RIVPACS site score
Lewis I-90 Rep 1	LewisRM0.8_R1	26	26	0.89	0.84
Lewis I-90 Rep 2	LewisRM0.8_R2	26		0.73	
Lewis I-90 Rep 3	LewisRM0.8_R3	30		0.89	
Coal Creek Below Parkway Rep 1	CoalRM1.8_R1	20	20	0.65	0.67
Coal Creek Below Parkway Rep 2	CoalRM1.8_R2	22		0.73	
Coal Creek Below Parkway Rep 3	CoalRM1.8_R3	22		0.65	
Coal Creek Cindermines Rep 1	CoalRM4.0_R1	28	28	0.64	0.64
Coal Creek Trailhead Rep 1	CoalRM2.3_R1	20	22	0.80	0.78
Coal Creek Trailhead Rep 2	CoalRM2.3_R2	28		0.80	
Coal Creek Trailhead Rep 3	CoalRM2.3_R3	24		0.72	
Upper Vasa Creek Rep 1	VasaRM1.9_R1	24	24	0.48	0.48

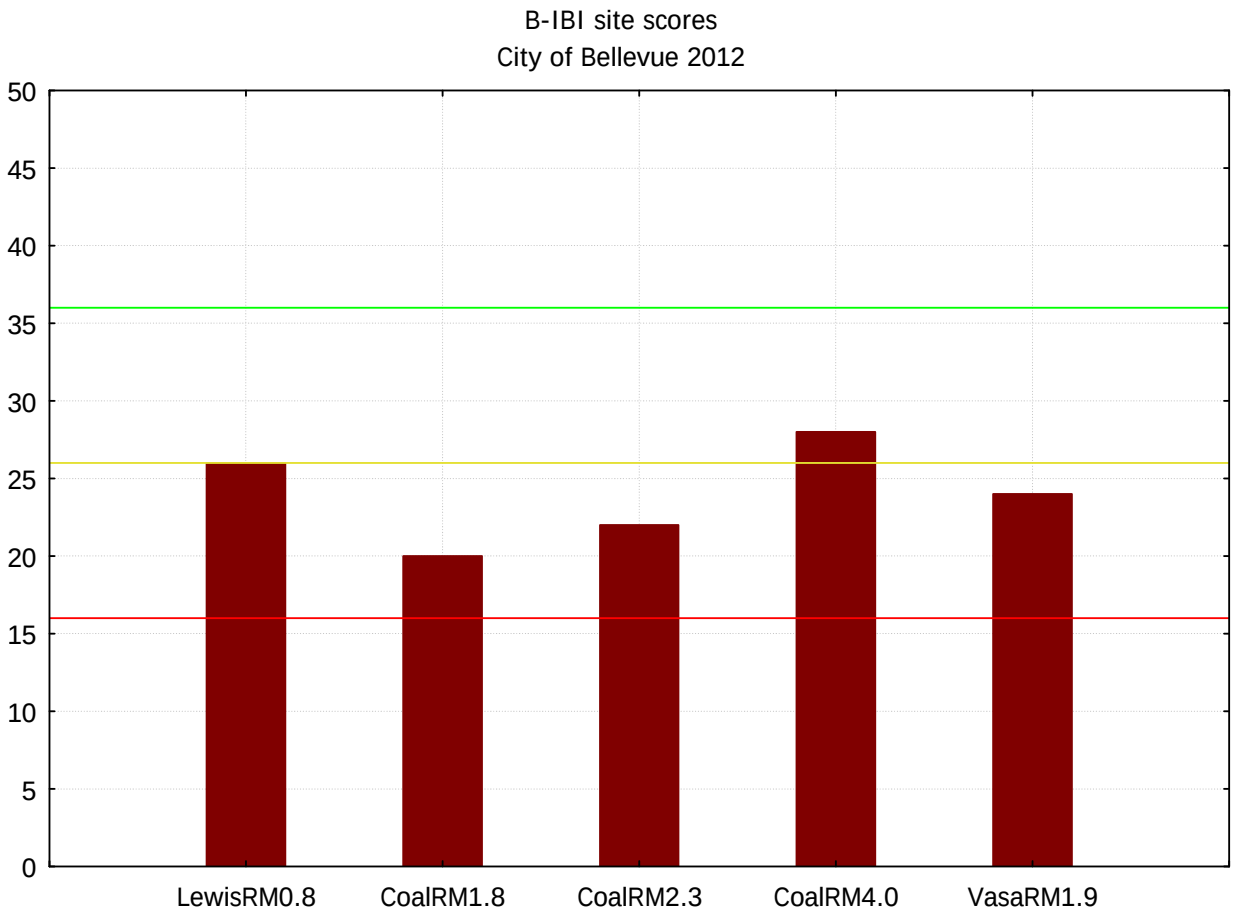


Figure 1. B-IBI site scores for stream sites in the City of Bellevue, 2012. For sites with replicate samples, site scores were calculated by scoring the average metric values across replicates. The green line indicates the threshold (B-IBI = 36) for "good" conditions. Scores below the threshold indicate 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.

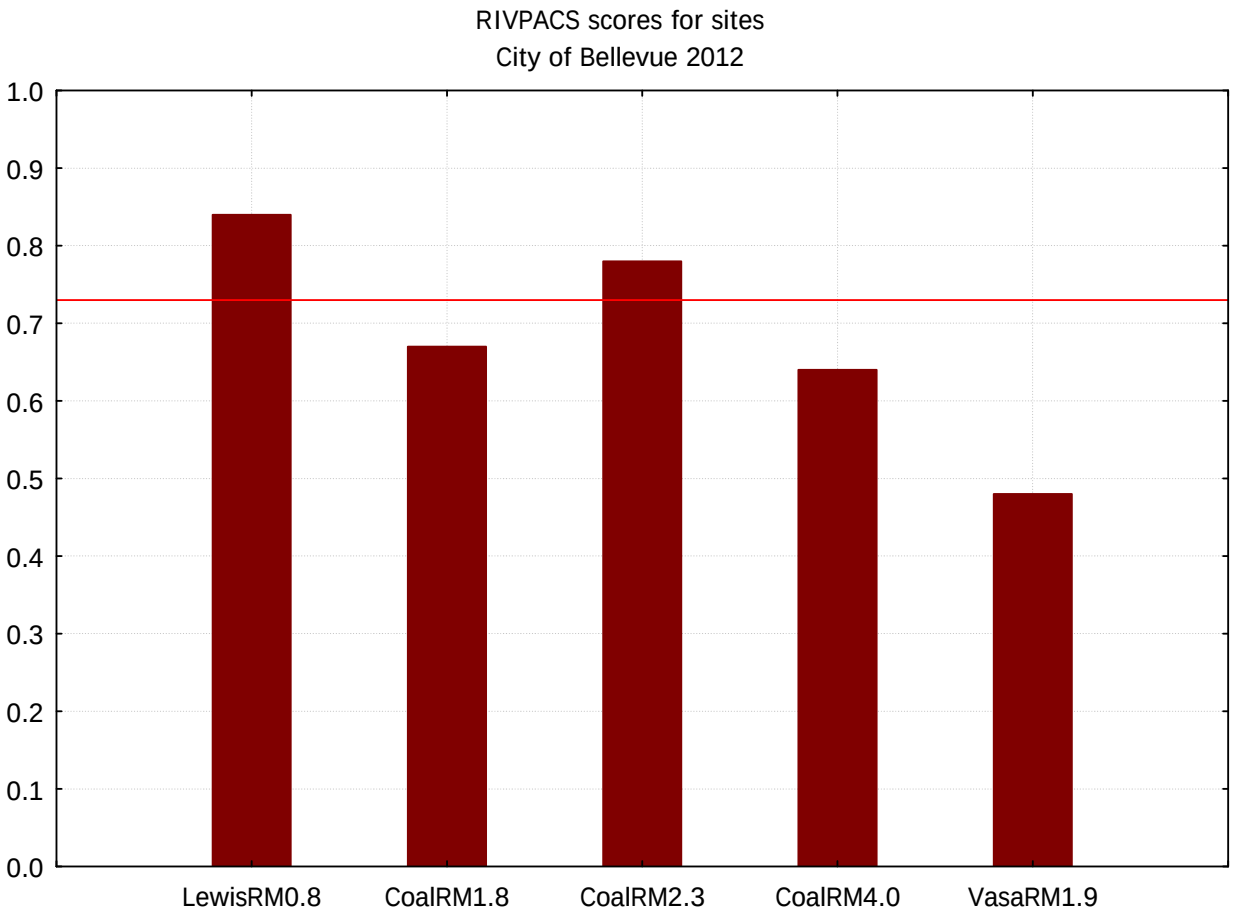


Figure 2. RIVPACS scores for stream sites in the City of Bellevue, 2012. The red line indicates the threshold (RIVPACS = 0.73) for "unimpaired" conditions, set by the Washington Department of Ecology. Scores below the threshold indicate impaired conditions.

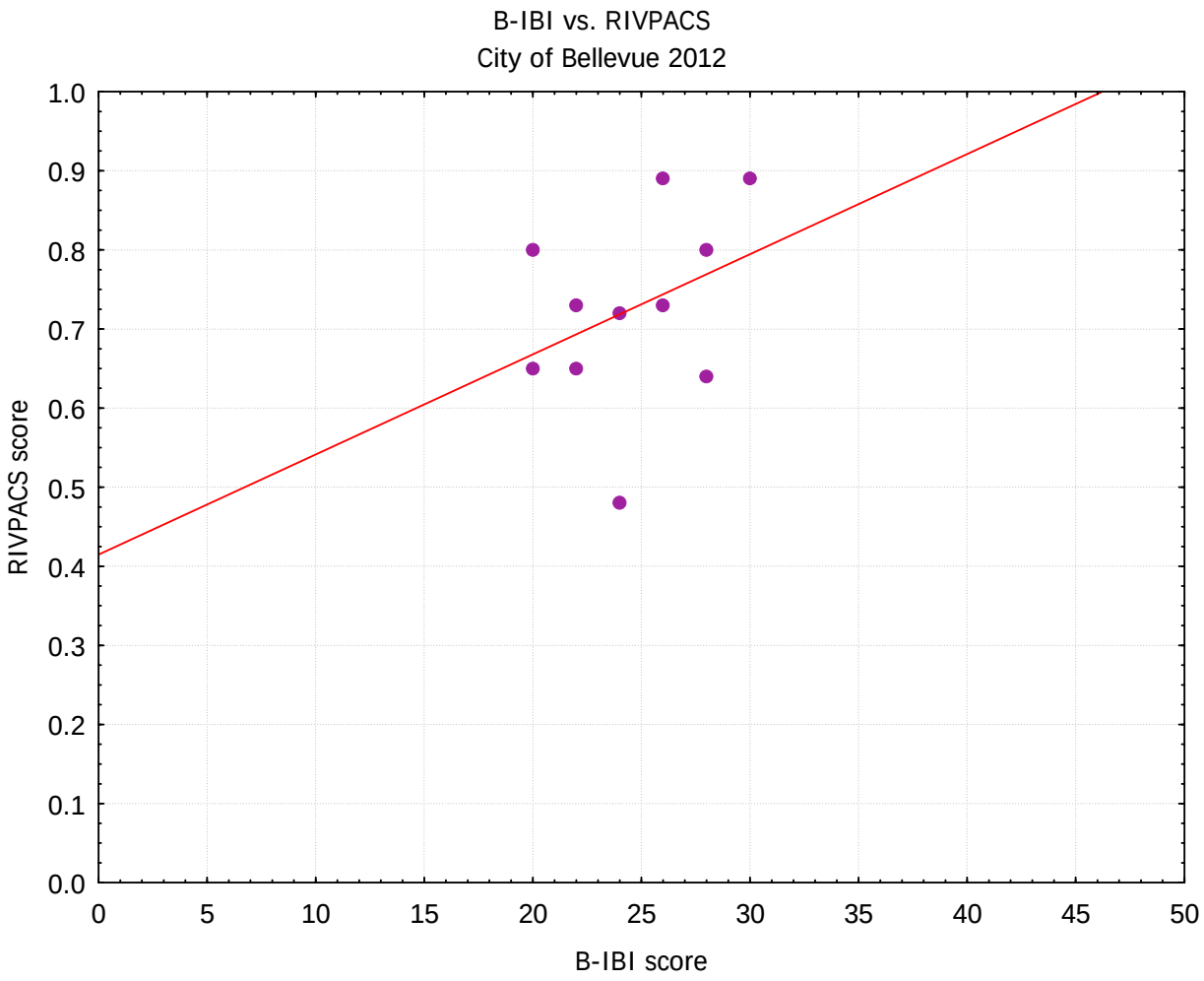


Figure 3. Correlation between B-IBI scores and RIVPACS scores for sites in the City of Bellevue, 2012. The relationship is not significant: r= 0.3539, p = 0.2856.

Aquatic invertebrate assemblage characteristics

Lewis Creek RM 0.8 (Lewis I-90)

- **Bioassessment scores: 2012**

The B-IBI site score (26) indicated "fair" biological conditions. The average RIVPACS score (0.84) for sample replicates indicated unimpaired conditions.

- **Indicators of ecological condition: 2012**

a. Water quality

Three mayfly taxa were counted in the samples collected at this site: these included the ubiquitous *Baetis tricaudatus*, *Diphetor hageni*, and a few specimens of the sensitive cold stenotherm, *Cinygma* sp. The biotic index value (4.25) was moderately elevated above expectations for a Puget Sound Lowlands stream. Mild water quality impairment cannot be ruled out at this site. The hemoglobin-bearing midge *Polypedilum* sp. accounted for nearly 14% of the sampled invertebrates. This finding suggests that hypoxic substrates may be present: these conditions may be associated with nutrient enrichment. Evidence for metals contamination was not apparent.

b. Thermal condition

Three cold stenotherm taxa were collected, but together these taxa accounted for less than 1% of sampled animals. The thermal preference estimated for the invertebrate assemblage was 14.3ºC.

c. Sediment deposition

The site supported at least 21 "clinger" taxa and 7 caddisfly taxa. These findings suggest that sediment deposition did not substantially limit colonization of stony substrates. The FSBI value (4.23) indicated a moderately sediment-intolerant assemblage.

d. Habitat diversity and integrity

Overall taxa richness (59) was high at this site, suggesting diverse instream habitats. Six stonefly taxa were collected in 2012; high taxa richness in this group may be related to intact riparian function, unaltered channel morphology, and/or stable streambanks. Samples yielded 6 semivoltine taxa, and several of these were common. It seems likely that that this site was not subjected to periodic scour, thermal stress, toxic pollutants or other catastrophes that would interrupt long life cycles. All expected functional groups were represented in samples and the proportions of each group appeared to be appropriate for a Puget Sound Lowlands stream.

Coal RM 1.8 (Coal Creek below Parkway)

- **Bioassessment scores: 2012**

The B-IBI site score for this site was 20, indicating "poor" conditions. The RIVPACS result (0.67) also indicated impairment.

- **Indicators of ecological condition: 2012**

a. Water quality

Two mayfly taxa were collected here, including *Baetis tricaudatus*, which was the dominant taxon, accounting for 44% of sampled animals. Low richness in this group, along with the moderately elevated biotic index value (4.49), are evidence that suggests that water quality was impaired here. Evidence for metals contamination was not readily apparent. The functional composition of the assemblage was dominated by gatherers: this is sometimes interpreted as evidence of water quality impairment.

b. Thermal condition

The composition of the benthic fauna suggested cool water temperatures: the calculated preference for the assemblage was 14.3ºC. No cold stenotherm taxa were encountered in the samples.

c. Sediment deposition

Thirteen “clinger” taxa were counted: this is somewhat fewer than expected. Five caddisfly taxa were present, but one of these (*Hydroptila* sp.) is associated with filamentous algae and is typically not influenced by the composition of the benthic substrates. The FSBI value (4.49) was the highest among sites in this study, and indicated a moderately sediment-intolerant assemblage.

d. Habitat diversity and integrity

Taxa richness (49) 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. Only 2 semivoltine taxa were counted, but these were well-represented, suggesting stable instream conditions. Scour, toxic inputs, and thermal extremes seem unlikely.

Coal RM 2.3 (Coal Creek trailhead)

- **Bioassessment scores: 2012**

The B-IBI and RIVPACS assessment tools yielded conflicting results for this site. The B-IBI site score for Coal Creek trailhead was 22, indicating "poor" biological conditions. The RIVPACS score was 0.78, indicating unimpaired biological conditions.

- **Indicators of ecological condition: 2012**

a. Water quality

Low mayfly taxa richness (2) and elevated biotic index value (4.89) suggest that water quality was impaired in this reach. The sample was dominated by tolerant insects, especially the blackfly *Simulium* sp. Metals contamination did not seem likely, based on the taxonomic composition of the assemblage.

b. Thermal condition

Two cold stenotherm taxa were counted, but each was represented by a single specimen. The thermal preference of the assemblage was calculated at 14.4ºC.

c. Sediment deposition

Seventeen "clinger" taxa and 7 caddisfly taxa were present in the samples, suggesting that sediment deposition did not appreciably limit colonization of stony substrate habitats. The FSBI value (3.83) indicated a moderately sediment tolerant assemblage.

d. Habitat diversity and integrity

Overall taxa richness (49) was high, suggesting that instream habitats were diverse. At least 4 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 gatherers (especially *Baetis tricaudatus*) and filterers (especially *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.

Coal Creek RM 4.0 (Coal Creek Cindermines)

- **Bioassessment scores: 2012**

A single, unreplicated sample was collected at Coal Creek RM 4.0. The B-IBI score calculated for this sample indicated "fair" conditions; the RIVPACS indicated impairment.

- **Indicators of ecological condition: 2012**

a. Water quality

Low mayfly taxa richness (2) suggests water quality impairment at this site, but the biotic index value (3.78) was within expectations for a Puget Sound Lowlands stream.

Three sensitive taxa were counted, including the stoneflies *Paraperla* sp. and *Kogotus* sp. It seems likely that water quality was relatively good in this reach.

b. Thermal condition

Two cold stenotherm taxa were encountered. The thermal preference of the assemblage was calculated at 13.7ºC.

c. Sediment deposition

Only 3 caddisfly taxa were counted, but at least 16 “clinger” taxa were present. It seems likely that sediment deposition did not appreciably limit colonization of stony substrate habitats. Nemourid stoneflies (*Zapada cinctipes* and *Malenka* sp.) were abundant; suggesting that leaf litter and other large organic material may have partially obliterated stony substrates, which could account for the dearth of caddisfly taxa. The presence of the hyporheic taxon *Paraperla* sp. suggests that sediment did not prohibit access to interstitial spaces in the substrates. The FSBI value (3.98) indicated a moderately sediment-tolerant assemblage.

d. Habitat diversity and integrity

Taxa richness (38) was high in the single sample collected here. Instream habitats may have been diverse and intact. At least 7 stonefly taxa were supported at this site; richness in this group may be related to streambank stability, intact riparian function, and natural channel morphology. 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 not well-represented: two elmid beetle taxa were collected, but neither was common. 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 gatherers, and shredders were notably abundant, suggesting ample riparian inputs of large organic material.

Vasa Creek RM1.9 (Upper Vasa Creek)

- **Bioassessment scores: 2012**

A single sample was collected at this site in 2012. The B-IBI score (24) generated by this sample indicated "poor" biological conditions, and the RIVPACS score (0.48) also indicated impairment.

- **Indicators of ecological condition: 2012**

a. Water quality

Three mayfly taxa were counted in the sample collected here, and although the biotic index value (3.83) was within expectations for a Puget Sound Lowlands stream, mild water quality impairment cannot be ruled out here. The mayfly fauna included a single specimen of the sensitive cold stenotherm *Cinygma* sp. Several specimens of the turbellarian *Polycelis coronata* were collected, indicating groundwater influences on surface flow.

b. Thermal condition

A single cold stenotherm taxon was present in the sample. The thermal preference calculated for this assemblage was 13.4ºC.

c. Sediment deposition

Sediment deposition may have influenced the invertebrate fauna at this site: only 9 "clinger" taxa and 3 caddisfly taxa were collected. The nemourid stonefly *Malenka* sp. was the dominant taxon, indicating that leafy debris and woody material may account for a large proportion of benthic substrates. The FSBI value (2.94) indicated a sediment-tolerant assemblage.

d. Habitat diversity and integrity

High taxa richness (41) may indicate that instream habitats were diverse here. At least 3 stonefly taxa were collected, suggesting that reach-scale habitat features such as riparian zones, channel morphology, and streambanks were in relatively good condition. Four semivoltine taxa were counted: periodic dewatering, scouring sediment pulses, or other catastrophes that would interrupt long life cycles can probably be ruled out. Gatherers were the dominant feeding group, but shredders, especially Malenka sp., were abundant. Abundant shredders, and few scrapers 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 were indicated at some of the stream sites in the highly urbanized watersheds of the City of Bellevue. One of the 5 sites sampled in 2012 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 4 sites, evidenced by low mayfly taxa richness and measures of assemblage tolerance. Mayfly taxa were limited at all Bellevue sites sampled in 2012. Water quality problems probably included nutrient enrichment. Habitat disturbance was also suggested for 2 sites.

Table 3. Summary of possible stressors, as suggested by the taxonomic and functional composition of invertebrate assemblages. City of Bellevue, 2012.

Site	water quality degradation	sediment deposition	thermal stress	habitat disruption
Lewis RM 0.8	+			
Coal RM 1.8	+			
Coal RM 2.3	+			
Coal RM 4.0				+
Vasa RM 1.9	+	+		

LITERATURE CITED

Anderson, N. H. 1976. The distribution and biology of the Oregon Trichoptera. Oregon Agricultual Experimentation Station Technical Bulletin No. 134: 1-152.

Barbour, M.T., J.Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Washington, D.C.

Bollman, W. 1998. Improving Stream Bioassessment Methods for the Montana Valleys and Foothill Prairies Ecoregion. Master's Thesis (MS). University of Montana. Missoula, Montana.

Brandt, D. 2001. Temperature Preferences and Tolerances for 137 Common Idaho Macroinvertebrate Taxa. Report to the Idaho Department of Environmental Quality, Coeur d' Alene, Idaho.

Bray, J. R. and J. T. Curtis. 1957. An ordination of upland forest communities of southern Wisconsin. Ecological Monographs 27: 325-349.

Cairns, J., Jr. and J. R. Pratt. 1993. A History of Biological Monitoring Using Benthic Macroinvertebrates. Chapter 2 *in* Rosenberg, D. M. and V. H. Resh, eds. *Freshwater Biomonitoring and Benthic Macroinvertebrates*. Chapman and Hall, New York.

Caton, L. W. 1991. Improving subsampling methods for the EPA's "Rapid Bioassessment" benthic protocols. Bulletin of the North American Benthological Society. 8(3): 317-319.

Clark, W.H. 1997. Macroinvertebrate temperature indicators for Idaho. Draft manuscript with citations. Idaho Department of Environmental Quality. Boise, Idaho.

Clements, W. H. 1999. Metal tolerance and predator-prey interactions in benthic stream communities. *Ecological Applications* 9: 1073-1084.

Clements, W. H. 2004. Small-scale experiments support casual relationships between metal contamination and macroinvertebrate community response. *Ecological Applications* 14: 954-967.

Fore, L.S. 2003. Biological assessment of mining disturbance on stream invertebrates in mineralized areas of Colorado. Chapter 19 *in* Simon, T.P. ed. *Biological Response Signatures: Indicator Patterns Using Aquatic Communities.*

Fore, L. S., J. R. Karr and R. W. Wisseman. 1996. Assessing invertebrate responses to human activities: evaluating alternative approaches. *Journal of the North American Benthological Society* 15(2): 212-231.

Hellawell, J. M. 1986. *Biological Indicators of Freshwater Pollution and Environmental Management*. Elsevier, London.

Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. *Great Lakes Entomologist.* 20: 31-39.

Karr, J.R. and E.W. Chu. 1999. *Restoring Life in Running Waters: Better Biological Monitoring.* Island Press. Washington D.C.

King County. 2008. http://www.pugetsoundstreambenthos/BIBI-Scoring-Types.aspx

Kleindl, W.J. 1995. A benthic index of biotic integrity for Puget Sound Lowland Streams, Washington, USA. M.S. Thesis. University of Washington, Seattle, Washington.

LeSage, L. and A. D. Harrison. 1980. The biology of *Cricotopus* (Chironomidae: Orthocladiinae) in an algal-enriched stream. Archiv fur Hydrobiologie Supplement 57: 375-418.

McGuire, D. 1998 cited in Bukantis, R. 1998. Rapid bioassessment macroinvertebrate protocols: Sampling and sample analysis SOP's. Working draft. Montana Department of Environmental Quality. Planning Prevention and Assistance Division. Helena, Montana.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers. Benthic Macroinvertebrates and Fish. EPA 440-4-89-001. Office of Water Regulations and Standards, U.S. Environmental Protection Agency, Washington, D.C.

Relyea, C. D., G.W. Minshall, and R.J. Danehy. 2000. Stream insects as bioindicators of fine sediment. *In:* Proceeding Watershed 2000, Water Environment Federation Specialty Conference. Vancouver, BC.

Rhithron Associates. 2012. Laboratory Quality Assurance Plan. Working draft, version 13.1.d. Rhithron Associates, Inc. Missoula, Montana.

Stribling, J.B., S.R Moulton II and G.T. Lester. 2003. Determining the quality of taxonomic data. J.N. Am. Benthol. Soc. 22(4): 621-631.

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R., and C.E. Cushing. 1980. The river continuum concept. *Canadian Journal of Fisheries and Aquatic Sciences* 37:130-137.

Walshe, J. F. 1947. On the function of haemoglobin in *Chironomus* after oxygen lack. *Journal of Experimental Biology* 24: 329-342.

Watson, V. J. 1988. Control of nuisance algae in the Clark Fork River. Report to Montana Department of Health and Environmental Sciences. Helena, Montana.

Wisseman R.W. 1998. Common Pacific Northwest benthic invertebrate taxa: Suggested levels for standard taxonomic effort: Attribute coding and annotated comments. Unpublished draft. Aquatic Biology Associates, Corvallis, Oregon.

APPENDIX

Taxa lists and metric summaries for composite samples

City of Bellevue, Washington

2012

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC001

RAI No.: CB12LDC001 **Sta. Name:** Lewis I-90
Client ID: LewisRM0.8_2012
Date Coll.: 8/2/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	56	3.61%	Yes	Unknown		5	PR
Hydrozoa	1	0.06%	Yes	Unknown		5	PR
Nemata	60	3.87%	Yes	Unknown		5	UN
Planariidae							
Polycelis coronata	1	0.06%	Yes	Unknown		1	OM
Planorbidae							
Planorbidae	1	0.06%	Yes	Immature		6	SC
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	1	0.06%	Yes	Unknown		4	CG
Mesenchytraeus sp.	1	0.06%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	7	0.45%	Yes	Immature		4	CG
Naididae							
Nais sp.	10	0.65%	Yes	Unknown		8	CG
Pristina sp.	1	0.06%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	168	10.84%	Yes	Larva		4	CG
Diphetor hageni	31	2.00%	Yes	Larva		5	CG
Heptageniidae							
Cinygma sp.	4	0.26%	Yes	Larva		0	SC
Plecoptera							
Chloroperlidae							
Sweltsa sp.	4	0.26%	Yes	Larva		0	PR
Leuctridae							
Leuctridae	1	0.06%	Yes	Larva	Early Instar	0	SH
Nemouridae							
Malenka sp.	19	1.23%	Yes	Larva		1	SH
Zapada cinctipes	10	0.65%	Yes	Larva		3	SH
Perlodidae							
Kogotus sp.	1	0.06%	Yes	Larva		1	PR
Skwala sp.	15	0.97%	Yes	Larva		3	PR

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC001

RAI No.: CB12LDC001 **Sta. Name:** Lewis I-90
Client ID: LewisRM0.8_2012
Date Coll.: 8/2/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Trichoptera							
Glossosomatidae							
Glossosoma sp.	100	6.45%	Yes	Larva		0	SC
Glossosomatidae	63	4.06%	No	Pupa		0	SC
Hydropsychidae							
Hydropsyche sp.	92	5.94%	Yes	Larva		5	CF
Hydropsychidae	1	0.06%	No	Pupa		4	CF
Hydropsychidae	9	0.58%	No	Larva	Early Instar	4	CF
Parapsyche almota	2	0.13%	Yes	Larva		3	PR
Lepidostomatidae							
Lepidostoma sp.	13	0.84%	Yes	Larva		1	SH
Lepidostoma sp.	2	0.13%	No	Pupa		1	SH
Limnephilidae							
Dicosmoecus gilvipes	1	0.06%	Yes	Larva		2	SC
Psychoglypha sp.	3	0.19%	Yes	Larva		0	SH
Rhyacophilidae							
Rhyacophila sp.	1	0.06%	No	Pupa		1	PR
Rhyacophila Betteni Gr.	3	0.19%	Yes	Larva		0	PR
Coleoptera							
Dytiscidae							
Oreodytes sp.	1	0.06%	Yes	Adult		5	PR
Elmidae							
Elmidae	11	0.71%	No	Larva	Early Instar	4	CG
Heterlimnius corpulentus	39	2.52%	No	Larva		3	CG
Heterlimnius corpulentus	3	0.19%	Yes	Adult		3	CG
Narpus concolor	9	0.58%	Yes	Larva		2	CG
Optioservus sp.	1	0.06%	Yes	Adult		5	SC
Zaitzevia sp.	7	0.45%	Yes	Adult		5	CG
Zaitzevia sp.	1	0.06%	No	Larva		5	CG

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC001

RAI No.: CB12LDC001 **Sta. Name:** Lewis I-90
Client ID: LewisRM0.8_2012
Date Coll.: 8/2/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Ceratopogonidae							
Ceratopogoninae	1	0.06%	Yes	Larva		6	PR
Forcipomyiinae	1	0.06%	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	4	0.26%	No	Larva	Early Instar	6	PR
Empididae	7	0.45%	Yes	Pupa		6	PR
Psychodidae							
Maruina sp.	2	0.13%	Yes	Larva		1	SC
Simuliidae							
Simulium sp.	237	15.29%	Yes	Larva		6	CF
Simulium sp.	16	1.03%	No	Pupa		6	CF
Tipulidae							
Antocha monticola	6	0.39%	No	Pupa		3	CG
Antocha monticola	13	0.84%	Yes	Larva		3	CG
Dicranota sp.	6	0.39%	Yes	Larva		3	PR
Limonia sp.	3	0.19%	Yes	Larva		6	SH
Chironomidae							
Chironomidae							
Brillia sp.	46	2.97%	Yes	Larva		4	SH
Chironomini	2	0.13%	No	Pupa	Damaged	6	CG
Corynoneura sp.	1	0.06%	Yes	Pupa		7	CG
Corynoneura sp.	3	0.19%	Yes	Larva		7	CG
Eukiefferiella Claripennis Gr.	4	0.26%	Yes	Larva		8	CG
Eukiefferiella Coerulescens Gr.	2	0.13%	Yes	Larva		8	CG
Eukiefferiella Devonica Gr.	1	0.06%	Yes	Larva		8	CG
Eukiefferiella tirolensis	5	0.32%	Yes	Larva		8	CG
Krenosmittia sp.	1	0.06%	Yes	Larva		1	CG
Krenosmittia sp.	1	0.06%	Yes	Pupa		1	CG
Micropsectra sp.	1	0.06%	No	Pupa		4	CG
Micropsectra sp.	193	12.45%	Yes	Larva		4	CG
Orthocladius sp.	1	0.06%	Yes	Pupa		6	CG
Parametriocnemus sp.	14	0.90%	Yes	Larva		5	CG
Parametriocnemus sp.	1	0.06%	No	Pupa		5	CG
Polypedilum sp.	7	0.45%	No	Pupa		6	SH
Polypedilum sp.	203	13.10%	Yes	Larva		6	SH
Rheotanytarsus sp.	3	0.19%	Yes	Larva		6	CF
Stempellinella sp.	1	0.06%	Yes	Larva		4	CG
Symposiocladius sp.	3	0.19%	Yes	Larva		5	SH
Thienemannimyia Gr.	1	0.06%	Yes	Larva		5	PR
Tvetenia Bavarica Gr.	2	0.13%	Yes	Larva		5	CG
Sample Count	**1550**						

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC002

RAI No.: CB12LDC002 **Sta. Name:** Coal Creek Below Parkway
Client ID: CoalRM1.8_2012
Date Coll.: 8/3/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	58	4.36%	Yes	Unknown		5	PR
Amphipoda	1	0.08%	No	Unknown	Damaged	4	CG
Nemata	1	0.08%	Yes	Unknown		5	UN
Crangonyctidae							
Crangonyx sp.	3	0.23%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	1	0.08%	Yes	Unknown		8	CF
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	3	0.23%	Yes	Unknown		4	CG
Fridericia sp.	4	0.30%	Yes	Unknown		11	CG
Mesenchytraeus sp.	1	0.08%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	2	0.15%	No	Unknown	Damaged	4	CG
Lumbriculidae	24	1.80%	Yes	Immature		4	CG
Lumbriculus sp.	10	0.75%	Yes	Unknown		4	CG
Naididae							
Naididae	2	0.15%	Yes	Immature		8	CG
Naididae	36	2.70%	No	Unknown	Damaged	8	CG
Nais sp.	18	1.35%	Yes	Unknown		8	CG
Tubificinae	12	0.90%	Yes	Immature		11	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	589	44.25%	Yes	Larva		4	CG
Diphetor hageni	39	2.93%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	8	0.60%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	50	3.76%	Yes	Larva		1	SH
Nemouridae	45	3.38%	No	Larva	Damaged	2	SH
Zapada cinctipes	32	2.40%	Yes	Larva		3	SH
Perlodidae							
Skwala sp.	8	0.60%	Yes	Larva		3	PR
Trichoptera							
Hydroptilidae							
Hydroptila sp.	40	3.01%	Yes	Larva		6	PH
Limnephilidae							
Dicosmoecus gilvipes	3	0.23%	Yes	Larva		2	SC
Rhyacophilidae							
Rhyacophila sp.	1	0.08%	No	Pupa		1	PR
Rhyacophila sp.	7	0.53%	Yes	Larva	Early Instar	1	PR
Rhyacophila Betteni Gr.	2	0.15%	Yes	Larva		0	PR
Rhyacophila Brunnea/Vemna Gr.	5	0.38%	Yes	Larva		2	PR

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC002

RAI No.: CB12LDC002 **Sta. Name:** Coal Creek Below Parkway
Client ID: CoalRM1.8_2012
Date Coll.: 8/3/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Coleoptera							
Elmidae							
Elmidae	8	0.60%	No	Larva	Early Instar	4	CG
Heterlimnius corpulentus	7	0.53%	Yes	Adult		3	CG
Heterlimnius corpulentus	26	1.95%	No	Larva		3	CG
Narpus concolor	27	2.03%	No	Larva		2	CG
Narpus concolor	4	0.30%	Yes	Adult		2	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	2	0.15%	Yes	Larva		6	PR
Empididae							
Empididae	2	0.15%	Yes	Larva	Damaged	6	PR
Psychodidae							
Psychodidae	1	0.08%	Yes	Pupa		4	CG
Simuliidae							
Simulium sp.	21	1.58%	No	Pupa		6	CF
Simulium sp.	92	6.91%	Yes	Larva		6	CF
Tipulidae							
Antocha monticola	18	1.35%	Yes	Larva		3	CG
Dicranota sp.	2	0.15%	Yes	Larva		3	PR
Pedicia sp.	1	0.08%	Yes	Larva		6	PR
Tipula sp.	1	0.08%	Yes	Larva		4	SH
Chironomidae							
Chironomidae							
Brillia sp.	7	0.53%	Yes	Larva		4	SH
Corynoneura sp.	3	0.23%	Yes	Larva		7	CG
Eukiefferiella Claripennis Gr.	21	1.58%	Yes	Larva		8	CG
Eukiefferiella Coerulescens Gr.	7	0.53%	Yes	Larva		8	CG
Eukiefferiella Devonica Gr.	1	0.08%	Yes	Larva		8	CG
Heleniella sp.	1	0.08%	Yes	Pupa		6	CG
Heleniella sp.	1	0.08%	Yes	Larva		6	CG
Krenosmittia sp.	1	0.08%	Yes	Larva		1	CG
Limnophyes sp.	1	0.08%	Yes	Larva		8	CG
Micropsectra sp.	12	0.90%	Yes	Larva		4	CG
Micropsectra sp.	1	0.08%	No	Pupa		4	CG
Pagastia sp.	1	0.08%	Yes	Larva		1	CG
Parametriocnemus sp.	5	0.38%	No	Pupa		5	CG
Parametriocnemus sp.	15	1.13%	Yes	Larva		5	CG
Polypedilum sp.	4	0.30%	Yes	Larva		6	SH
Thienemanniella sp.	8	0.60%	Yes	Larva		6	CG
Thienemannimyia Gr.	14	1.05%	Yes	Larva		5	PR
Tvetenia Bavarica Gr.	11	0.83%	Yes	Larva		5	CG
Sample Count	**1331**						

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC003

RAI No.: CB12LDC003 **Sta. Name:** Upper Vasa Creek
Client ID: VasaRM1.9_2012
Date Coll.: 8/7/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	4	0.75%	Yes	Unknown		5	PR
Crangonyctidae							
Crangonyx sp.	34	6.36%	Yes	Unknown		6	CG
Physidae							
Physidae	4	0.75%	Yes	Unknown		8	SC
Planariidae							
Polycelis coronata	7	1.31%	Yes	Unknown		1	OM
Planorbidae							
Promenetus sp.	18	3.36%	Yes	Unknown		6	SC
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	38	7.10%	Yes	Unknown		4	CG
Fridericia sp.	24	4.49%	Yes	Unknown		11	CG
Mesenchytraeus sp.	10	1.87%	Yes	Unknown		4	CG
Lumbriculidae							
Lumbriculidae	40	7.48%	No	Immature		4	CG
Lumbriculus sp.	21	3.93%	Yes	Unknown		4	CG
Naididae							
Naididae	6	1.12%	Yes	Immature		8	CG
Nais sp.	7	1.31%	Yes	Unknown		8	CG
Pristina sp.	1	0.19%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	40	7.48%	Yes	Larva		4	CG
Heptageniidae							
Cinygma sp.	1	0.19%	Yes	Larva		0	SC
Leptophlebiidae							
Paraleptophlebia sp.	2	0.37%	Yes	Larva		1	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	5	0.93%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	89	16.64%	Yes	Larva		1	SH
Nemouridae	35	6.54%	No	Larva	Damaged	2	SH
Zapada cinctipes	9	1.68%	Yes	Larva		3	SH
Trichoptera							
Hydropsychidae							
Parapsyche almota	2	0.37%	Yes	Larva		3	PR
Limnephilidae							
Dicosmoecus gilvipes	1	0.19%	Yes	Larva		2	SC
Psychoglypha sp.	2	0.37%	Yes	Larva		0	SH
Coleoptera							
Elmidae							
Lara sp.	4	0.75%	Yes	Larva		1	SH
Narpus concolor	3	0.56%	Yes	Larva		2	CG

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC003

RAI No.: CB12LDC003 **Sta. Name:** Upper Vasa Creek
Client ID: VasaRM1.9_2012
Date Coll.: 8/7/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Dixidae							
Dixa sp.	5	0.93%	Yes	Larva		1	CG
Simuliidae							
Simulium sp.	50	9.35%	Yes	Larva		6	CF
Tipulidae							
Dicranota sp.	3	0.56%	Yes	Larva		3	PR
Tipula sp.	1	0.19%	Yes	Larva		4	SH
Chironomidae							
Chironomidae							
Boreochlus sp.	2	0.37%	Yes	Larva		1	CG
Brillia sp.	1	0.19%	No	Pupa		4	SH
Brillia sp.	15	2.80%	Yes	Larva		4	SH
Chaetocladius sp.	1	0.19%	Yes	Larva		6	CG
Corynoneura sp.	5	0.93%	Yes	Larva		7	CG
Eukiefferiella Claripennis Gr.	1	0.19%	Yes	Larva		8	CG
Eukiefferiella Coerulescens Gr.	6	1.12%	Yes	Larva		8	CG
Limnophyes sp.	2	0.37%	Yes	Larva		8	CG
Micropsectra sp.	5	0.93%	Yes	Larva		4	CG
Parametriocnemus sp.	10	1.87%	Yes	Larva		5	CG
Polypedilum sp.	2	0.37%	Yes	Larva		6	SH
Radotanypus sp.	1	0.19%	Yes	Larva		7	PR
Reomyia sp.	3	0.56%	Yes	Larva		11	PR
Rheocricotopus sp.	1	0.19%	Yes	Larva		4	CG
Tvetenia sp.	1	0.19%	No	Pupa		5	CG
Tvetenia Bavarica Gr.	13	2.43%	Yes	Larva		5	CG
Sample Count	**535**						

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC004

RAI No.: CB12LDC004 **Sta. Name:** Coal Creek Cindermines
Client ID: CoalRM4.0_2012
Date Coll.: 8/8/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	17	3.25%	Yes	Unknown		5	PR
Oligochaeta							
Lumbriculidae							
Lumbriculus sp.	5	0.96%	Yes	Unknown		4	CG
Stylodrilus sp.	1	0.19%	Yes	Unknown		4	CG
Naididae							
Naidinae	5	0.96%	No	Unknown	Damaged	8	CG
Nais sp.	7	1.34%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	105	20.08%	Yes	Larva		4	CG
Diphetor hageni	11	2.10%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Paraperla sp.	2	0.38%	Yes	Larva		1	CG
Sweltsa sp.	3	0.57%	Yes	Larva		0	PR
Leuctridae							
Leuctridae	1	0.19%	Yes	Larva	Early Instar	0	SH
Nemouridae							
Malenka sp.	13	2.49%	Yes	Larva		1	SH
Nemouridae	34	6.50%	No	Larva	Damaged	2	SH
Zapada cinctipes	90	17.21%	Yes	Larva		3	SH
Perlodidae							
Kogotus sp.	1	0.19%	Yes	Larva		1	PR
Skwala sp.	13	2.49%	Yes	Larva		3	PR
Trichoptera							
Hydropsychidae							
Hydropsychidae	5	0.96%	Yes	Larva	Early Instar	4	CF
Rhyacophilidae							
Rhyacophila sp.	9	1.72%	Yes	Larva	Early Instar	1	PR
Rhyacophila Betteni Gr.	15	2.87%	Yes	Larva		0	PR
Rhyacophila Brunnea/Vemna Gr.	6	1.15%	Yes	Larva		2	PR
Coleoptera							
Elmidae							
Heterlimnius corpulentus	1	0.19%	Yes	Larva		3	CG
Narpus concolor	9	1.72%	Yes	Larva		2	CG

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC004

RAI No.: CB12LDC004 **Sta. Name:** Coal Creek Cindermines
Client ID: CoalRM4.0_2012
Date Coll.: 8/8/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Ceratopogonidae							
Ceratopogoninae	3	0.57%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	2	0.38%	Yes	Larva		1	CG
Empididae							
Empididae	1	0.19%	Yes	Larva	Damaged	6	PR
Simuliidae							
Simulium sp.	9	1.72%	No	Pupa		6	CF
Simulium sp.	33	6.31%	Yes	Larva		6	CF
Tipulidae							
Dicranota sp.	5	0.96%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Brillia sp.	11	2.10%	Yes	Larva		4	SH
Chaetocladius sp.	1	0.19%	Yes	Larva		6	CG
Corynoneura sp.	1	0.19%	Yes	Larva		7	CG
Cricotopus (Cricotopus) sp.	3	0.57%	Yes	Larva		7	SH
Eukiefferiella Claripennis Gr.	2	0.38%	Yes	Larva		8	CG
Heterotrissocladius sp.	2	0.38%	Yes	Larva		0	CG
Micropsectra sp.	61	11.66%	Yes	Larva		4	CG
Micropsectra sp.	1	0.19%	No	Pupa		4	CG
Orthocladiinae	1	0.19%	No	Pupa	Damaged	6	CG
Orthocladiinae	1	0.19%	No	Larva	Early Instar	6	CG
Parametriocnemus sp.	1	0.19%	No	Pupa		5	CG
Parametriocnemus sp.	1	0.19%	Yes	Larva		5	CG
Polypedilum sp.	25	4.78%	Yes	Larva		6	SH
Radotanypus sp.	1	0.19%	Yes	Larva		7	PR
Rheocricotopus sp.	1	0.19%	Yes	Larva		4	CG
Thienemannimyia Gr.	1	0.19%	Yes	Larva		5	PR
Tvetenia Bavarica Gr.	2	0.38%	Yes	Larva		5	CG
Zavrelimyia sp.	1	0.19%	Yes	Larva		8	PR
Sample Count	**523**						

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC005

RAI No.: CB12LDC005 **Sta. Name:** Coal Creek Trailhead
Client ID: CoalRM2.3_2012
Date Coll.: 8/9/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Acari	61	3.81%	Yes	Unknown		5	PR
Nemata	4	0.25%	Yes	Unknown		5	UN
Crangonyctidae							
Crangonyx sp.	1	0.06%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	1	0.06%	Yes	Unknown		8	CF
Oligochaeta							
Lumbriculidae							
Lumbriculus sp.	19	1.19%	Yes	Unknown		4	CG
Naididae							
Naididae	1	0.06%	Yes	Immature		8	CG
Nais sp.	14	0.88%	Yes	Unknown		8	CG
Pristina sp.	1	0.06%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	355	22.19%	Yes	Larva		4	CG
Diphetor hageni	126	7.88%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	2	0.13%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	9	0.56%	Yes	Larva		1	SH
Nemouridae	6	0.38%	No	Larva	Damaged	2	SH
Zapada cinctipes	16	1.00%	Yes	Larva		3	SH
Perlodidae							
Skwala sp.	5	0.31%	Yes	Larva		3	PR
Megaloptera							
Sialidae							
Sialis sp.	1	0.06%	Yes	Larva		4	PR
Trichoptera							
Hydropsychidae							
Hydropsyche sp.	12	0.75%	Yes	Larva		5	CF
Hydropsychidae	16	1.00%	No	Larva	Early Instar	4	CF
Limnephilidae							
Dicosmoecus atripes	1	0.06%	Yes	Larva		1	SC
Dicosmoecus gilvipes	7	0.44%	Yes	Larva		2	SC
Psychoglypha sp.	1	0.06%	Yes	Larva		0	SH
Rhyacophilidae							
Rhyacophila sp.	7	0.44%	Yes	Larva	Early Instar	1	PR
Rhyacophila Betteni Gr.	11	0.69%	Yes	Larva		0	PR
Rhyacophila Brunnea/Vemna Gr.	10	0.63%	Yes	Larva		2	PR

Taxa Listing

Project ID: CB12LDC
RAI No.: CB12LDC005

RAI No.: CB12LDC005 **Sta. Name:** Coal Creek Trailhead
Client ID: CoalRM2.3_2012
Date Coll.: 8/9/2012 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Coleoptera							
Elmidae							
Heterlimnius corpulentus	32	2.00%	No	Larva		3	CG
Heterlimnius corpulentus	1	0.06%	Yes	Adult		3	CG
Lara sp.	1	0.06%	Yes	Larva		1	SH
Narpus concolor	1	0.06%	Yes	Adult		2	CG
Narpus concolor	36	2.25%	No	Larva		2	CG
Zaitzevia sp.	5	0.31%	Yes	Adult		5	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	12	0.75%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	2	0.13%	Yes	Larva		1	CG
Sciomyzidae							
Sciomyzidae	1	0.06%	Yes	Larva		6	PR
Simuliidae							
Simulium sp.	644	40.25%	Yes	Larva		6	CF
Simulium sp.	11	0.69%	No	Pupa		6	CF
Tipulidae							
Antocha monticola	19	1.19%	Yes	Larva		3	CG
Antocha monticola	4	0.25%	No	Pupa		3	CG
Dicranota sp.	2	0.13%	Yes	Larva		3	PR
Limnophila sp.	1	0.06%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Brillia sp.	3	0.19%	Yes	Larva		4	SH
Corynoneura sp.	1	0.06%	Yes	Larva		7	CG
Cricotopus (Cricotopus) sp.	1	0.06%	Yes	Larva		7	SH
Eukiefferiella Claripennis Gr.	7	0.44%	Yes	Larva		8	CG
Eukiefferiella Coerulescens Gr.	10	0.63%	Yes	Larva		8	CG
Heleniella sp.	1	0.06%	Yes	Larva		6	CG
Helopelopia sp.	1	0.06%	Yes	Pupa		11	PR
Krenosmittia sp.	1	0.06%	Yes	Larva		1	CG
Micropsectra sp.	60	3.75%	Yes	Larva		4	CG
Micropsectra sp.	1	0.06%	No	Pupa		4	CG
Pagastia sp.	5	0.31%	Yes	Larva		1	CG
Parametriocnemus sp.	6	0.38%	Yes	Larva		5	CG
Parametriocnemus sp.	2	0.13%	No	Pupa		5	CG
Polypedilum sp.	18	1.13%	Yes	Larva		6	SH
Rheocricotopus sp.	2	0.13%	Yes	Larva		4	CG
Rheotanytarsus sp.	3	0.19%	Yes	Larva		6	CF
Symposiocladius sp.	1	0.06%	Yes	Larva		5	SH
Thienemannimyia Gr.	17	1.06%	No	Larva		5	PR
Tvetenia Bavarica Gr.	1	0.06%	Yes	Larva		5	CG
Sample Count	**1600**						

Metrics Report

Project ID: CB12LDC
RAI No.: CB12LDC001
Sta. Name: Lewis I-90
Client ID: LewisRM0.8_2012
STORET ID
Coll. Date: 8/2/2012

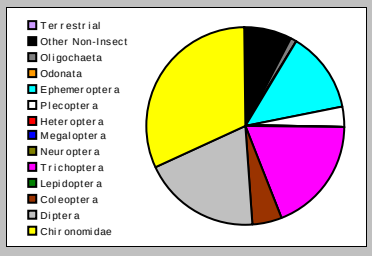
Abundance Measures

Sample Count: 1550
Sample Abundance: of sample used

Coll. Procedure: Surber
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	119	7.68%
Oligochaeta	5	20	1.29%
Odonata			
Ephemeroptera	3	203	13.10%
Plecoptera	6	50	3.23%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	7	290	18.71%
Lepidoptera			
Coleoptera	5	72	4.65%
Diptera	10	300	19.35%
Chironomidae	18	496	32.00%

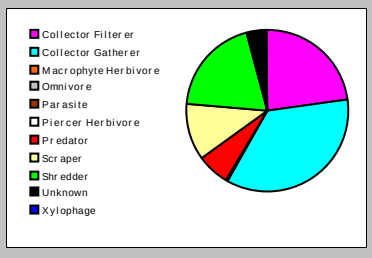


Dominant Taxa

Category	A	PRA
Simulium	253	16.32%
Polypedilum	210	13.55%
Micropsectra	194	12.52%
Baetis tricaudatus	168	10.84%
Glossosoma	100	6.45%
Hydropsyche	92	5.94%
Glossosomatidae	63	4.06%
Nemata	60	3.87%
Acari	56	3.61%
Brillia	46	2.97%
Heterlimnius corpulentus	42	2.71%
Diphetor hageni	31	2.00%
Malenka	19	1.23%
Antocha monticola	19	1.23%
Parametriocnemus	15	0.97%

Functional Composition

Category	R	A	PRA
Predator	14	105	6.77%
Parasite			
Collector Gatherer	25	544	35.10%
Collector Filterer	3	358	23.10%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	6	172	11.10%
Shredder	9	310	20.00%
Omnivore	1	1	0.06%
Unknown	1	60	3.87%

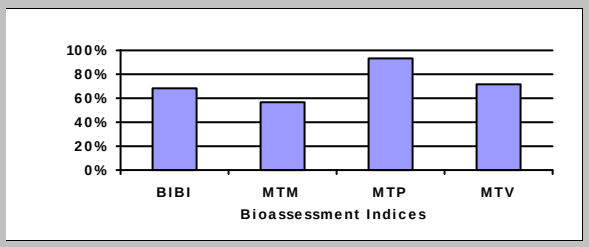


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	59
E Richness	3
P Richness	6
T Richness	7
EPT Richness	16
EPT Percent	35.03%
All Non-Insect Abundance	139
All Non-Insect Richness	10
All Non-Insect Percent	8.97%
Oligochaeta+Hirudinea Percent	1.29%
Baetidae/Ephemeroptera	0.980
Hydropsychidae/Trichoptera	0.359
Dominance	
Dominant Taxon Percent	16.32%
Dominant Taxa (2) Percent	29.87%
Dominant Taxa (3) Percent	42.39%
Dominant Taxa (10) Percent	80.13%
Diversity	
Shannon H (loge)	2.718
Shannon H (log2)	3.922
Margalef D	8.052
Simpson D	0.100
Evenness	0.051
Function	
Predator Richness	14
Predator Percent	6.77%
Filterer Richness	3
Filterer Percent	23.10%
Collector Percent	58.19%
Scraper+Shredder Percent	31.10%
Scraper/Filterer	0.480
Scraper/Scraper+Filterer	0.325
Habit	
Burrower Richness	3
Burrower Percent	3.74%
Swimmer Richness	4
Swimmer Percent	13.10%
Clinger Richness	21
Clinger Percent	56.00%
Characteristics	
Cold Stenotherm Richness	3
Cold Stenotherm Percent	0.52%
Hemoglobin Bearer Richness	2
Hemoglobin Bearer Percent	13.61%
Air Breather Richness	5
Air Breather Percent	2.00%
Voltinism	
Univoltine Richness	29
Semivoltine Richness	6
Multivoltine Percent	52.39%
Tolerance	
Sediment Tolerant Richness	5
Sediment Tolerant Percent	2.32%
Sediment Sensitive Richness	1
Sediment Sensitive Percent	6.45%
Metals Tolerance Index	3.588
Pollution Sensitive Richness	2
Pollution Tolerant Percent	0.84%
Hilsenhoff Biotic Index	4.252
Intolerant Percent	14.97%
Supertolerant Percent	1.48%
CTQa	78.735

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	34	68.00%	
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)	12	57.14%	Slight



Metrics Report

Project ID: CB12LDC
RAI No.: CB12LDC002
Sta. Name: Coal Creek Below Parkway
Client ID: CoalRM1.8_2012
STORET ID
Coll. Date: 8/3/2012

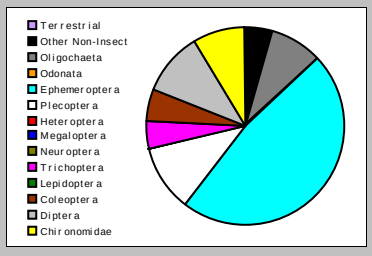
Abundance Measures

Sample Count: 1331
Sample Abundance: of sample used

Coll. Procedure: Surber
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	4	64	4.81%
Oligochaeta	8	112	8.41%
Odonata			
Ephemeroptera	2	628	47.18%
Plecoptera	4	143	10.74%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	5	58	4.36%
Lepidoptera			
Coleoptera	2	72	5.41%
Diptera	8	140	10.52%
Chironomidae	16	114	8.56%

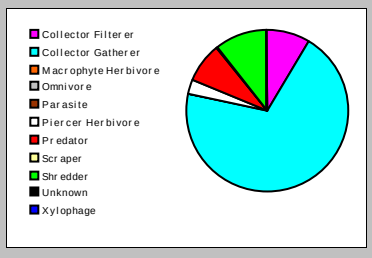


Dominant Taxa

Category	A	PRA
Baetis tricaudatus	589	44.25%
Simulium	113	8.49%
Acari	58	4.36%
Malenka	50	3.76%
Nemouridae	45	3.38%
Hydroptila	40	3.01%
Diphetor hageni	39	2.93%
Naididae	38	2.85%
Heterlimnius corpulentus	33	2.48%
Zapada cinctipes	32	2.40%
Narpus concolor	31	2.33%
Lumbriculidae	26	1.95%
Eukiefferiella Claripennis Gr.	21	1.58%
Parametriocnemus	20	1.50%
Nais	18	1.35%

Functional Composition

Category	R	A	PRA
Predator	11	110	8.26%
Parasite			
Collector Gatherer	28	924	69.42%
Collector Filterer	2	114	8.56%
Macrophyte Herbivore			
Piercer Herbivore	1	40	3.01%
Xylophage			
Scraper	1	3	0.23%
Shredder	5	139	10.44%
Omnivore			
Unknown	1	1	0.08%

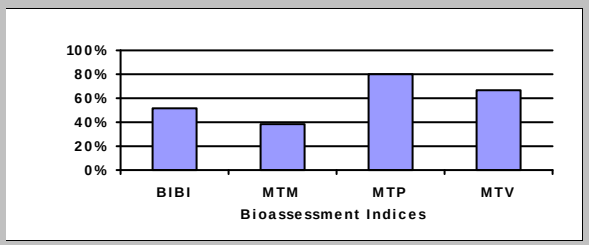


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	49
E Richness	2
P Richness	4
T Richness	5
EPT Richness	11
EPT Percent	62.28%
All Non-Insect Abundance	176
All Non-Insect Richness	12
All Non-Insect Percent	13.22%
Oligochaeta+Hirudinea Percent	8.41%
Baetidae/Ephemeroptera	1.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	44.25%
Dominant Taxa (2) Percent	52.74%
Dominant Taxa (3) Percent	57.10%
Dominant Taxa (10) Percent	77.91%
Diversity	
Shannon H (loge)	2.230
Shannon H (log2)	3.217
Margalef D	6.816
Simpson D	0.274
Evenness	0.058
Function	
Predator Richness	11
Predator Percent	8.26%
Filterer Richness	2
Filterer Percent	8.57%
Collector Percent	77.99%
Scraper+Shredder Percent	10.67%
Scraper/Filterer	0.026
Scraper/Scraper+Filterer	0.026
Habit	
Burrower Richness	6
Burrower Percent	3.46%
Swimmer Richness	2
Swimmer Percent	47.18%
Clinger Richness	13
Clinger Percent	31.10%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	0.30%
Air Breather Richness	5
Air Breather Percent	1.73%
Voltinism	
Univoltine Richness	22
Semivoltine Richness	2
Multivoltine Percent	63.19%
Tolerance	
Sediment Tolerant Richness	5
Sediment Tolerant Percent	3.61%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.219
Pollution Sensitive Richness	0
Pollution Tolerant Percent	3.08%
Hilsenhoff Biotic Index	4.281
Intolerant Percent	11.57%
Supertolerant Percent	6.54%
CTQa	82.658

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	26	52.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	24	80.00%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	12	66.67%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	8	38.10%	Moderate



Metrics Report

Project ID: CB12LDC
RAI No.: CB12LDC003
Sta. Name: Upper Vasa Creek
Client ID: VasaRM1.9_2012
STORET ID
Coll. Date: 8/7/2012

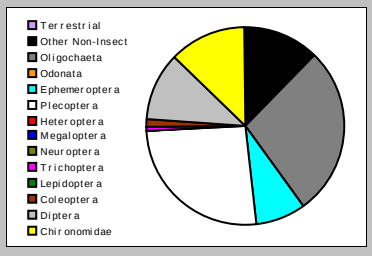
Abundance Measures

Sample Count: 535
Sample Abundance: of sample used

Coll. Procedure: Surber
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	67	12.52%
Oligochaeta	7	147	27.48%
Odonata			
Ephemeroptera	3	43	8.04%
Plecoptera	3	138	25.79%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	3	5	0.93%
Lepidoptera			
Coleoptera	2	7	1.31%
Diptera	4	59	11.03%
Chironomidae	14	69	12.90%

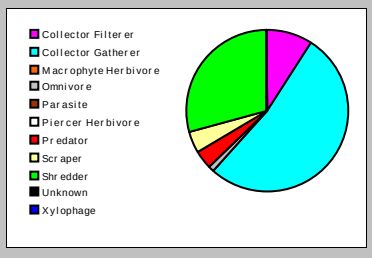


Dominant Taxa

Category	A	PRA
Malenka	89	16.64%
Simulium	50	9.35%
Lumbriculidae	40	7.48%
Baetis tricaudatus	40	7.48%
Enchytraeus	38	7.10%
Nemouridae	35	6.54%
Crangonyx	34	6.36%
Fridericia	24	4.49%
Lumbriculus	21	3.93%
Promenetus	18	3.36%
Brillia	16	2.99%
Tvetenia Bavarica Gr.	13	2.43%
Parametriocnemus	10	1.87%
Mesenchytraeus	10	1.87%
Zapada cinctipes	9	1.68%

Functional Composition

Category	R	A	PRA
Predator	6	18	3.36%
Parasite			
Collector Gatherer	22	278	51.96%
Collector Filterer	1	50	9.35%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	4	24	4.49%
Shredder	7	158	29.53%
Omnivore	1	7	1.31%
Unknown			

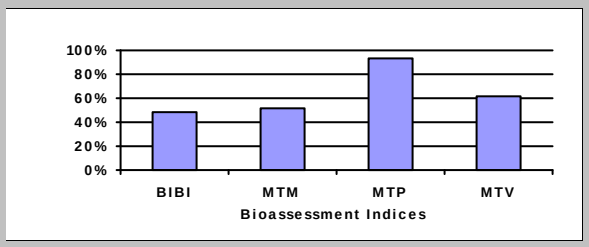


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	41
E Richness	3
P Richness	3
T Richness	3
EPT Richness	9
EPT Percent	34.77%
All Non-Insect Abundance	214
All Non-Insect Richness	12
All Non-Insect Percent	40.00%
Oligochaeta+Hirudinea Percent	27.48%
Baetidae/Ephemeroptera	0.930
Hydropsychidae/Trichoptera	0.400
Dominance	
Dominant Taxon Percent	16.64%
Dominant Taxa (2) Percent	25.98%
Dominant Taxa (3) Percent	33.46%
Dominant Taxa (10) Percent	72.71%
Diversity	
Shannon H (loge)	2.964
Shannon H (log2)	4.276
Margalef D	6.529
Simpson D	0.079
Evenness	0.048
Function	
Predator Richness	6
Predator Percent	3.36%
Filterer Richness	1
Filterer Percent	9.35%
Collector Percent	61.31%
Scraper+Shredder Percent	34.02%
Scraper/Filterer	0.480
Scraper/Scraper+Filterer	0.324
Habit	
Burrower Richness	3
Burrower Percent	14.58%
Swimmer Richness	3
Swimmer Percent	8.79%
Clinger Richness	9
Clinger Percent	37.94%
Characteristics	
Cold Stenotherm Richness	2
Cold Stenotherm Percent	0.56%
Hemoglobin Bearer Richness	3
Hemoglobin Bearer Percent	3.93%
Air Breather Richness	2
Air Breather Percent	0.75%
Voltinism	
Univoltine Richness	17
Semivoltine Richness	4
Multivoltine Percent	22.43%
Tolerance	
Sediment Tolerant Richness	3
Sediment Tolerant Percent	11.59%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	2.818
Pollution Sensitive Richness	1
Pollution Tolerant Percent	4.49%
Hilsenhoff Biotic Index	3.829
Intolerant Percent	29.16%
Supertolerant Percent	5.05%
CTQa	78.593

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)	11	52.38%	Moderate



Metrics Report

Project ID: CB12LDC
RAI No.: CB12LDC004
Sta. Name: Coal Creek Cindermines
Client ID: CoalRM4.0_2012
STORET ID
Coll. Date: 8/8/2012

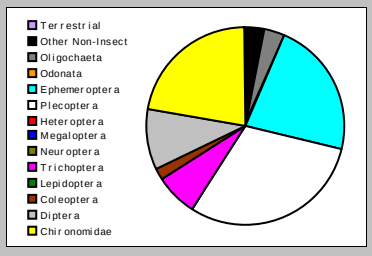
Abundance Measures

Sample Count: 523
Sample Abundance: of sample used

Coll. Procedure: Surber
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	1	17	3.25%
Oligochaeta	3	18	3.44%
Odonata			
Ephemeroptera	2	116	22.18%
Plecoptera	7	157	30.02%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	4	35	6.69%
Lepidoptera			
Coleoptera	2	10	1.91%
Diptera	5	53	10.13%
Chironomidae	14	117	22.37%

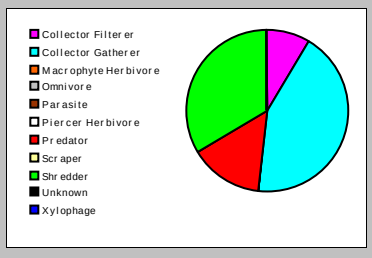


Dominant Taxa

Category	A	PRA
Baetis tricaudatus	105	20.08%
Zapada cinctipes	90	17.21%
Micropsectra	62	11.85%
Simulium	42	8.03%
Nemouridae	34	6.50%
Polypedilum	25	4.78%
Acari	17	3.25%
Rhyacophila Betteni Gr.	15	2.87%
Skwala	13	2.49%
Malenka	13	2.49%
Diphetor hageni	11	2.10%
Brillia	11	2.10%
Rhyacophila	9	1.72%
Narpus concolor	9	1.72%
Nais	7	1.34%

Functional Composition

Category	R	A	PRA
Predator	13	76	14.53%
Parasite			
Collector Gatherer	17	223	42.64%
Collector Filterer	2	47	8.99%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	6	177	33.84%
Omnivore			
Unknown			

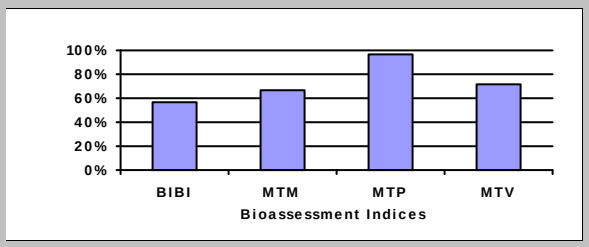


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	38
E Richness	2
P Richness	7
T Richness	4
EPT Richness	13
EPT Percent	58.89%
All Non-Insect Abundance	35
All Non-Insect Richness	4
All Non-Insect Percent	6.69%
Oligochaeta+Hirudinea Percent	3.44%
Baetidae/Ephemeroptera	1.000
Hydropsychidae/Trichoptera	0.143
Dominance	
Dominant Taxon Percent	20.08%
Dominant Taxa (2) Percent	37.28%
Dominant Taxa (3) Percent	49.14%
Dominant Taxa (10) Percent	79.54%
Diversity	
Shannon H (loge)	2.644
Shannon H (log2)	3.815
Margalef D	6.012
Simpson D	0.115
Evenness	0.059
Function	
Predator Richness	13
Predator Percent	14.53%
Filterer Richness	2
Filterer Percent	8.99%
Collector Percent	51.63%
Scraper+Shredder Percent	33.84%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	2
Burrower Percent	3.06%
Swimmer Richness	3
Swimmer Percent	22.56%
Clinger Richness	16
Clinger Percent	59.08%
Characteristics	
Cold Stenotherm Richness	1
Cold Stenotherm Percent	0.19%
Hemoglobin Bearer Richness	2
Hemoglobin Bearer Percent	4.97%
Air Breather Richness	1
Air Breather Percent	0.96%
Voltinism	
Univoltine Richness	16
Semivoltine Richness	2
Multivoltine Percent	47.80%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	0.96%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.340
Pollution Sensitive Richness	3
Pollution Tolerant Percent	0.19%
Hilsenhoff Biotic Index	3.778
Intolerant Percent	18.55%
Supertolerant Percent	2.87%
CTQa	76.300

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	28	56.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	29	96.67%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	13	72.22%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	14	66.67%	Slight



Metrics Report

Project ID: CB12LDC
RAI No.: CB12LDC005
Sta. Name: Coal Creek Trailhead
Client ID: CoalRM2.3_2012
STORET ID
Coll. Date: 8/9/2012

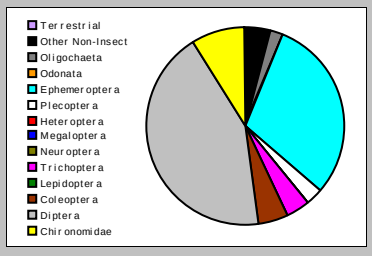
Abundance Measures

Sample Count: 1600
Sample Abundance: of sample used

Coll. Procedure: Surber
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	4	67	4.19%
Oligochaeta	4	35	2.19%
Odonata			
Ephemeroptera	2	481	30.06%
Plecoptera	4	38	2.38%
Heteroptera			
Megaloptera	1	1	0.06%
Neuroptera			
Trichoptera	7	65	4.06%
Lepidoptera			
Coleoptera	4	76	4.75%
Diptera	7	696	43.50%
Chironomidae	16	141	8.81%

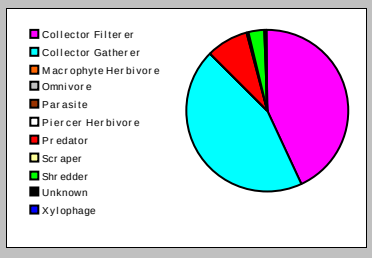


Dominant Taxa

Category	A	PRA
Simulium	655	40.94%
Baetis tricaudatus	355	22.19%
Diphetor hageni	126	7.88%
Micropsectra	61	3.81%
Acari	61	3.81%
Narpus concolor	37	2.31%
Heterlimnius corpulentus	33	2.06%
Antocha monticola	23	1.44%
Lumbriculus	19	1.19%
Polypedilum	18	1.13%
Thienemannimyia Gr.	17	1.06%
Zapada cinctipes	16	1.00%
Hydropsychidae	16	1.00%
Nais	14	0.88%
Ceratopogoninae	12	0.75%

Functional Composition

Category	R	A	PRA
Predator	12	131	8.19%
Parasite			
Collector Gatherer	22	714	44.63%
Collector Filterer	4	687	42.94%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	8	0.50%
Shredder	8	56	3.50%
Omnivore			
Unknown	1	4	0.25%



Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	49
E Richness	2
P Richness	4
T Richness	7
EPT Richness	13
EPT Percent	36.50%
All Non-Insect Abundance	102
All Non-Insect Richness	8
All Non-Insect Percent	6.38%
Oligochaeta+Hirudinea Percent	2.19%
Baetidae/Ephemeroptera	1.000
Hydropsychidae/Trichoptera	0.431
Dominance	
Dominant Taxon Percent	40.94%
Dominant Taxa (2) Percent	63.13%
Dominant Taxa (3) Percent	71.00%
Dominant Taxa (10) Percent	86.75%
Diversity	
Shannon H (loge)	1.977
Shannon H (log2)	2.852
Margalef D	6.579
Simpson D	0.260
Evenness	0.071
Function	
Predator Richness	12
Predator Percent	8.19%
Filterer Richness	4
Filterer Percent	42.94%
Collector Percent	87.56%
Scraper+Shredder Percent	4.00%
Scraper/Filterer	0.012
Scraper/Scraper+Filterer	0.012
Habit	
Burrower Richness	4
Burrower Percent	1.50%
Swimmer Richness	3
Swimmer Percent	30.19%
Clinger Richness	17
Clinger Percent	57.06%
Characteristics	
Cold Stenotherm Richness	2
Cold Stenotherm Percent	0.13%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	1.13%
Air Breather Richness	3
Air Breather Percent	1.63%
Voltinism	
Univoltine Richness	21
Semivoltine Richness	5
Multivoltine Percent	42.88%
Tolerance	
Sediment Tolerant Richness	3
Sediment Tolerant Percent	1.63%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.211
Pollution Sensitive Richness	1
Pollution Tolerant Percent	0.38%
Hilsenhoff Biotic Index	4.891
Intolerant Percent	6.25%
Supertolerant Percent	2.13%
CTQa	79.526

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	30	60.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	22	73.33%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	11	61.11%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	5	23.81%	Moderate