BIOLOGICAL ASSESSMENT OF STREAM SITES IN THE CITY OF BELLEVUE, BASED ON MACROINVERTEBRATE ASSEMBLAGES

Report to the City of Bellevue, Washington
Utilities Department
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INTRODUCTION

This brief report summarizes and interprets aquatic macroinvertebrate data collected in August 2009 at stream sites in the City of Bellevue, King County, Washington. The methods employed for sample processing and analyses are the same as those used for the summary report of October 2009 (Bollman 2009), in which data from 7 years of similar collections were summarized. The objectives of these studies 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 2008a). 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 20 aquatic invertebrate samples from 6 sites on 4 streams. The City's standard procedure for sampling was described in the summary report (Bollman 2009). Three or 4 replicate samples were collected at each site using a Surber sampler. Samples were processed and invertebrates identified by Rhithron Associates, Missoula, Montana.

Sample processing

Upon arrival at the Rhithron laboratory, samples were unpacked and examined, and checked against the inventory provided by City of Bellevue project managers. An inventory spreadsheet that included project code and internal laboratory identification numbers was created and uploaded into the Rhithron database.

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. 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.

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.

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.

Comparisons between B-IBI and RIVPACS results are facilitated by the similarity in impairment thresholds for the 2 assessment tools, particularly when B-IBI scores are transformed into a percent of maximum score: the impairment threshold for Washington RIVPACS was set by the Washington Department of Ecology (WADOE) at 0.73 (WADOE 2006), and the threshold adopted by King County for distinguishing between "good" and "fair" conditions indicated by B-IBI scores is between 72% (B-IBI = 36) and 76% (B-IBI = 38) of maximum score (King County 2008).

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 1996, 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 are given in Table 1. Sorting efficiency averaged 97.49%, and taxonomic precision for identification and enumeration averaged 98.28% 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 14 to 30 for City of Bellevue sample replicates collected in 2009. These scores indicated "poor" or "very poor" conditions for 16 of the replicates. Three replicates (Lewis I-90 replicates 1 and 2, and Lewis Elliott replicate 1) were rated "poor/fair". The score for Lewis I-90 rep 3 indicated "fair" conditions. Average B-IBI scores for replicates collected at each site are graphed in Figure 1. RIVPACS scores varied from 0.17 to 0.84. These scores indicated impaired biological conditions in 2009 for 16 sample replicates. Scores for Coal Creek Trailhead replicates 1 and 2 and for Lewis I-90 replicates 2 and 3 indicated unimpaired conditions. Average RIVPACS scores for replicates collected at each site are graphed in Figure 2.

In spite of some differences in the results rendered by the assessment methods, total B-IBI scores (transformed so as to be expressed as percent of maximum score) and RIVPACS results were strongly correlated with each other ($r = 0.769$, $p = 0.00007$). Figure 3 illustrates this relationship.

Table 1. Results of internal quality control procedures for subsampling and taxonomy. City of Bellevue, 2009.

RAI Sample ID	Station name and replicate number	Alternate station name	Sorting efficiency	Bray-Curtis similarity
CB09LD001	Kelsey / Peltzer Rep 1	Kelsey RM 3.9	100.00%	
CB09LD002	Kelsey / Peltzer Rep 2		97.21%	99.58%
CB09LD003	Kelsey / Peltzer Rep 3		95.16%	
CB09LD004	Kelsey / Peltzer Rep 3		97.47%	
CB09LD005	Kelsey / Glendale "wooded" Rep 1	Kelsey RM 1.8	92.77%	
CB09LD006	Kelsey / Glendale "wooded" Rep 2		94.38%	
CB09LD007	Kelsey / Glendale "wooded" Rep 3		97.33%	
CB09LD008	Kelsey / Glendale "wooded" Rep 4		98.23%	96.98%
CB09LD009	Coal Creek Trailhead Rep 1	Coal RM 2.3	95.47%	
CB09LD010	Coal Creek Trailhead Rep 2		96.87%	
CB09LD011	Coal Creek Trailhead Rep 3		98.23%	
CB09LD012	Lewis I-90 Rep 1	Lewis RM 0.8	99.07%	
CB09LD013	Lewis I-90 Rep 2		98.11%	
CB09LD014	Lewis I-90 Rep 3		97.34%	
CB09LD015	Lewis Elliot Rep 1	Lewis RM 0.3	98.21%	
CB09LD016	Lewis Elliot Rep 2		99.03%	
CB09LD017	Lewis Elliot Rep 3		99.64%	
CB09LD018	West Trib Farm Rep 1	-none-	96.27%	
CB09LD019	West Trib Farm Rep 2		99.08%	
CB09LD020	West Trib Farm Rep 3		100.00%	

Table 2. B-IBI scores and RIVPACS scores for sample replicates. City of Bellevue, 2009.

RAI Sample ID	Station name and replicate number	Alternate station name	B-IBI score	RIVPACS score
CB09LD001	Kelsey / Peltzer Rep 1	Kelsey RM 3.9	14	0.25
CB09LD002	Kelsey / Peltzer Rep 2		16	0.25
CB09LD003	Kelsey / Peltzer Rep 3		14	0.17
CB09LD004	Kelsey / Peltzer Rep 3		14	0.34
CB09LD005	Kelsey / Glendale "wooded" Rep 1	Kelsey RM 1.8	20	0.34
CB09LD006	Kelsey / Glendale "wooded" Rep 2		18	0.34
CB09LD007	Kelsey / Glendale "wooded" Rep 3		16	0.34
CB09LD008	Kelsey / Glendale "wooded" Rep 4		18	0.42
CB09LD009	Coal Creek Trailhead Rep 1	Coal RM 2.3	20	0.76
CB09LD010	Coal Creek Trailhead Rep 2		18	0.76
CB09LD011	Coal Creek Trailhead Rep 3		20	0.50
CB09LD012	Lewis I-90 Rep 1	Lewis RM 0.8	28	0.67
CB09LD013	Lewis I-90 Rep 2		26	0.84
CB09LD014	Lewis I-90 Rep 3		30	0.76
CB09LD015	Lewis Elliot Rep 1	Lewis RM 0.3	26	0.64
CB09LD016	Lewis Elliot Rep 2		20	0.64
CB09LD017	Lewis Elliot Rep 3		20	0.64
CB09LD018	West Trib Farm Rep 1	-none-	16	0.40
CB09LD019	West Trib Farm Rep 2		16	0.40
CB09LD020	West Trib Farm Rep 3		16	0.40

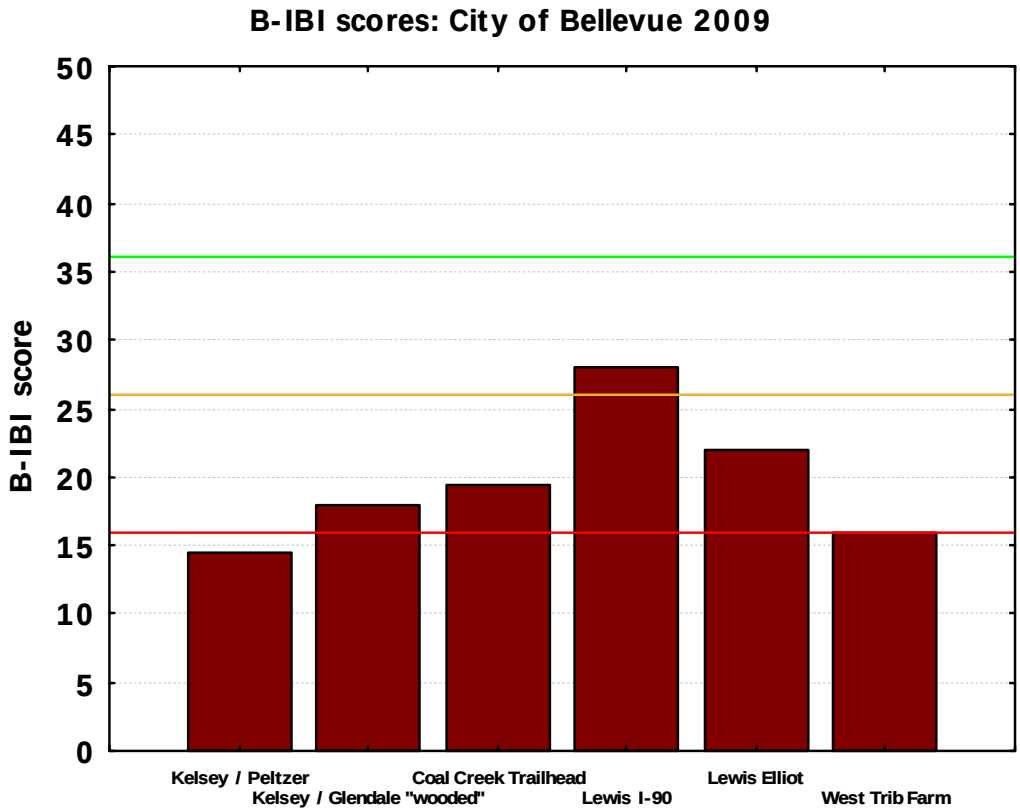


Figure 1. B-IBI scores for stream sites in the City of Bellevue, 2009. The green line indicates the threshold (B-IBI = 36) for "good" conditions, set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

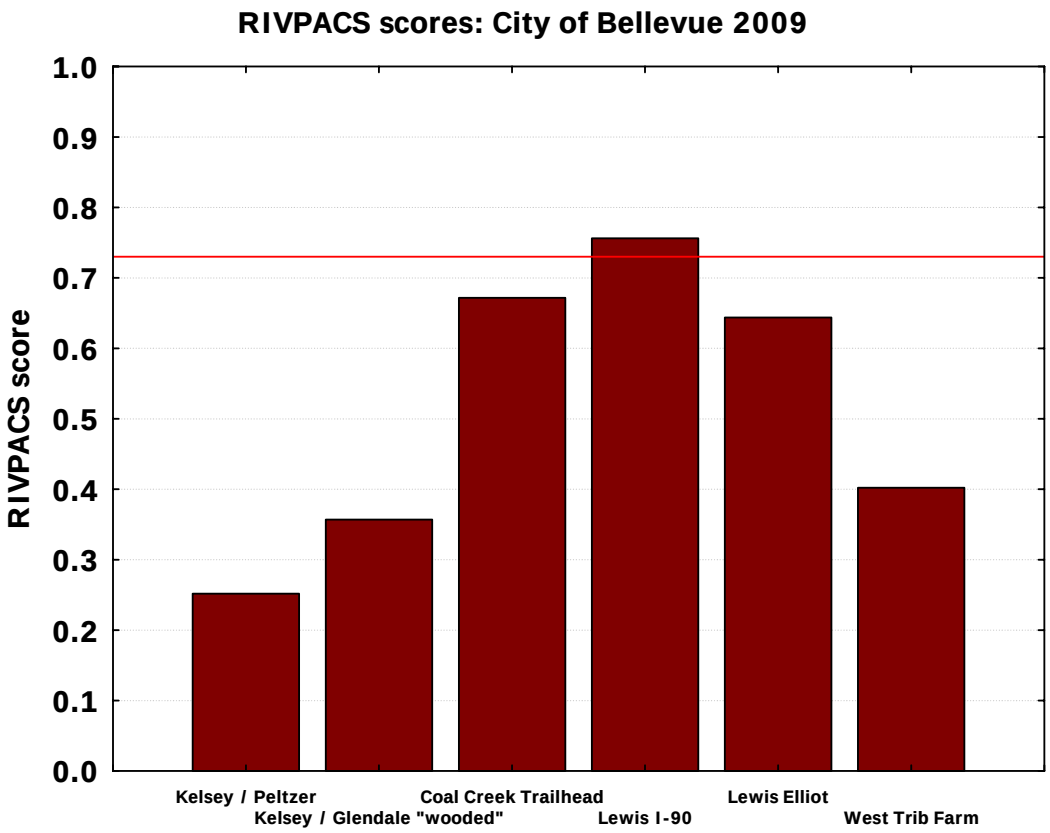


Figure 2. RIVPACS scores for stream sites in the City of Bellevue, 2009. The red line indicates the threshold (RIVPACS = 0.73) for "unimpaired" conditions, set by WADOE. Scores below the threshold indicate impaired conditions.

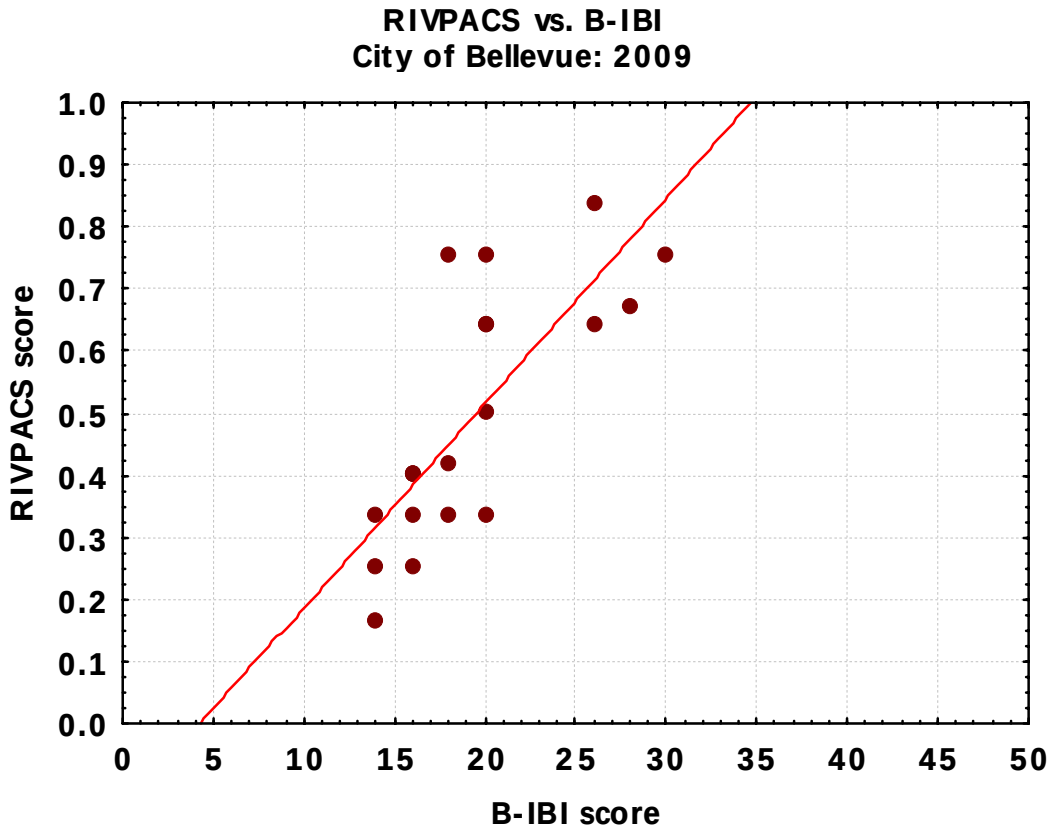


Figure 3. Relationship of B-IBI scores (as percent of maximum score) and RIVPACS scores for sites in the City of Bellevue, 2009. The relationship is significant: r= 0.769, p = 0.00007.

Aquatic invertebrate assemblage characteristics

- ***Coal Creek at Trailhead (RM 2.3)***

Bioassessment scores

Figures 4 and 5 compare mean scores and 95% confidence intervals for B-IBI and RIVPACS, respectively, over all of the years of sampling at Coal Creek at Trailhead.

Indicators of ecological condition: 2009

a. Water quality

Two mayfly taxa were collected at this site in 2009, and the biotic index value (5.94) was higher than expected for a functional stream in the Puget Sound Lowlands. While the ubiquitous mayfly *Baetis tricaudatus* dominated the replicate composite sample, midges and blackflies (*Simulium* sp.) were very abundant. No sensitive taxa were collected. These findings suggest that water quality was impaired in this reach; impairment may have been related to increased nutrient availability. The functional composition of the assemblage was strongly dominated by gatherers and filterers; this pattern is sometimes interpreted as a sign of water quality impairment. A relatively low value for the metals tolerance index, and the presence of the stoneflies *Sweltsa* sp. and *Skwala* sp. suggest that metals contamination was not an important stressor here.

b. Thermal condition

No cold stenotherm taxa were collected at this site in 2009. The thermal preference estimated for the invertebrate assemblage was 13.4ºC.

c. Sediment deposition

Eleven "clinger" taxa and 5 caddisfly taxa were present, suggesting that stony substrate habitats were available for colonization. The FSBI value indicates a moderately sediment-tolerant assemblage in 2009.

d. Habitat diversity and integrity

Taxa richness was moderately high, which may reflect moderate instream habitat diversity. Four stonefly taxa were collected in 2009, suggesting that reach-scale habitat features were intact: stable streambanks, functional riparian communities, and natural channel morphology may be indicated. Since at least 6 semivoltine taxa were supported here, it seems unlikely that scouring flows, periodic dewatering or thermal extremes influenced the aquatic biota in the reach.

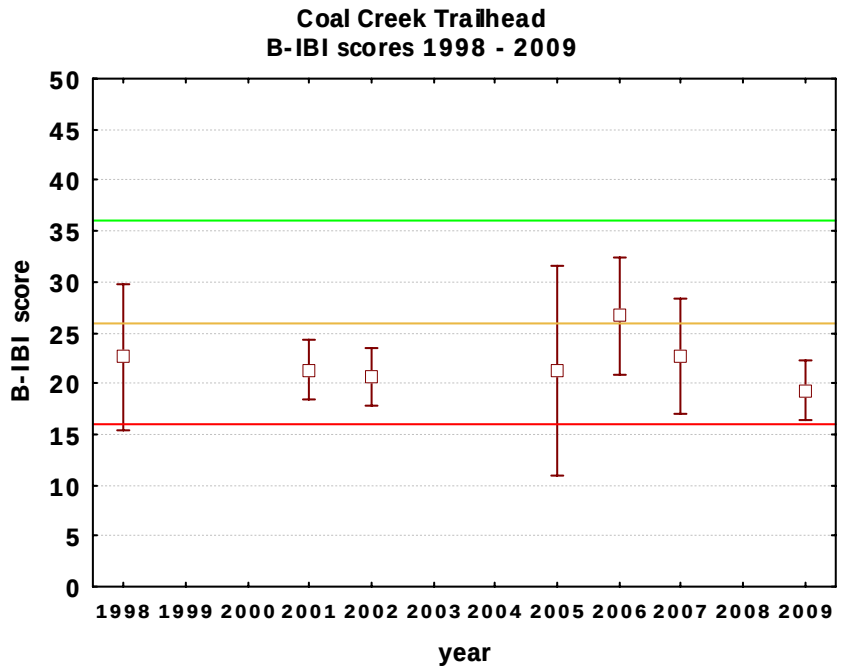


Figure 4. B-IBI scores (means and 95% confidence intervals) for Coal Creek at RM 2.3. Three replicate samples were collected in each year of sampling. The green line indicates the threshold (B-IBI = 36) for "good" conditions, as set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

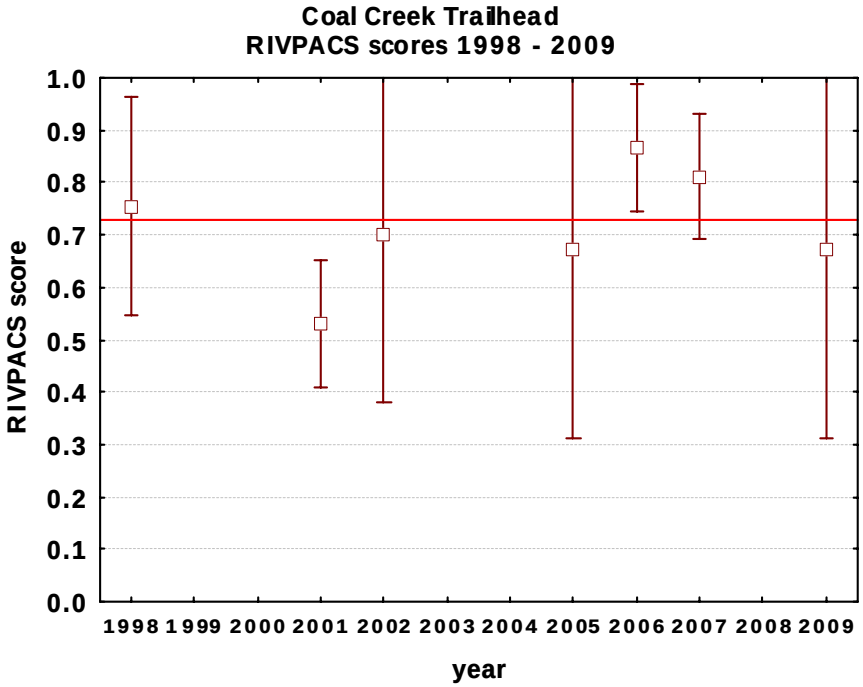


Figure 5. RIVPACS scores (means and 95% confidence intervals) for Coal Creek at RM 2.3. Three replicate samples were collected in each year of sampling. The red line represents the WADOE impairment threshold (0.73) for RIVPACS scores.

- ***Kelsey Creek at Peltzer (RM 3.9)***

Bioassessment scores

Figures 6 and 7 compare mean scores and 95% confidence intervals for B-IBI and RIVPACS, respectively, over all of the years of sampling at Kelsey Creek at Peltzer.

Indicators of ecological condition: 2009

a. Water quality

A single mayfly taxon was collected at the Kelsey Creek Peltzer site in 2009: this was the ubiquitous taxon *Baetis tricaudatus*. The biotic index value (6.00) was the highest calculated at any site in this year, indicating a tolerant assemblage. The invertebrate fauna at this site was overwhelmed by the blackfly *Simulium* sp., suggesting ample supplies of fine organic particulates in suspension. Increased nutrient availability may account for the abundance of this filter-feeding organism. Severely degraded water quality is strongly implied by these findings.

b. Thermal condition

No cold stenotherm taxa were collected at this site in 2009, and the common occurrence of the isopod *Caecidotea* sp. in samples suggests that warm water temperatures characterized the site. The thermal preference of the assemblage could not be calculated due to low taxa richness.

c. Sediment deposition

Only 3 “clinger” taxa were present in samples, and caddisflies were represented by a few individuals in a single taxon. Deposition of fine sediments may have influenced the composition of the benthic fauna at RM 3.9. A very low value for the FSBI also suggested a sediment tolerant assemblage. The stonefly *Malenka* sp. was common, and may indicate that a substantial component of benthic substrates was composed of leaf litter and woody debris.

d. Habitat diversity and integrity

Instream habitat diversity was probably limited, since taxa richness was low at this site. A single stonefly taxon was collected. Low richness in this group may be related to channelization or unstable streambanks. Two long-lived taxa were collected in 2009; these were the caddisfly *Parapsyche almota*, and the elmid *Lara* sp. It seems likely that their presence indicates stable instream conditions. The functional composition of sampled assemblages was very simple, generally dominated by the gatherer and filterer feeding groups. Dominance by these groups is sometimes interpreted as evidence of water quality impairment.

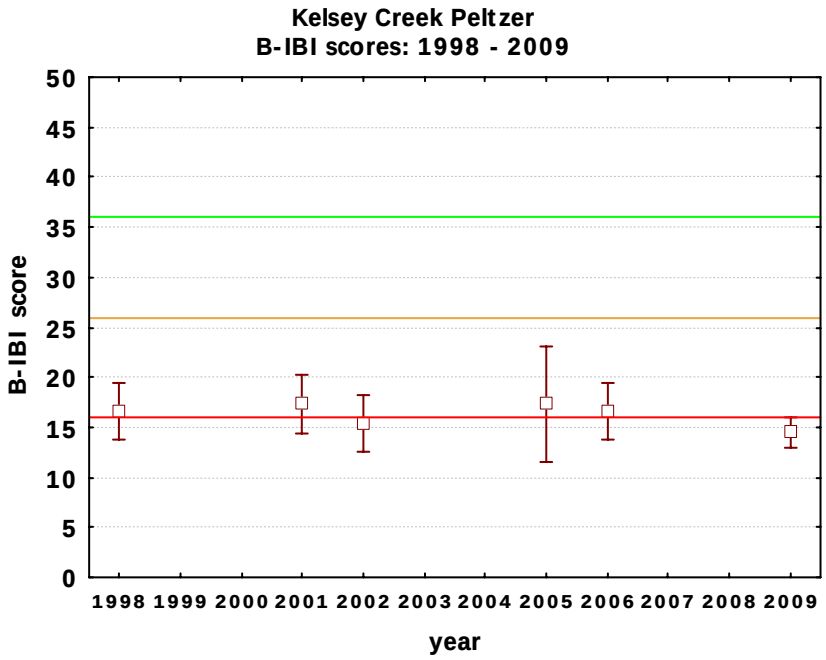


Figure 6. B-IBI scores (means and 95% confidence intervals) for Kelsey Creek at RM 3.9. Three replicate samples were collected in each year of sampling between 1998 and 2006. Four replicates were collected in 2009. The green line indicates the threshold (B-IBI = 36) for "good" conditions, as set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

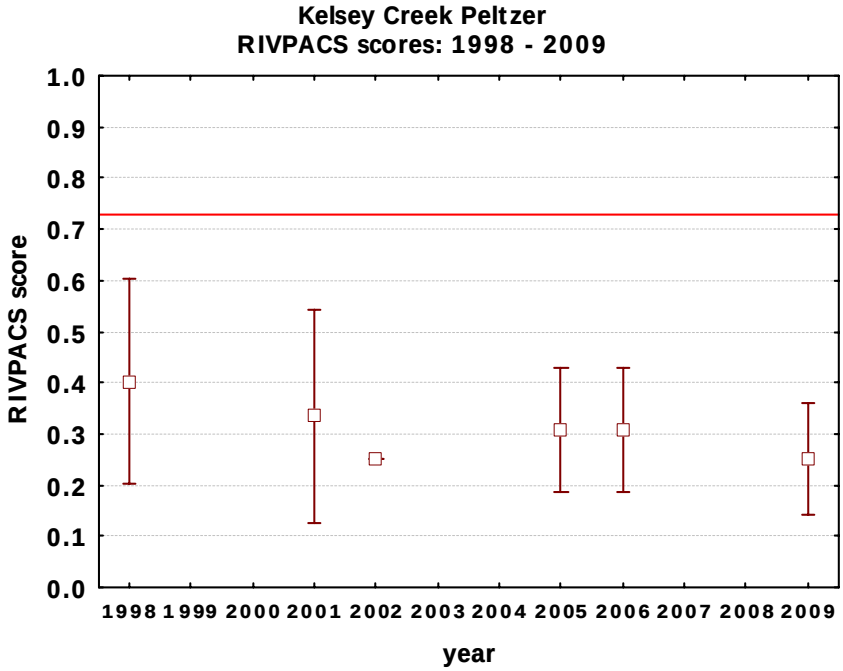


Figure 7. RIVPACS scores (means and 95% confidence intervals) for Kelsey Creek at RM 3.9. Three replicate samples were collected in each year of sampling between 1998 and 2006. Four replicates were collected in 2009. The red line represents the WADOE impairment threshold (0.73) for RIVPACS scores.

- ***Kelsey Creek at Glendale (RM 1.8)***

Bioassessment scores

Figures 8 and 9 compare mean scores and 95% confidence intervals for B-IBI and RIVPACS, respectively, over all of the years of sampling at Kelsey Creek at Glendale.

Indicators of ecological condition: 2009

a. Water quality

Baetis tricaudatus remained the only mayfly taxon to be collected at this site on Kelsey Creek. The high biotic index value (5.67) indicated a tolerant invertebrate assemblage, which was likely influenced by impaired water quality in the reach. Tolerant non-insect taxa such as amphipods, oligochaetes, and turbellarian flatworms were abundant in samples taken in 2009.

b. Thermal condition

Warm water temperatures were suggested by the abundance of the isopod *Caecidotea* sp. and the absence of cold stenotherm taxa. Low taxa richness prevented a reliable estimate of thermal preference.

c. Sediment deposition

Ten "clinger" taxa and 4 caddisfly taxa were collected at this site in 2009. Although none of these was abundant, these findings suggest that some hard substrate habitat may have been available. Leafy debris may have been abundant, since the shredder *Malenka* sp. was common in samples. An FSBI value could not be calculated due to low taxa richness.

d. Habitat diversity and integrity

Moderately low taxa richness at this site suggests that instream habitats were not as diverse as expected for a functional stream in the Puget Sound Lowlands. Low stonefly taxa richness suggests that reach-scale habitat features may have been disturbed. Low diversity among the stoneflies may be associated with unstable streambanks, alteration of natural channel morphology, or loss of riparian function. Two long-lived taxa were collected in 2009, but neither of these was abundant. Periodic dewatering, scouring sediment pulses, or toxic inputs cannot be ruled out. The functional composition of invertebrate assemblages was impoverished consisting mostly of gatherers.

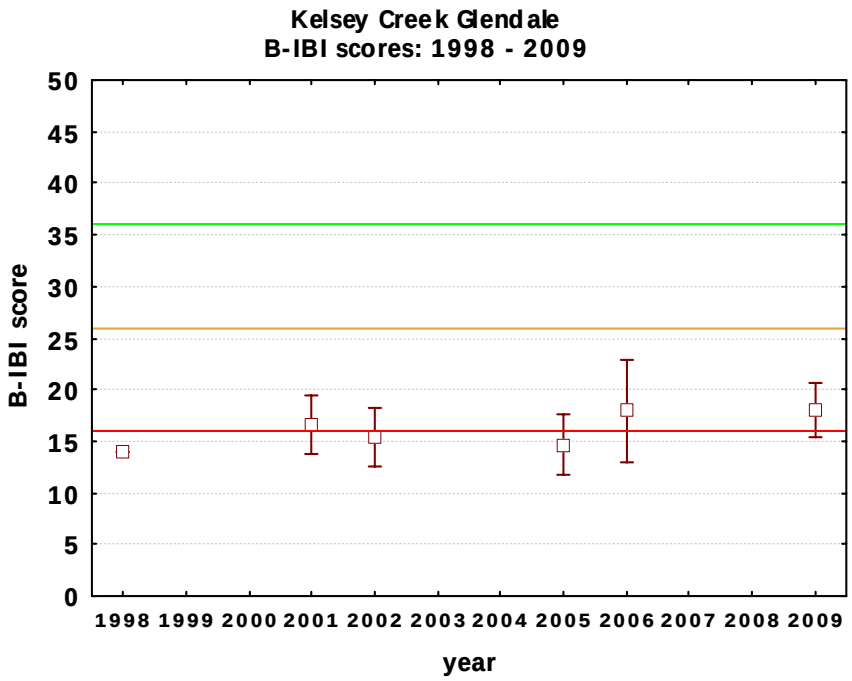


Figure 8. B-IBI scores (means and 95% confidence intervals) for Kelsey Creek at RM 1.8. Three replicate samples were collected in each year of sampling between 1998 and 2006. Four replicates were collected in 2009. The green line indicates the threshold (B-IBI = 36) for "good" conditions, as set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

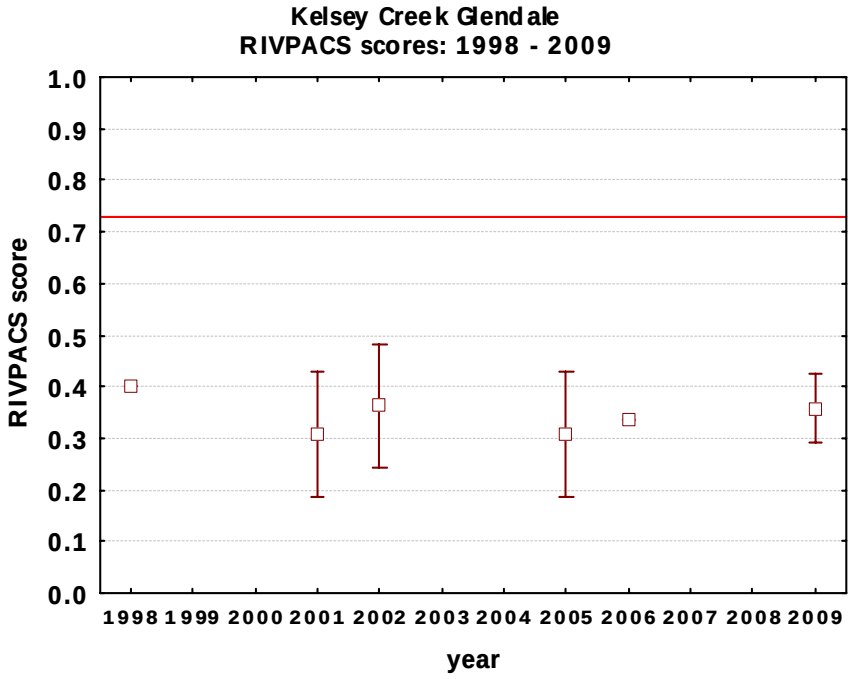


Figure 9. RIVPACS scores (means and 95% confidence intervals) for Kelsey Creek at RM 1.8. Three replicate samples were collected in each year of sampling between 1998 and 2006. Four replicates were collected in 2009. The red line represents the WADOE impairment threshold (0.73) for RIVPACS scores.

- ***Lewis Creek at I-90 (RM 0.8)***

Bioassessment scores

Figures 10 and 11 compare mean scores and 95% confidence intervals for B-IBI and RIVPACS, respectively, over all of the years of sampling at Lewis Creek at I-90.

Indicators of ecological condition: 2009

a. Water quality

Two mayfly taxa were present in samples collected at this site in 2009, and the biotic index value was only slightly elevated compared to expectations for unpolluted sites in the Puget Sound Lowlands. These findings suggest that water quality may have been good in the reach. No fewer than 4 sensitive taxa were supported at the site, including the caddisflies *Dolophilodes* sp. and *Psychoglypha* sp., and the stonefly *Paraperla* sp.

b. Thermal condition

Four cold stenotherm taxa were collected here in 2009, and the estimated thermal preference of the assemblage was 13.4ºC. This suggests that water temperatures were lower than at most sampled sites.

c. Sediment deposition

Fifteen "clinger" taxa and 8 caddisfly taxa were counted in samples, suggesting that stony substrate habitats were not impaired by sediment deposition. The presence of the hyporheic stonefly *Paraperla* sp. indicates that interstitial deposition of sediment was minimal in this reach. FSBI values calculated for these assemblages indicated moderate sediment tolerance.

d. Habitat diversity and integrity

Taxa richness (42) at this site was higher than any other site sampled in 2009 suggesting that instream habitats here were diverse and intact. Stable streambanks, intact riparian function, and natural channel morphology may be indicated by high stonefly taxa richness (6). Long-lived taxa were diverse and abundant, implying stable instream habitat conditions. The site did not support a diverse functional composition; gatherers and filterers dominated the feeding group distribution. Scrapers were notably scarce in 2009.

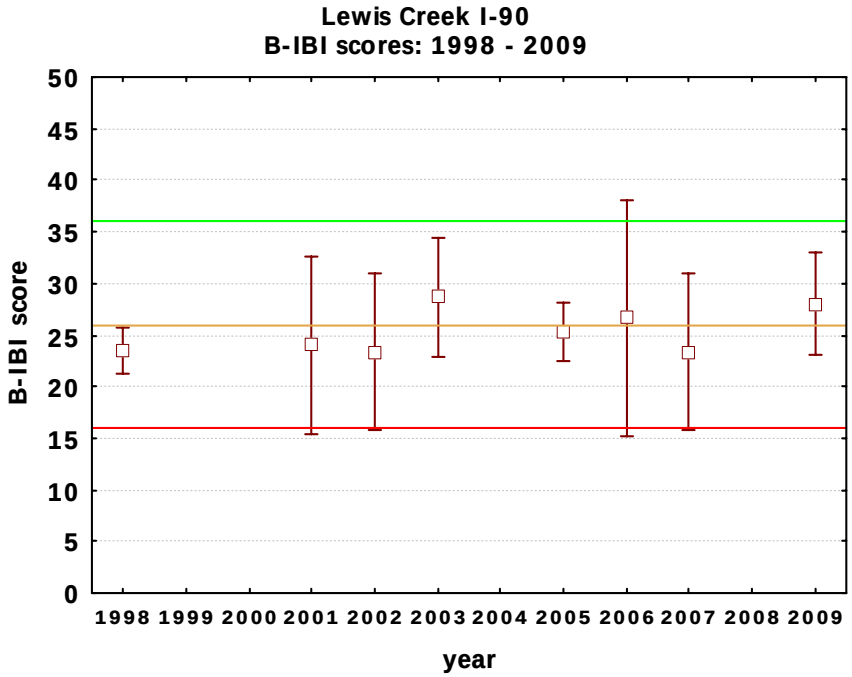


Figure 10. B-IBI scores (means and 95% confidence intervals) for Lewis Creek at RM 0.8. Three replicate samples were collected in each year of sampling. The green line indicates the threshold (B-IBI = 36) for "good" conditions, as set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

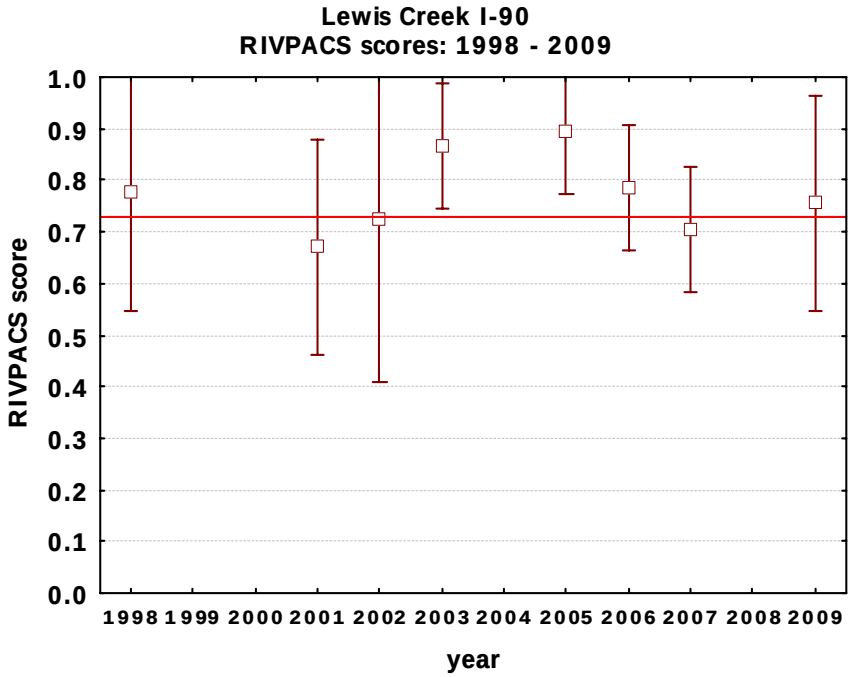


Figure 11. RIVPACS scores (means and 95% confidence intervals) for Lewis Creek at RM 0.8. Three replicate samples were collected in each year of sampling. The red line represents the WADOE impairment threshold (0.73) for RIVPACS scores.

- ***Lewis Creek at Elliott (RM 0.3)***

Bioassessment scores

Figures 12 and 13 compare mean scores and 95% confidence intervals for B-IBI and RIVPACS, respectively, over all of the years of sampling at Lewis Creek at Elliott.

Indicators of ecological condition: 2009

a. Water quality

Only 2 mayfly taxa were collected at this site in 2009, but the biotic index value (5.33) was the lowest calculated for this study, indicating relatively sensitive invertebrate assemblages. Water quality may have been good in the reach.

b. Thermal condition

Cold stenotherm taxa were rare in 2009, and the thermal preference of the assemblage was estimated to be 14.0ºC, which was the highest value calculated for this metric. However, the taxonomic composition of the samples suggested cool-to-cold water temperatures.

c. Sediment deposition

Eleven "clinger" taxa and 6 caddisfly taxa were present in samples collected at this site. These findings suggest that sediment deposition did not obliterate stony substrate habitats here. The FSBI value (4.69) suggested a moderately sediment-tolerant assemblage. However, the shredder *Malenka* sp. was common at the site, suggesting that substrates were composed of significant leaf litter and woody debris.

d. Habitat diversity and integrity

Taxa richness was mildly depressed here, compared to expected diversity in least-impaired streams of the Puget Sound Lowlands. Instream habitats may have been monotonous in the reach. Two stonefly taxa were present in samples in 2009, suggesting that reach-scale habitat features such as channel morphology, riparian functionality, and streambank integrity may have been mildly disturbed. At least 5 semivoltine taxa were supported at the site: surface flow apparently persisted throughout the year, and toxic pollutants or scouring flows were unlikely. Gatherers and filterers overwhelmed the functional composition of the assemblage, which may indicate some impairment to water quality.

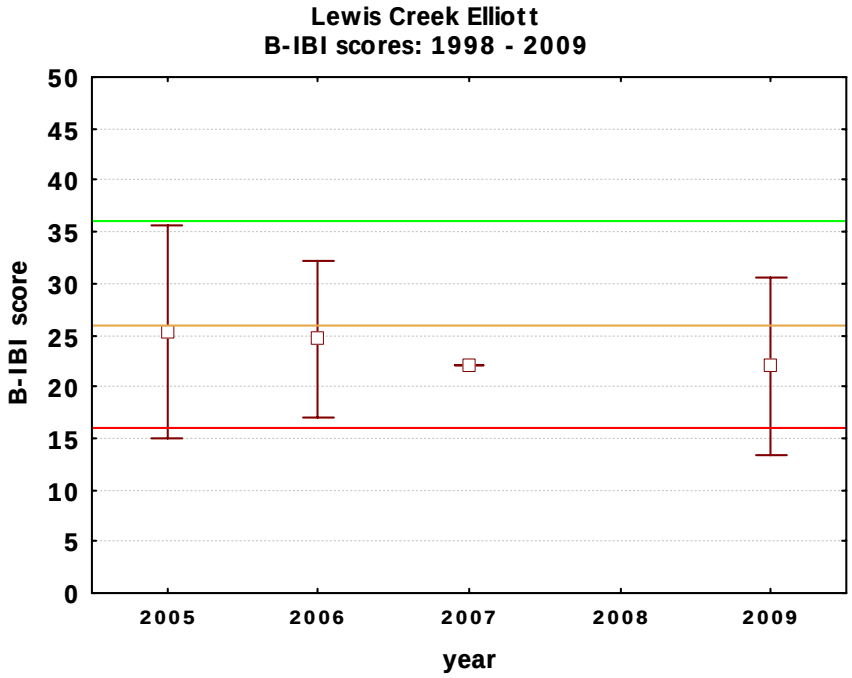


Figure 12. B-IBI scores (means and 95% confidence intervals) for Lewis Creek at RM 0.3. Three replicate samples were collected in each year of sampling. The green line indicates the threshold (B-IBI = 36) for "good" conditions, as set by WADOE. Scores below the threshold indicate impaired conditions. The orange line is the threshold for "fair" conditions; scores falling below the threshold indicate "poor" conditions. Scores falling below the red line indicate "very poor" conditions.

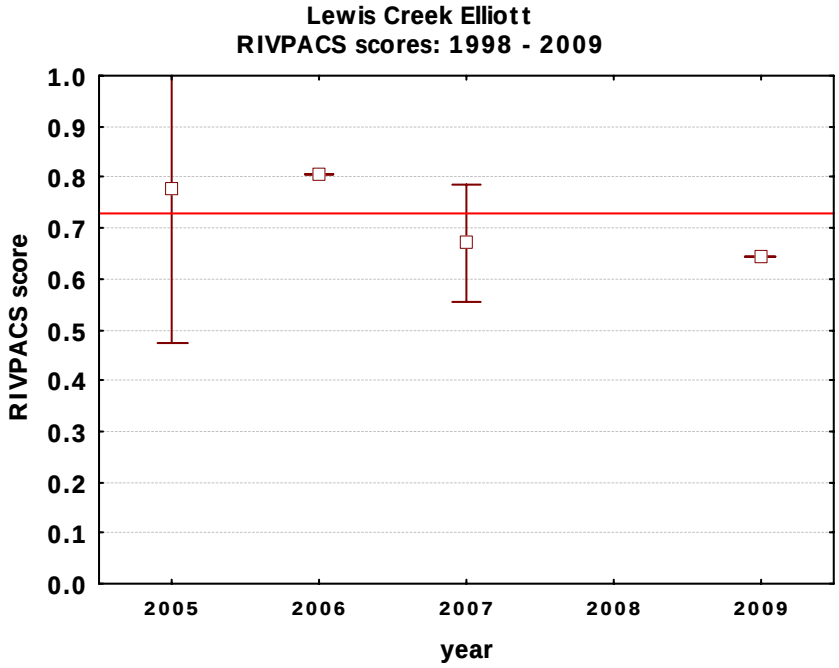


Figure 13. RIVPACS scores (means and 95% confidence intervals) for Lewis Creek at RM 0.3. Three replicate samples were collected in each year of sampling. The red line represents the WADOE impairment threshold (0.73) for RIVPACS scores.

- ***West Trib Farm***

Indicators of ecological condition: 2009

a. Water quality

Metric indicators of water quality suggested impaired conditions at this site. The mayfly fauna at this site consisted of a single taxon, and the biotic index value was moderately elevated. The invertebrate assemblage was dominated by the blackfly *Simulium* sp., a filter-feeder. Suspended organic particulates were apparently an important source of energy in the reach: this may indicate increased nutrient availability.

b. Thermal condition

There were no cold stenotherm taxa in samples collected at this site in 2009. Low taxa richness prevented a reliable estimation of thermal preference, but cool water temperatures are suggested by the presence of the caddisfly *Parapsyche almota*.

c. Sediment deposition

Only 4 "clinger" taxa and a single caddisfly taxon were counted in samples, suggesting that sediment deposition may have prevented colonization of stony substrate habitats here. The stonefly *Malenka* sp. was common, however, which may indicate that substrate composition included substantial amounts of leaf litter and woody debris. A reliable FSBI calculation could not be made due to low diversity.

d. Habitat diversity and integrity

Low taxa richness (15) suggests monotonous instream habitats, and low diversity among the stoneflies may be related to disruption of reach-scale habitat features such as riparian zone integrity, streambank stability, or natural channel morphology. Although only a single semivoltine taxon was collected, the composition of the sampled assemblage suggests that surface flow persisted year-round in the reach. Gatherers and filterers were the dominant functional components, but shredders were not uncommon.

Since this was the first sampling occasion at West Trib Farm, no graphical comparisons of past bioassessments were possible.

DISCUSSION

The highly urbanized watersheds in the City of Bellevue support aquatic invertebrate communities that often lack expected taxonomic and functional components. In 2009, 3 of the 6 sampled sites supported assemblages that suggested multiple sources of stress, most of which are probably related to alterations of the natural environment, and human-caused degradation to water quality.

The B-IBI and RIVPACS tools performed similarly for assemblages collected in the City of Bellevue. Correlation between the 2 methods was strong (Figure 3), and the ecological evidence discussed in the site-by-site narratives generally supported the results of the bioassessment tools.

Table 3 summarizes the stressors suggested by the analysis of taxonomic and functional composition of invertebrate assemblages and described in the site-by-site narratives. 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 2009: 2 taxa were the most that were supported at any site in the study. Water quality problems probably included nutrient enrichment.

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

Site	water quality degradation	sediment deposition	thermal stress	habitat disruption
Coal at Trailhead	*			
Kelsey at Peltzer	*	*	*	?
Kelsey at Glendale	*	?	*	*
Lewis I-90				
Lewis Elliott				*
West Trib	*	?		*

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.

Bollman, W. 2009. Biological assessment of stream sites in the City of Bellevue, based on macroinvertebrate assemblages. Report to the City of Bellevue, Washington. Utilities Department.

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.

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.

WADOE 2006. http://www.ecy.wa.gov/programs/wq/303d/wqp01-11-ch1Final2006.pdf

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

2009

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C001

RAI No.: CB09LD-C001 **Sta. Name:** Kelsey / Peltzer Composite
Client ID:
Date Coll.: 8/25/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	2	0.09%	Yes	Unknown		5	PR
Hydrozoa	2	0.09%	Yes	Unknown		5	PR
Nematoda	3	0.13%	Yes	Unknown		5	PA
Oligochaeta	27	1.21%	Yes	Unknown		10	CG
Turbellaria	4	0.18%	Yes	Unknown		4	PR
Asellidae							
Caecidotea sp.	59	2.65%	Yes	Unknown		8	CG
Crangonyctidae							
Crangonyx sp.	170	7.62%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	10	0.45%	Yes	Unknown		8	CF
Ephemeroptera							
Baetidae							
Baetis tricaudatus	171	7.67%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	67	3.00%	Yes	Larva		1	SH
Trichoptera							
Hydropsychidae							
Hydropsychidae	1	0.04%	No	Pupa		4	CF
Hydropsychidae	22	0.99%	No	Larva	Early Instar	4	CF
Parapsyche almota	7	0.31%	Yes	Larva		3	PR
Coleoptera							
Elmidae							
Lara sp.	2	0.09%	Yes	Larva		1	SH
Diptera							
Simuliidae							
Simuliidae	47	2.11%	No	Pupa		6	CF
Simulium sp.	1506	67.53%	Yes	Larva		6	CF
Chironomidae							
Chironomidae							
Chironomidae	127	5.70%	Yes	Larva		10	CG
Chironomidae	3	0.13%	No	Pupa		10	CG
Sample Count	**2230**						

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C002

RAI No.: CB09LD-C002 **Sta. Name:** Kelsey / Glendale "wooded" Composite
Client ID:
Date Coll.: 8/24/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	22	1.11%	Yes	Unknown		5	PR
Copepoda	1	0.05%	Yes	Unknown		8	CG
Hydrozoa	6	0.30%	Yes	Unknown		5	PR
Nematoda	11	0.55%	Yes	Unknown		5	PA
Oligochaeta	50	2.52%	Yes	Unknown		10	CG
Turbellaria	95	4.78%	Yes	Unknown		4	PR
Asellidae							
Caecidotea sp.	56	2.82%	Yes	Unknown		8	CG
Crangonyctidae							
Crangonyx sp.	396	19.94%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	11	0.55%	Yes	Unknown		8	CF
Ephemeroptera							
Baetidae							
Baetis tricaudatus	669	33.69%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	83	4.18%	Yes	Larva		1	SH
Perlodidae							
Perlodidae	1	0.05%	Yes	Larva	Early Instar	2	PR
Trichoptera							
Hydropsychidae							
Hydropsychidae	3	0.15%	Yes	Larva	Early Instar	4	CF
Hydropsychidae	1	0.05%	Yes	Larva	Damaged	4	CF
Hydroptilidae							
Hydroptila sp.	5	0.25%	Yes	Larva		6	PH
Rhyacophilidae							
Rhyacophila sp.	1	0.05%	Yes	Larva	Damaged	1	PR
Coleoptera							
Elmidae							
Elmidae	1	0.05%	Yes	Larva	Early Instar	4	CG
Narpus concolor	6	0.30%	Yes	Larva		2	CG
Diptera							
Empididae							
Hemerodromia sp.	2	0.10%	Yes	Larva		6	PR
Ephydridae							
Ephydridae	3	0.15%	Yes	Larva		6	CG
Simuliidae							
Simuliidae	4	0.20%	No	Pupa		6	CF
Simuliidae	1	0.05%	Yes	Pupa		6	CF
Simulium sp.	67	3.37%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	1	0.05%	No	Pupa		3	CG
Antocha sp.	132	6.65%	Yes	Larva		3	CG

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C002

RAI No.: CB09LD-C002 **Sta. Name:** Kelsey / Glendale "wooded" Composite
Client ID:
Date Coll.: 8/24/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Chironomidae							
Chironomidae							
Chironomidae	346	17.42%	Yes	Larva		10	CG
Chironomidae	12	0.60%	No	Pupa		10	CG
Sample Count	**1986**						

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C003

RAI No.: CB09LD-C003 **Sta. Name:** Coal Creek Trailhead Composite
Client ID:
Date Coll.: 8/26/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	12	0.70%	Yes	Unknown		5	PR
Nematoda	3	0.18%	Yes	Unknown		5	PA
Oligochaeta	15	0.88%	Yes	Unknown		10	CG
Ostracoda	2	0.12%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis tricaudatus	436	25.59%	Yes	Larva		4	CG
Diphetor hageni	27	1.58%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Sweltsa sp.	2	0.12%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	80	4.69%	Yes	Larva		1	SH
Nemouridae	11	0.65%	No	Larva	Early Instar	2	SH
Zapada cinctipes	19	1.12%	Yes	Larva		3	SH
Perlodidae							
Skwala sp.	7	0.41%	Yes	Larva		3	PR
Trichoptera							
Hydropsychidae							
Hydropsyche sp.	150	8.80%	Yes	Larva		5	CF
Hydropsychidae	9	0.53%	No	Larva	Early Instar	4	CF
Hydroptilidae							
Hydroptila sp.	8	0.47%	Yes	Larva		6	PH
Hydroptilidae	1	0.06%	No	Larva	Early Instar	4	PH
Hydroptilidae	6	0.35%	No	Pupa		4	PH
Limnephilidae							
Dicosmoecus atripes	1	0.06%	Yes	Larva		1	PR
Rhyacophilidae							
Rhyacophila Betteni Gr.	5	0.29%	Yes	Larva		0	PR
Rhyacophila Brunnea Gr.	8	0.47%	Yes	Larva		2	PR
Coleoptera							
Elmidae							
Elmidae	12	0.70%	No	Larva	Early Instar	4	CG
Heterlimnius sp.	7	0.41%	Yes	Larva		3	CG
Lara sp.	2	0.12%	Yes	Larva		1	SH
Narpus concolor	3	0.18%	Yes	Larva		2	CG
Optioservus sp.	2	0.12%	Yes	Adult		5	SC
Optioservus sp.	4	0.23%	No	Larva		5	SC
Zaitzevia sp.	1	0.06%	Yes	Adult		5	CG

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C003

RAI No.: CB09LD-C003 **Sta. Name:** Coal Creek Trailhead Composite
Client ID:
Date Coll.: 8/26/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Dixidae							
Dixa sp.	1	0.06%	Yes	Larva		1	CG
Empididae							
Hemerodromia sp.	1	0.06%	Yes	Larva		6	PR
Ephydridae							
Ephydridae	1	0.06%	Yes	Larva		6	CG
Simuliidae							
Simuliidae	44	2.58%	No	Pupa		6	CF
Simulium sp.	392	23.00%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	3	0.18%	Yes	Larva		3	CG
Dicranota sp.	11	0.65%	Yes	Larva		3	PR
Limnophila sp.	1	0.06%	Yes	Larva		3	PR
Tipula sp.	1	0.06%	Yes	Larva		4	SH
Chironomidae							
Chironomidae							
Chironomidae	23	1.35%	No	Pupa		10	CG
Chironomidae	393	23.06%	Yes	Larva		10	CG
Sample Count	**1704**						

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C004

RAI No.: CB09LD-C004 **Sta. Name:** Lewis I-90 Composite
Client ID:
Date Coll.: 8/21/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	25	1.58%	Yes	Unknown		5	PR
Copepoda	1	0.06%	Yes	Unknown		8	CG
Nematoda	3	0.19%	Yes	Unknown		5	PA
Oligochaeta	46	2.91%	Yes	Unknown		10	CG
Ostracoda	4	0.25%	Yes	Unknown		8	CG
Turbellaria	5	0.32%	Yes	Unknown		4	PR
Crangonyctidae							
Crangonyx sp.	8	0.51%	Yes	Unknown		6	CG
Planorbidae							
Planorbidae	3	0.19%	Yes	Immature		6	SC
Sphaeriidae							
Sphaeriidae	2	0.13%	Yes	Unknown		8	CF
Ephemeroptera							
Baetidae							
Baetis tricaudatus	316	19.99%	Yes	Larva		4	CG
Diphetor hageni	50	3.16%	Yes	Larva		5	CG
Plecoptera							
Chloroperlidae							
Paraperla sp.	1	0.06%	Yes	Larva		1	CG
Sweltsa sp.	3	0.19%	Yes	Larva		0	PR
Leuctridae							
Leuctridae	6	0.38%	Yes	Larva		0	SH
Nemouridae							
Malenka sp.	38	2.40%	Yes	Larva		1	SH
Nemouridae	11	0.70%	No	Larva	Early Instar	2	SH
Zapada cinctipes	3	0.19%	Yes	Larva		3	SH
Perlodidae							
Skwala sp.	18	1.14%	Yes	Larva		3	PR

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C004

RAI No.: CB09LD-C004 **Sta. Name:** Lewis I-90 Composite
Client ID:
Date Coll.: 8/21/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Trichoptera							
Glossosomatidae							
Glossosoma sp.	1	0.06%	Yes	Larva		0	SC
Glossosomatidae	1	0.06%	Yes	Pupa		0	SC
Glossosomatidae	7	0.44%	No	Pupa		0	SC
Glossosomatidae	1	0.06%	No	Larva	Damaged	0	SC
Hydropsychidae							
Hydropsyche sp.	455	28.78%	Yes	Larva		5	CF
Hydropsychidae	53	3.35%	No	Larva	Early Instar	4	CF
Parapsyche almota	2	0.13%	Yes	Larva		3	PR
Lepidostomatidae							
Lepidostoma sp.	7	0.44%	Yes	Larva		1	SH
Limnephilidae							
Psychoglypha sp.	1	0.06%	Yes	Larva		0	CG
Philopotamidae							
Dolophilodes sp.	1	0.06%	Yes	Larva		0	CF
Rhyacophilidae							
Rhyacophila sp.	18	1.14%	No	Larva	Early Instar	1	PR
Rhyacophila sp.	1	0.06%	No	Pupa		1	PR
Rhyacophila Betteni Gr.	18	1.14%	Yes	Larva		0	PR
Coleoptera							
Dytiscidae							
Oreodytes sp.	1	0.06%	Yes	Adult		5	PR
Elmidae							
Elmidae	9	0.57%	No	Larva	Early Instar	4	CG
Heterlimnius sp.	20	1.27%	Yes	Larva		3	CG
Lara sp.	10	0.63%	Yes	Larva		1	SH
Narpus concolor	16	1.01%	Yes	Larva		2	CG
Zaitzevia sp.	3	0.19%	Yes	Adult		5	CG

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C004

RAI No.: CB09LD-C004 **Sta. Name:** Lewis I-90 Composite
Client ID:
Date Coll.: 8/21/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Diptera							
Ceratopogonidae							
Ceratopogoninae	2	0.13%	Yes	Larva		6	PR
Dixidae							
Dixa sp.	1	0.06%	Yes	Larva		1	CG
Empididae							
Chelifera sp.	2	0.13%	Yes	Larva		5	PR
Clinocera sp.	16	1.01%	Yes	Larva		5	PR
Empididae	5	0.32%	Yes	Larva	Damaged	6	PR
Pelecorhynchidae							
Glutops sp.	1	0.06%	Yes	Larva		1	PR
Psychodidae							
Psychodidae	1	0.06%	Yes	Pupa		4	CG
Simuliidae							
Simuliidae	6	0.38%	No	Pupa		6	CF
Simulium sp.	57	3.61%	Yes	Larva		6	CF
Thaumaleidae							
Thaumalea sp.	1	0.06%	Yes	Larva		11	OM
Tipulidae							
Antocha sp.	1	0.06%	No	Pupa		3	CG
Antocha sp.	3	0.19%	Yes	Larva		3	CG
Dicranota sp.	17	1.08%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Chironomidae	293	18.53%	Yes	Larva		10	CG
Chironomidae	7	0.44%	No	Pupa		10	CG
Sample Count	**1581**						

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C005

RAI No.: CB09LD-C005 **Sta. Name:** Lewis Elliot Composite
Client ID:
Date Coll.: 8/22/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	32	2.04%	Yes	Unknown		5	PR
Nematoda	3	0.19%	Yes	Unknown		5	PA
Oligochaeta	28	1.79%	Yes	Unknown		10	CG
Crangonyctidae							
Crangonyx sp.	13	0.83%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	1	0.06%	Yes	Unknown		8	CF
Ephemeroptera							
Baetidae							
Baetidae	30	1.91%	No	Larva	Early Instar	4	CG
Baetis tricaudatus	309	19.72%	Yes	Larva		4	CG
Diphetor hageni	37	2.36%	Yes	Larva		5	CG
Plecoptera							
Nemouridae							
Malenka sp.	33	2.11%	Yes	Larva		1	SH
Nemouridae	3	0.19%	No	Larva	Early Instar	2	SH
Nemouridae	2	0.13%	No	Larva	Damaged	2	SH
Perlodidae							
Skwala sp.	7	0.45%	Yes	Larva		3	PR
Trichoptera							
Glossosomatidae							
Glossosomatidae	1	0.06%	Yes	Pupa		0	SC
Hydropsychidae							
Hydropsyche sp.	382	24.38%	Yes	Larva		5	CF
Hydropsychidae	121	7.72%	No	Larva	Early Instar	4	CF
Lepidostomatidae							
Lepidostoma sp.	5	0.32%	Yes	Larva		1	SH
Limnephilidae							
Dicosmoecus atripes	2	0.13%	Yes	Larva		1	PR
Rhyacophilidae							
Rhyacophila sp.	1	0.06%	No	Pupa		1	PR
Rhyacophila sp.	11	0.70%	No	Larva	Early Instar	1	PR
Rhyacophila Betteni Gr.	15	0.96%	Yes	Larva		0	PR
Rhyacophila Brunnea Gr.	2	0.13%	Yes	Larva		2	PR
Coleoptera							
Elmidae							
Elmidae	13	0.83%	No	Larva	Early Instar	4	CG
Heterlimnius sp.	53	3.38%	Yes	Larva		3	CG
Lara sp.	7	0.45%	Yes	Larva		1	SH
Narpus concolor	14	0.89%	Yes	Larva		2	CG
Optioservus sp.	2	0.13%	Yes	Larva		5	SC

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C005

RAI No.: CB09LD-C005 **Sta. Name:** Lewis Elliot Composite
Client ID:
Date Coll.: 8/22/2009 **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.	1	0.06%	Yes	Larva		1	CG
Empididae							
Chelifera sp.	5	0.32%	Yes	Larva		5	PR
Clinocera sp.	3	0.19%	Yes	Larva		5	PR
Empididae	1	0.06%	No	Larva	Early Instar	6	PR
Simuliidae							
Simuliidae	7	0.45%	No	Pupa		6	CF
Simulium sp.	100	6.38%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	45	2.87%	Yes	Larva		3	CG
Antocha sp.	9	0.57%	No	Pupa		3	CG
Dicranota sp.	1	0.06%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Chironomidae	261	16.66%	Yes	Larva		10	CG
Chironomidae	5	0.32%	No	Pupa		10	CG
Sample Count	**1567**						

Taxa Listing

Project ID: CB09LD-C
RAI No.: CB09LD-C006

RAI No.: CB09LD-C006 **Sta. Name:** West Trib Farm Composite
Client ID:
Date Coll.: 8/27/2009 **No. Jars:** **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Acari	13	0.77%	Yes	Unknown		5	PR
Amphipoda	31	1.83%	No	Unknown	Damaged	4	CG
Nematoda	13	0.77%	Yes	Unknown		5	PA
Oligochaeta	24	1.42%	Yes	Unknown		10	CG
Turbellaria	14	0.83%	Yes	Unknown		4	PR
Ancylidae							
Ferrissia sp.	1	0.06%	Yes	Unknown		6	SC
Crangonyctidae							
Crangonyx sp.	64	3.79%	Yes	Unknown		6	CG
Sphaeriidae							
Sphaeriidae	15	0.89%	Yes	Unknown		8	CF
Ephemeroptera							
Baetidae							
Baetidae	128	7.57%	No	Larva	Early Instar	4	CG
Baetis sp.	16	0.95%	No	Larva	Early Instar	5	CG
Baetis sp.	3	0.18%	No	Larva	Damaged	5	CG
Baetis tricaudatus	254	15.03%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	164	9.70%	Yes	Larva		1	SH
Nemouridae	1	0.06%	No	Larva	Damaged	2	SH
Nemouridae	13	0.77%	No	Larva	Early Instar	2	SH
Trichoptera							
Hydropsychidae							
Hydropsychidae	8	0.47%	No	Larva	Early Instar	4	CF
Parapsyche sp.	6	0.36%	No	Larva	Early Instar	0	PR
Parapsyche sp.	1	0.06%	Yes	Larva	Early Instar	0	PR
Parapsyche almota	6	0.36%	Yes	Larva		3	PR
Diptera							
Simuliidae							
Simuliidae	6	0.36%	No	Larva	Early Instar	6	CF
Simuliidae	33	1.95%	No	Pupa		6	CF
Simuliidae	4	0.24%	No	Larva	Damaged	6	CF
Simulium sp.	490	28.99%	Yes	Larva		6	CF
Tipulidae							
Antocha sp.	1	0.06%	No	Pupa		3	CG
Antocha sp.	16	0.95%	Yes	Larva		3	CG
Dicranota sp.	2	0.12%	Yes	Larva		3	PR
Chironomidae							
Chironomidae							
Chironomidae	12	0.71%	No	Pupa		10	CG
Chironomidae	351	20.77%	Yes	Larva		10	CG
Sample Count	**1690**						

Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C001
Sta. Name: Kelsey / Peltzer Composite
Client ID:
STORET ID:
Coll. Date: 8/25/2009

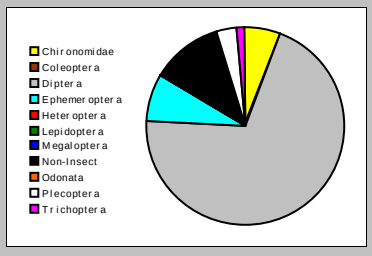
Abundance Measures

Sample Count: 2230
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	8	277	12.42%
Odonata			
Ephemeroptera	1	171	7.67%
Plecoptera	1	67	3.00%
Heteroptera			
Megaloptera			
Trichoptera	1	30	1.35%
Lepidoptera			
Coleoptera	1	2	0.09%
Diptera	1	1553	69.64%
Chironomidae	1	130	5.83%

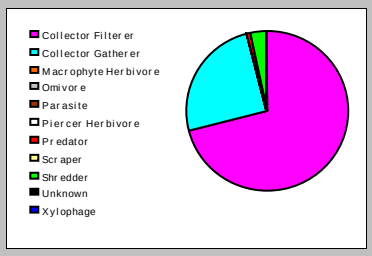


Dominant Taxa

Category	A	PRA
Simulium	1506	67.53%
Baetis tricaudatus	171	7.67%
Crangonyx	170	7.62%
Chironomidae	130	5.83%
Malenka	67	3.00%
Caecidotea	59	2.65%
Simuliidae	47	2.11%
Oligochaeta	27	1.21%
Hydropsychidae	23	1.03%
Sphaeriidae	10	0.45%
Parapsyche almota	7	0.31%
Turbellaria	4	0.18%
Nematoda	3	0.13%
Lara	2	0.09%
Hydrozoa	2	0.09%

Functional Composition

Category	R	A	PRA
Predator	4	15	0.67%
Parasite	1	3	0.13%
Collector Gatherer	5	557	24.98%
Collector Filterer	2	1586	71.12%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	2	69	3.09%
Omivore			
Unknown			

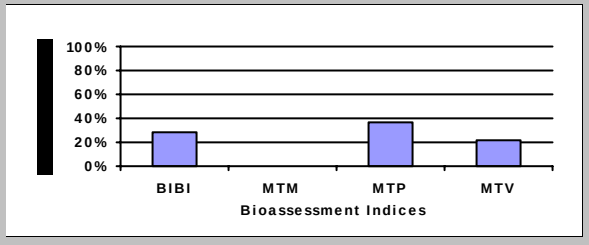


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	14	1	1		0
Non-Insect Percent	12.42%				
E Richness	1	1		0	
P Richness	1	1		1	
T Richness	1	1		0	
EPT Richness	3		1		0
EPT Percent	12.02%		1		0
Oligochaeta+Hirudinea Percent	1.21%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	1.000				
Dominance					
Dominant Taxon Percent	67.53%		0		0
Dominant Taxa (2) Percent	75.20%				
Dominant Taxa (3) Percent	82.83%	1			
Dominant Taxa (10) Percent	99.10%				
Diversity					
Shannon H (loge)	1.164				
Shannon H (log2)	1.679		0		
Margalef D	1.693				
Simpson D	0.505				
Evenness	0.085				
Function					
Predator Richness	4		2		
Predator Percent	0.67%	1			
Filterer Richness	2				
Filterer Percent	71.12%			0	
Collector Percent	96.10%		0		0
Scraper+Shredder Percent	3.09%		1		0
Scraper/Filterer	0.000				
Scraper/Scraper+Filterer	0.000				
Habit					
Burrower Richness	1				
Burrower Percent	5.83%				
Swimmer Richness	1				
Swimmer Percent	7.67%				
Clinger Richness	3	1			
Clinger Percent	71.08%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	0				
Air Breather Percent	0.00%				
Voltinism					
Univoltine Richness	7				
Semivoltine Richness	2	1			
Multivoltine Percent	13.90%		3		
Tolerance					
Sediment Tolerant Richness	1				
Sediment Tolerant Percent	1.21%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.836				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	2.65%	5		3	
Hilsenhoff Biotic Index	5.999		2		0
Intolerant Percent	3.09%				
Supertolerant Percent	10.13%				
CTQa	88.909				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	11	36.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	4	22.22%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe



Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C002
Sta. Name: Kelsey / Glendale "wooded" Composite
Client ID:
STORET ID:
Coll. Date: 8/24/2009

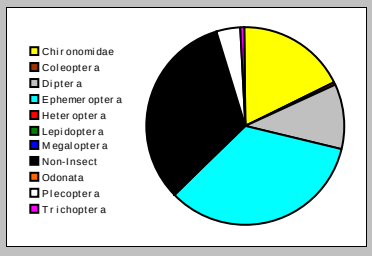
Abundance Measures

Sample Count: 1986
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	9	648	32.63%
Odonata			
Ephemeroptera	1	669	33.69%
Plecoptera	2	84	4.23%
Heteroptera			
Megaloptera			
Trichoptera	4	10	0.50%
Lepidoptera			
Coleoptera	2	7	0.35%
Diptera	5	210	10.57%
Chironomidae	1	358	18.03%

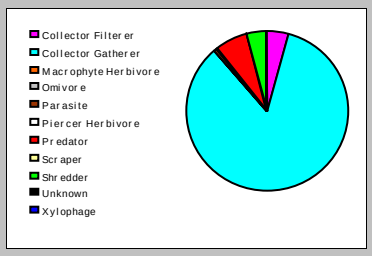


Dominant Taxa

Category	A	PRA
Baetis tricaudatus	669	33.69%
Crangonyx	396	19.94%
Chironomidae	358	18.03%
Antocha	133	6.70%
Turbellaria	95	4.78%
Malenka	83	4.18%
Simulium	67	3.37%
Caecidotea	56	2.82%
Oligochaeta	50	2.52%
Acari	22	1.11%
Sphaeriidae	11	0.55%
Nematoda	11	0.55%
Narpus concolor	6	0.30%
Hydrozoa	6	0.30%
Hydroptila	5	0.25%

Functional Composition

Category	R	A	PRA
Predator	6	127	6.39%
Parasite	1	11	0.55%
Collector Gatherer	10	1673	84.24%
Collector Filterer	5	87	4.38%
Macrophyte Herbivore			
Piercer Herbivore	1	5	0.25%
Xylophage			
Scraper			
Shredder	1	83	4.18%
Omivore			
Unknown			

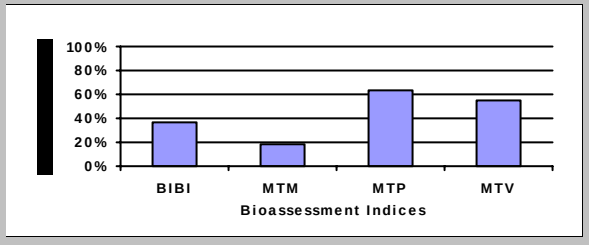


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	24	3	2		2
Non-Insect Percent	32.63%				
E Richness	1	1		0	
P Richness	2	1		2	
T Richness	4	1		2	
EPT Richness	7		2		0
EPT Percent	38.42%		2		0
Oligochaeta+Hirudinea Percent	2.52%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.400				
Dominance					
Dominant Taxon Percent	33.69%		2		2
Dominant Taxa (2) Percent	53.63%				
Dominant Taxa (3) Percent	71.65%	3			
Dominant Taxa (10) Percent	97.13%				
Diversity					
Shannon H (loge)	1.973				
Shannon H (log2)	2.846		2		
Margalef D	3.038				
Simpson D	0.198				
Evenness	0.088				
Function					
Predator Richness	6		3		
Predator Percent	6.39%	1			
Filterer Richness	5				
Filterer Percent	4.38%			3	
Collector Percent	88.62%		1		0
Scraper+Shredder Percent	4.18%		1		0
Scraper/Filterer	0.000				
Scraper/Scraper+Filterer	0.000				
Habit					
Burrower Richness	2				
Burrower Percent	18.13%				
Swimmer Richness	1				
Swimmer Percent	33.69%				
Clinger Richness	10	1			
Clinger Percent	11.23%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	1				
Air Breather Percent	6.70%				
Voltinism					
Univoltine Richness	15				
Semivoltine Richness	2	1			
Multivoltine Percent	58.46%		2		
Tolerance					
Sediment Tolerant Richness	2				
Sediment Tolerant Percent	9.21%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.472				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	3.07%	5		3	
Hilsenhoff Biotic Index	5.670		2		0
Intolerant Percent	4.58%				
Supertolerant Percent	23.97%				
CTQa	90.050				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	19	63.33%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	10	55.56%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	4	19.05%	Severe



Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C003
Sta. Name: Coal Creek Trailhead Composite
Client ID:
STORET ID:
Coll. Date: 8/26/2009

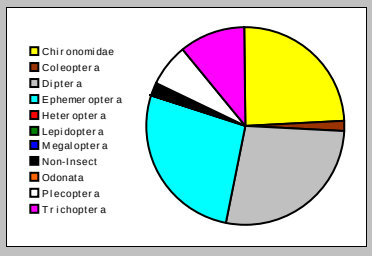
Abundance Measures

Sample Count: 1704
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	4	32	1.88%
Odonata			
Ephemeroptera	2	463	27.17%
Plecoptera	4	119	6.98%
Heteroptera			
Megaloptera			
Trichoptera	5	188	11.03%
Lepidoptera			
Coleoptera	5	31	1.82%
Diptera	8	455	26.70%
Chironomidae	1	416	24.41%

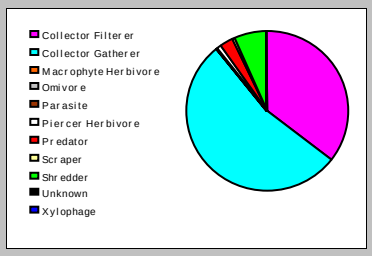


Dominant Taxa

Category	A	PRA
Baetis tricaudatus	436	25.59%
Chironomidae	416	24.41%
Simulium	392	23.00%
Hydropsyche	150	8.80%
Malenka	80	4.69%
Simuliidae	44	2.58%
Diphetor hageni	27	1.58%
Zapada cinctipes	19	1.12%
Oligochaeta	15	0.88%
Elmidae	12	0.70%
Acari	12	0.70%
Nemouridae	11	0.65%
Dicranota	11	0.65%
Hydropsychidae	9	0.53%
Hydroptila	8	0.47%

Functional Composition

Category	R	A	PRA
Predator	9	48	2.82%
Parasite	1	3	0.18%
Collector Gatherer	11	924	54.23%
Collector Filterer	2	595	34.92%
Macrophyte Herbivore			
Piercer Herbivore	1	15	0.88%
Xylophage			
Scraper	1	6	0.35%
Shredder	4	113	6.63%
Omivore			
Unknown			

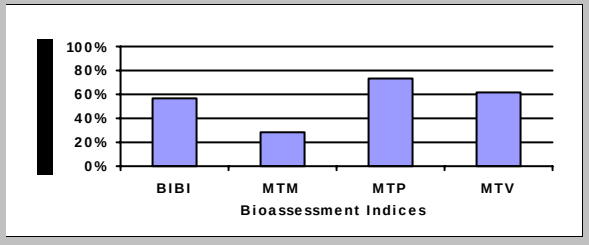


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	29	3	3		3
Non-Insect Percent	1.88%				
E Richness	2	1		1	
P Richness	4	3		3	
T Richness	5	3		3	
EPT Richness	11		3		0
EPT Percent	45.19%		2		1
Oligochaeta+Hirudinea Percent	0.88%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.846				
Dominance					
Dominant Taxon Percent	25.59%		3		2
Dominant Taxa (2) Percent	50.00%				
Dominant Taxa (3) Percent	73.00%	3			
Dominant Taxa (10) Percent	93.37%				
Diversity					
Shannon H (loge)	1.875				
Shannon H (log2)	2.704		2		
Margalef D	3.797				
Simpson D	0.208				
Evenness	0.089				
Function					
Predator Richness	9		3		
Predator Percent	2.82%	1			
Filterer Richness	2				
Filterer Percent	34.92%			0	
Collector Percent	89.14%		1		0
Scraper+Shredder Percent	6.98%		1		0
Scraper/Filterer	0.010				
Scraper/Scraper+Filterer	0.010				
Habit					
Burrower Richness	5				
Burrower Percent	25.23%				
Swimmer Richness	3				
Swimmer Percent	27.23%				
Clinger Richness	11	3			
Clinger Percent	38.56%				
Characteristics					
Cold Stenotherm Richness	1				
Cold Stenotherm Percent	0.06%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	4				
Air Breather Percent	0.94%				
Voltinism					
Univoltine Richness	16				
Semivoltine Richness	6	5			
Multivoltine Percent	53.46%		2		
Tolerance					
Sediment Tolerant Richness	5				
Sediment Tolerant Percent	1.82%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.482				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	0.88%	5		3	
Hilsenhoff Biotic Index	5.944		2		0
Intolerant Percent	6.63%				
Supertolerant Percent	25.41%				
CTQa	69.115				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	28	56.00%	
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)	6	28.57%	Moderate



Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C004
Sta. Name: Lewis I-90 Composite
Client ID:
STORET ID:
Coll. Date: 8/21/2009

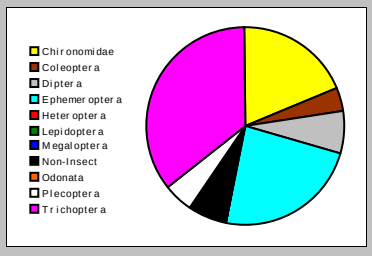
Abundance Measures

Sample Count: 1581
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	9	97	6.14%
Odonata			
Ephemeroptera	2	366	23.15%
Plecoptera	6	80	5.06%
Heteroptera			
Megaloptera			
Trichoptera	8	566	35.80%
Lepidoptera			
Coleoptera	5	59	3.73%
Diptera	11	113	7.15%
Chironomidae	1	300	18.98%

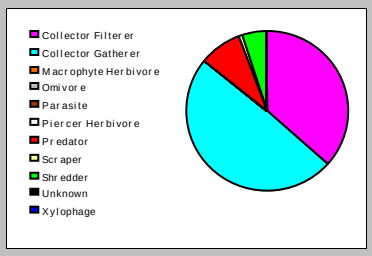


Dominant Taxa

Category	A	PRA
Hydropsyche	455	28.78%
Baetis tricaudatus	316	19.99%
Chironomidae	300	18.98%
Simulium	57	3.61%
Hydropsychidae	53	3.35%
Diphetor hageni	50	3.16%
Oligochaeta	46	2.91%
Malenka	38	2.40%
Acari	25	1.58%
Heterlimnius	20	1.27%
Rhyacophila	19	1.20%
Skwala	18	1.14%
Rhyacophila Betteni Gr.	18	1.14%
Dicranota	17	1.08%
Narpus concolor	16	1.01%

Functional Composition

Category	R	A	PRA
Predator	13	134	8.48%
Parasite	1	3	0.19%
Collector Gatherer	15	781	49.40%
Collector Filterer	4	574	36.31%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	3	13	0.82%
Shredder	5	75	4.74%
Omivore	1	1	0.06%
Unknown			

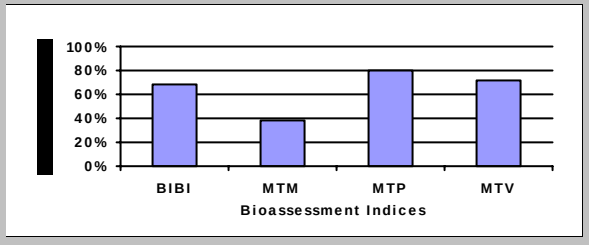


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	42	5	3		3
Non-Insect Percent	6.14%				
E Richness	2	1		1	
P Richness	6	3		3	
T Richness	8	3		3	
EPT Richness	16		3		1
EPT Percent	64.01%		3		2
Oligochaeta+Hirudinea Percent	2.91%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.901				
Dominance					
Dominant Taxon Percent	28.78%		3		2
Dominant Taxa (2) Percent	48.77%				
Dominant Taxa (3) Percent	67.74%	3			
Dominant Taxa (10) Percent	86.02%				
Diversity					
Shannon H (loge)	2.178				
Shannon H (log2)	3.142		3		
Margalef D	5.623				
Simpson D	0.188				
Evenness	0.072				
Function					
Predator Richness	13		3		
Predator Percent	8.48%	1			
Filterer Richness	4				
Filterer Percent	36.31%			0	
Collector Percent	85.71%		1		0
Scraper+Shredder Percent	5.57%		1		0
Scraper/Filterer	0.023				
Scraper/Scraper+Filterer	0.022				
Habit					
Burrower Richness	5				
Burrower Percent	20.37%				
Swimmer Richness	4				
Swimmer Percent	23.28%				
Clinger Richness	15	3			
Clinger Percent	44.34%				
Characteristics					
Cold Stenotherm Richness	4				
Cold Stenotherm Percent	0.57%				
Hemoglobin Bearer Richness	1				
Hemoglobin Bearer Percent	0.19%				
Air Breather Richness	4				
Air Breather Percent	1.45%				
Voltinism					
Univoltine Richness	28				
Semivoltine Richness	6	5			
Multivoltine Percent	44.53%		2		
Tolerance					
Sediment Tolerant Richness	4				
Sediment Tolerant Percent	4.43%				
Sediment Sensitive Richness	2				
Sediment Sensitive Percent	0.13%				
Metals Tolerance Index	4.291				
Pollution Sensitive Richness	4	5		3	
Pollution Tolerant Percent	0.38%	5		3	
Hilsenhoff Biotic Index	5.466		2		0
Intolerant Percent	9.04%				
Supertolerant Percent	22.33%				
CTQa	67.667				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	34	68.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	24	80.00%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	13	72.22%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	8	38.10%	Moderate



Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C005
Sta. Name: Lewis Elliot Composite
Client ID:
STORET ID:
Coll. Date: 8/22/2009

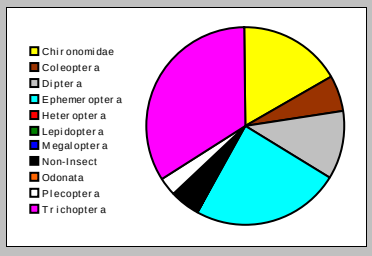
Abundance Measures

Sample Count: 1567
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	5	77	4.91%
Odonata			
Ephemeroptera	2	376	23.99%
Plecoptera	2	45	2.87%
Heteroptera			
Megaloptera			
Trichoptera	6	540	34.46%
Lepidoptera			
Coleoptera	4	89	5.68%
Diptera	8	174	11.10%
Chironomidae	1	266	16.98%

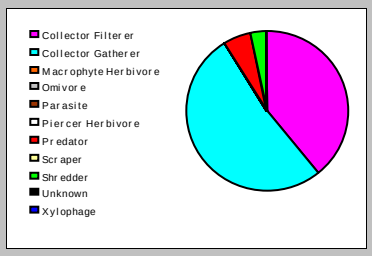


Dominant Taxa

Category	A	PRA
Hydropsyche	382	24.38%
Baetis tricaudatus	309	19.72%
Chironomidae	266	16.98%
Hydropsychidae	121	7.72%
Simulium	100	6.38%
Antocha	54	3.45%
Heterlimnius	53	3.38%
Diphetor hageni	37	2.36%
Malenka	33	2.11%
Acari	32	2.04%
Baetidae	30	1.91%
Oligochaeta	28	1.79%
Rhyacophila Betteni Gr.	15	0.96%
Narpus concolor	14	0.89%
Elmidae	13	0.83%

Functional Composition

Category	R	A	PRA
Predator	10	82	5.23%
Parasite	1	3	0.19%
Collector Gatherer	9	818	52.20%
Collector Filterer	3	611	38.99%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	3	0.19%
Shredder	3	50	3.19%
Omivore			
Unknown			

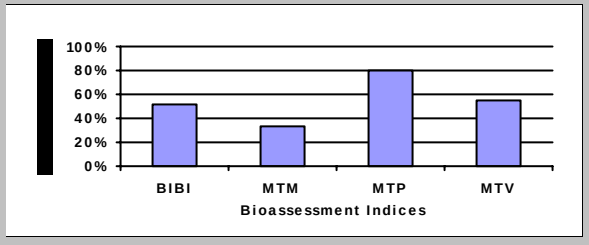


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	28	3	3		2
Non-Insect Percent	4.91%				
E Richness	2	1		1	
P Richness	2	1		2	
T Richness	6	3		3	
EPT Richness	10		3		0
EPT Percent	61.33%		3		2
Oligochaeta+Hirudinea Percent	1.79%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	0.931				
Dominance					
Dominant Taxon Percent	24.38%		3		3
Dominant Taxa (2) Percent	44.10%				
Dominant Taxa (3) Percent	61.07%	3			
Dominant Taxa (10) Percent	88.51%				
Diversity					
Shannon H (loge)	2.119				
Shannon H (log2)	3.057		3		
Margalef D	3.741				
Simpson D	0.176				
Evenness	0.081				
Function					
Predator Richness	10		3		
Predator Percent	5.23%	1			
Filterer Richness	3				
Filterer Percent	38.99%			0	
Collector Percent	91.19%		1		0
Scraper+Shredder Percent	3.38%		1		0
Scraper/Filterer	0.005				
Scraper/Scraper+Filterer	0.005				
Habit					
Burrower Richness	4				
Burrower Percent	17.42%				
Swimmer Richness	3				
Swimmer Percent	22.14%				
Clinger Richness	11	3			
Clinger Percent	50.16%				
Characteristics					
Cold Stenotherm Richness	1				
Cold Stenotherm Percent	0.13%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	2				
Air Breather Percent	3.51%				
Voltinism					
Univoltine Richness	18				
Semivoltine Richness	5	5			
Multivoltine Percent	43.20%		2		
Tolerance					
Sediment Tolerant Richness	3				
Sediment Tolerant Percent	5.30%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.399				
Pollution Sensitive Richness	1	1		1	
Pollution Tolerant Percent	0.13%	5		3	
Hilsenhoff Biotic Index	5.325		2		0
Intolerant Percent	6.19%				
Supertolerant Percent	18.83%				
CTQa	75.083				

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)	10	55.56%	Slight
MTM	Montana DEQ Mountains (Bukantis 1998)	7	33.33%	Moderate



Metrics Report

Project ID: CB09LD-C
RAI No.: CB09LD-C006
Sta. Name: West Trib Farm Composite
Client ID:
STORET ID:
Coll. Date: 8/27/2009

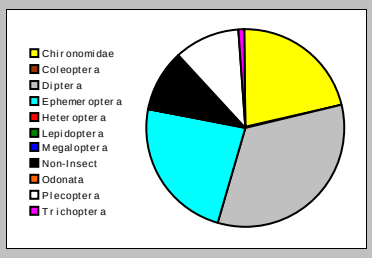
Abundance Measures

Sample Count: 1690
Sample Abundance: of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	7	175	10.36%
Odonata			
Ephemeroptera	1	401	23.73%
Plecoptera	1	178	10.53%
Heteroptera			
Megaloptera			
Trichoptera	2	21	1.24%
Lepidoptera			
Coleoptera			
Diptera	3	552	32.66%
Chironomidae	1	363	21.48%

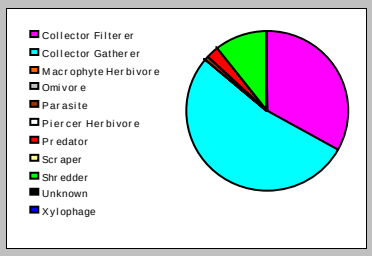


Dominant Taxa

Category	A	PRA
Simulium	490	28.99%
Chironomidae	363	21.48%
Baetis tricaudatus	254	15.03%
Malenka	164	9.70%
Baetidae	128	7.57%
Crangonyx	64	3.79%
Simuliidae	43	2.54%
Amphipoda	31	1.83%
Oligochaeta	24	1.42%
Baetis	19	1.12%
Antocha	17	1.01%
Sphaeriidae	15	0.89%
Turbellaria	14	0.83%
Nemouridae	14	0.83%
Nematoda	13	0.77%

Functional Composition

Category	R	A	PRA
Predator	5	42	2.49%
Parasite	1	13	0.77%
Collector Gatherer	5	900	53.25%
Collector Filterer	2	556	32.90%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	1	0.06%
Shredder	1	178	10.53%
Omivore			
Unknown			



Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	15	1	1		0
Non-Insect Percent	10.36%				
E Richness	1	1		0	
P Richness	1	1		1	
T Richness	2	1		1	
EPT Richness	4		1		0
EPT Percent	35.50%		2		0
Oligochaeta+Hirudinea Percent	1.42%				
Baetidae/Ephemeroptera	1.000				
Hydropsychidae/Trichoptera	1.000				
Dominance					
Dominant Taxon Percent	28.99%		3		2
Dominant Taxa (2) Percent	50.47%				
Dominant Taxa (3) Percent	65.50%	3			
Dominant Taxa (10) Percent	93.49%				
Diversity					
Shannon H (loge)	1.747				
Shannon H (log2)	2.520		2		
Margalef D	1.927				
Simpson D	0.225				
Evenness	0.112				
Function					
Predator Richness	5		2		
Predator Percent	2.49%	1			
Filterer Richness	2				
Filterer Percent	32.90%			0	
Collector Percent	86.15%		1		0
Scraper+Shredder Percent	10.59%		1		0
Scraper/Filterer	0.002				
Scraper/Scraper+Filterer	0.002				
Habit					
Burrower Richness	2				
Burrower Percent	21.60%				
Swimmer Richness	1				
Swimmer Percent	16.15%				
Clinger Richness	4	1			
Clinger Percent	33.79%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness					
Hemoglobin Bearer Percent					
Air Breather Richness	2				
Air Breather Percent	1.12%				
Voltinism					
Univoltine Richness	8				
Semivoltine Richness	2	1			
Multivoltine Percent	47.57%		2		
Tolerance					
Sediment Tolerant Richness	4				
Sediment Tolerant Percent	2.60%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.233				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	0.06%	5		3	
Hilsenhoff Biotic Index	5.805		2		0
Intolerant Percent	10.95%				
Supertolerant Percent	23.79%				
CTQa	78.923				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	16	32.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	17	56.67%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	5	27.78%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	2	9.52%	Severe