Benthic Macroinvertebrate Study of the Greater Lake Washington and Green-Duwamish River Watersheds Year 2003 Data Analysis

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King County

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TABLE OF CONTENTS

TABLE OF CONTENTS i

LIST OF FIGURES iii

LIST OF TABLES iv

LIST OF ACRONYMS vi

ACKNOWLEDGEMENTS vii

EXECUTIVE SUMMARY ---------- 1

1. INTRODUCTION ---------- 1

1.1 Goals/Purpose of Report 1

2. METHODS ---------- 3

2.1 Study Area 3
2.2 Sampling Sites 3
2.3 Data Sources 9
2.3.1 Benthic Macroinvertebrate Data 9
2.3.2 Physico-Chemical Data 9
2.3.2.1 Water Quality Data 9
2.3.2.2 Hydrology Data 10
2.3.2.3 Land-Use Data 10
2.3.2.4 Habitat Data 10
2.4 Calculation of Benthic Community Indices 11
2.4.1 B-IBI 11
2.4.2 Functional Feeding Group Analysis 11
2.4.3 Hilsenhoff Biotic Index 12
2.4.4 Shannon-Weiner Diversity Index 12
2.5 Statistical Analyses 13

3. RESULTS AND DISCUSSION ---------- 14

3.1 B-IBI Scores 14
3.1.1 Individual Station B-IBI-Scores, 2003 14
3.1.2 Comparison of 2002 and 2003 Individual Station B-IBI-Scores and Rankings 15
3.1.3 Mean Sub-Basin B-IBI-Scores, 2003 18
3.1.4 Comparison of 2002 and 2003 Mean Sub-Basin B-IBI-Scores 20
3.2 B-IBI Scores and Other Indices 22

3.3 B-IBI and Functional Feeding Groups 25
3.3.1 Mean Sub-Basin B-IBI-Scores vs. Mean Sub-Basin Proportions of Organisms in Functional Feeding Groups, 2003 25
3.3.2 Comparison of 2002 and 2003 Mean Sub-Basin Proportions of Organisms in Various Functional Feeding Groups 28
3.4 B-IBI Scores and Land-Use Parameters 29
3.4.1 Total Impervious Area (TIA) versus Effective Impervious Area (EIA) 29
3.4.2 B-IBI vs. %EIA 29
3.4.3 B-IBI vs. Upstream Land Use 31
3.5 B-IBI Scores and Water Quality 34
3.6 B-IBI Scores and Habitat Variables 37
3.7 B-IBI Scores and Hydrological Parameters 38

4. CONCLUSIONS ---------- 42

5. REFERENCES ---------- 44

Appendix A – 2002 and 2003 Benthic Sites with Data Types Available for Each Site

Appendix B – Land Use Data

Appendix C – B-IBI Calculation

Appendix D – HBI Pollution Tolerance Values

Appendix E – Benthic Indices for All Sites

Appendix F – 2003 Benthic Macroinvertebrate Raw Data

LIST OF FIGURES

Figure 1: 2002 and 2003 study area overview. **5**

Figure 2: Proportions of stations in 20 sub-basins sampled in 2003 with B-IBI scores ranked as being "good", "fair", "poor", or "very poor". Numbers of stations sampled in each sub-basin are provided in parentheses. **15**

Figure 3: Frequency distribution of differences between 2002 and 2003 B-IBI scores for streams sampled in both years (n=120). **16**

Figure 4: Proportion of sampled sites, by sub-basin, for which B-IBI rankings remained the same, increased, or decreased from 2002 to 2003. **17**

Figure 5: For the 120 stations sampled in both 2002 and 2003, the frequency distribution of stations with good, fair, poor, and very poor B-IBI rankings. **18**

Figure 6: Mean sub-basin B-IBI scores (+1 standard deviation) based on 120 stations which were sampled in both 2002 and 2003. ..... **21**

Figure 7a: Sub-basin mean B-IBI scores vs. mean number of taxa (± standard deviation). Filled circles (●) indicate 2003 data, empty circles (○) indicate 2002 data. **23**

Figure 8: Mean proportions of organisms in each functional feeding group for 20 sub-basins in the study area, based upon 2003 samples. Sub-basins are sorted by mean B-IBI score (in parentheses). **27**

Figure 9: Overall mean proportion of organisms in seven functional feeding groups in samples collected in 2002 and 2003. ..... **29**

Figure 10a: Individual site B-IBI scores vs. mean % EIA, 2002 and 2003. Regression lines for 2002 (- - -) and 2003 (—) data are shown. **30**

Figure 11: Proportions of watersheds in each sampled sub-basins with each land-use type. Sub-basins are sorted in order of mean sub-basin B-IBI score (in parentheses). **33**

Figure 12: Total monthly rainfall at Seattle Tacoma Airport, April to September, 2002 and 2003. Source National Weather Service. **40**

LIST OF TABLES

Table 1: Numbers of benthic macroinvertebrate stations in sampled in King Country sub-basins in 2002, 2003, and both years. Numbers of sites sampled only during one year or the other are given in parentheses. **4**

Table 2: Mean sub-basin B-IBI scores, HBI scores, total numbers of taxa, numbers of EPT taxa, and SWDI values for 20 sub-basins in the Green-Duwamish and Greater Lake Washington watersheds, based on 2003 samples. **19**

Table 3: Results of paired comparisons among sub-basin mean B-IBI scores for 20 sub-basins in the study area, based upon 2002 samples. Pairs of means indicated by ● are significantly different (p<0.05). . **20**

Table 4: Spearman rank correlation coefficients for site-level B-IBI scores and percentages of organisms at each site in different functional feeding groups (n=143). **25**

Table 5: Proportions of organisms in each functional feeding group for 20 sub-basins in the study area, based upon 2003 samples. Note, only taxa assigned to a functional feeding group by Merritt and Cummins (1997) were included in this analysis. **26**

Table 6: Sub-basin mean proportions of organisms in each functional feeding group for sub-basins sampled in 2002 and 2003. ..... **28**

Table 7: Spearman rank correlation coefficients for site-level B-IBI scores and percentages of watersheds occupied by various land-use types (n=130). **31**

Table 8: Spearman rank correlation coefficients for sub-basin-level mean B-IBI scores and mean percentages of sub-basins occupied by various land-use types (n=20). **32**

Table 9: Spearman rank correlation coefficients for site-level B-IBI scores and selected mean base-flow water quality parameters. **35**

Table 10: Spearman rank correlation coefficients for site-level B-IBI scores and selected mean storm-flow water quality parameters. **36**

Table 11: Spearman rank correlation coefficients for site-level land use data and selected mean base-flow water quality parameters. **37**

Table 12: Spearman rank correlation coefficients for site-level B-IBI scores and selected habitat parameters. **38**

Table 13: Spearman rank correlation coefficients for 2003 site-level B-IBI scores and discharge (Q) summary data. **39**

Table 14: Spearman rank correlation coefficients for site-level land use categories and instantaneous flow and discharge (Q) summary data. **41**

LIST OF ACRONYMS

ANOVA	Analysis of Variance
BI	Biotic Index
B-IBI	Benthic Index of Biological Integrity
BMEP	Basin Management Evaluation Program
BOD	Biological Oxygen Demand
CFU	Colony Forming Units
CTI	Community Tolerance Index
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
EPT	Ephemeroptera, Plecoptera, Trichoptera
EVS	EVS Environment Consultants
FFG	Functional Feeding Group
GIS	Geographic Information System
HBI	Hilsenhoff Biotic Index
MS	Microsoft
NTU	Nephelometric Turbidity Units
QA/QC	Quality Assurance / Quality Control
RBP	Rapid Bioassessment Protocol
SAP	Sampling and Analysis Plan
SWDI	Shannon-Weiner Diversity Index
EIA	Effective Impervious Area
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USGS	United States Geological Survey
WLRD	Water and Land Resources Division
WQ	Water Quality
WQI	Water Quality Index

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Introduction

In 2002, the King County Water and Land Resources Division (WLRD) began conducting a baseline study to assess whether resident benthic macroinvertebrate communities can be used to assess environmental conditions in King County watercourses, and thereby provide a practical tool for monitoring changes in aquatic ecosystem health. EVS-Golder previously completed an analysis of WLRD's 2002 benthic macroinvertebrate data, and this report presents the results of our analysis of the 2003 data. The focus of this report is the use of the Benthic Index of Biotic Integrity (B-IBI).

Data Sources

The 2003 data were collected from a total of 130 sites in 20 sub-basins in the Green-Duwamish River and Greater Lake Washington watersheds during August and September 2003. This analysis included data from a total of 29 water quality (WQ) monitoring stations and 20 hydrological gauging stations. Land-use data derived from WLRD's GIS land-use database were used to derive the percentage effective impervious area and land-use types upstream from each benthic macroinvertebrate sampling site.

B-IBI Scores

Mean 2003 sub-basin B-IBI scores in King County streams ranged from a high of 38.0 in the Deep/Coal sub-basin to a low of 14.0 in the Duwamish sub-basin. Of the 20 sub-basins sampled, one was ranked as having a "good" mean B-IBI score, one "fair-good", five "fair", two "fair-poor", seven "poor", one "poor-very poor" and three "very poor". The B-IBI scores indicate that most watercourses in the Deep/Coal and Issaquah sub-basins are in relatively good biological condition, whereas most of the watercourses in the Duwamish, West Lake Washington and Black sub-basins are heavily impacted by human development. Overall, 2003 sub-basin B-IBI scores were similar to those measured in 2002.

B-IBI Scores and Other Indices

As was the case in 2002, there are strong significant correlations between a sample's B-IBI score and the number of invertebrate and EPT taxa present, as well as significant but weaker correlations between a sample's B-IBI score and the Shannon-Weiner Diversity Index (SWDI) and Hilsenhoff Biotic Index (HBI). SWDI and HBI are alternatives to B-IBI as methods for measuring invertebrate community diversity.

B-IBI Scores and Function Feeding Groups

In 2002 and 2003, there was no apparent relationship between a sample's B-IBI score and the proportions of organisms in various functional feeding groups. The mean proportion of organisms in each functional feeding group is generally consistent among sub-basins. Although the taxonomic composition and diversity of benthic macroinvertebrate communities vary widely among the sampled communities, the structure of all the communities, in terms of the proportion of organisms in each feeding group, is similar.

B-IBI and Land Use

The B-IBI score of a given site is closely correlated with the land-use practices within the site's watershed, whether this is measured in terms of the percentage effective impervious area (%EIA), or the proportion of a watershed that is occupied by different types of development. The relationship between the B-IBI score and %EIA in 2003 was similar to that observed in 2002.

B-IBI increases as the amount of forest and scrub/shrub in a watershed increases, and decreases with the amount of developed land (i.e., bare ground/asphalt, bare rock/concrete, and high, medium, and low-intensity development). As the %EIA in a watershed increases, its B-IBI score decreases.

B-IBI and Water Quality

B-IBI scores decrease as mean base-flow conductivity, alkalinity, turbidity, total suspended solids (TSS), total phosphorus (P), total zinc (Zn), and total copper (Cu) in a stream increase. However, these parameters are often significantly correlated with one another, which makes it difficult to infer a causal relationship between individual water quality variables and B-IBI scores.

Water Quality and Land-Use

In light of the very strong correlations observed between site-level B-IBI scores and land-use parameters, the relationship between water quality parameters and land-use was examined. The most consistent correlations were observed between land-use and conductivity, and between land-use and alkalinity. As watersheds become increasingly urbanized, the conductivity and alkalinity of their watercourses increase.

B-IBI and Aquatic Habitat Variables

B-IBI score was significantly positively correlated with subdominant substrate particle size and riparian tree density. B-IBI score increased with increasing substrate particle size and increasing riparian tree density.

B-IBI and Hydrology

The higher the instantaneous stream velocity at a sampled site, and the greater the watershed area upstream from a site, the higher the site's B-IBI score. However, none of the stream discharge (Q) parameters measured were significantly correlated with B-IBI score.

Conclusions

The B-IBI provides a useful tool for monitoring the health of King County stream ecosystems, providing scores that closely parallel the degree of urbanization in the sampled watersheds.

The following responses are offered in response to the questions that this study was designed to address:

Question 1 and 2: Do different watershed sub-basins within the Greater Lake Washington Watershed and Greater Green-Duwamish Watershed differ in terms of biological condition? Summarizing data from the sampling sites within a sub-basin into a mean sub-basin score offers a convenient means of simplifying the presentation and discussion of data concerning the biological condition of King County streams. Although differences between mean B-IBI scores were only statistically significant between the sub-basins with the highest and lowest mean B-IBI scores, mean sub-basin scores generally provide an accurate reflection of the overall biological health of the streams in each sub-basin. The sub-basins in the best biological condition were Deep/Coal creeks and Issaquah Creek, where watercourses generally have "good" or "fair" B-IBI scores. In contrast, all of the watercourses in the Duwamish, West Lake Washington, Black, and North/Swamp sub-basins had "poor" or very poor" B-IBI scores. B-IBI scores and rankings were similar in 2002 and 2003 for streams sampled in both years.

Question 4: Do different land use patterns measured at the sub-basin level affect biological conditions differently within the watershed? In general, differences in land-use patterns within sub-basins closely reflected differences in B-IBI scores among sub-basins. Overall, mean sub-basin B-IBI scores declined with increasing development.

Site and sub-basin level B-IBI scores decline significantly as the percentage of upstream EIA, bare ground/asphalt, bare rock/concrete, and high, medium and low intensity development increases. Conversely, site-level B-IBI scores increase as the amount of upstream forest and scrub/shrub increase. Although limitations in the available data did not permit us to determine precisely which urbanization-related hydrological or water quality parameters are causing invertebrate community integrity to decline with increasing urban development, B-IBI scores are significantly correlated with conductivity, alkalinity, turbidity, total phosphorus, total copper and total zinc, and stream flow.

Question 3: *Is the biological condition improving (or declining) over time? Is the trend significant?* Two years of data, which had different levels of rainfall, are of limited value in assessing whether the biological condition of King County streams is improving or declining over time. However, our data indicate that the biological conditions in most of the sampled streams were similar during the two years of study.

Biological condition declined between 2002 and 2003 in the Evans Creek and Jenkins Creek sub-basins, and improved in the Mill Creek sub-basin. Although reasons for these changes were not apparent, these sub-basins should be monitored closely to determine if the observed changes are part of a long-term trend.

Continued use of the 10-metric B-IBI for monitoring King County streams is recommended. Of the different indices that were tested, the B-IBI provides the most information. If adoption of a "simpler" biotic index is required (e.g., as a cost-saving measure), separation of the mayfly, stonefly, and caddisfly (EPT) taxa from benthic macroinvertebrate samples and submitting them to the taxonomic laboratory for analysis, then summing the number of EPT taxa for each site is recommended. This would dramatically reduce the amount of taxonomic identification required, but would yield a score which corresponds very closely to the site's B-IBI score.

1. INTRODUCTION

1.1 GOALS/PURPOSE OF REPORT

The Water and Land Resources Division (WLRD) is responsible for monitoring water quality and overall ecological health in the surface waters of King County, Washington. WLRD monitors physical and chemical water quality variables, and also collects data regarding stream-resident benthic macroinvertebrate communities. WLRD is currently evaluating the *Benthic Index of Biotic Integrity* (B-IBI) as a multimetric bioassessment framework for interpreting their benthic macroinvertebrate monitoring data. The B-IBI involves calculation of a series of "metrics" (e.g., numbers and types of taxa, pollution tolerance) which quantify community attributes sensitive to environmental changes. The metrics can then be compared to values that correspond to known states of ecosystem health (i.e., excellent - very poor) to assess the biological condition of sampled watercourses.

The objective of this report is to provide an analysis of the second year of data collected by WLRD, with the goal of providing answers to four questions posed in WLRD's *Benthic Sampling and Analysis Plan* (SAP)(King County, 2002a, b):

1. Do different sub-basins within the Greater Lake Washington watershed differ in terms of biological condition?
2. Do different sub-basins within the Green-Duwamish watershed differ in terms of biological condition?
3. Is the biological condition improving (or declining) over time? Is the trend significant?
4. Do different land use patterns measured at the sub-basin level affect biological conditions differently within the watershed?

To address Questions 1 and 2, benthic macroinvertebrate data collected in 2003 from sites in the Green-Duwamish and Greater Lake Washington watersheds (i.e., the *study area*) were used to calculate B-IBI scores, in order to rate the biological conditions at the sampled sites and sub-basins. This analysis compliments a similar effort conducted with 2002 data (EVS 2004); data from both years were compared.

To address Question 3, the benthic macroinvertebrate data from 2002 and 2003 were summarized to establish a "baseline" against which future changes in habitat conditions (e.g., such as wastewater conveyance lines, roads, stormwater drainage, erosion, vegetation clearing, natural catastrophic events) in each sub-basin can be measured.

To address Question 4, GIS land-use data collected by WRLD staff were compared to each benthic sampling station's upstream land-use patterns with its B-IBI score. When there were cases where the macroinvertebrate data indicated substantial habitat impairment in a particular sub-basin, available land-use, water quality, and hydrology data were evaluated further in an attempt to investigate potential sources of this impairment.

A further objective of this report was to compare the B-IBI with several other commonly used measures of aquatic community structure and integrity, the Shannon-Weiner Diversity Index, the Hilsenhoff Biotic Index, and the Functional Feeding Group structure, to determine if the B-IBI offers any significant advantages over these simpler indices.

2. METHODS

2.1 STUDY AREA

The 2003 study area was the same as that sampled in 2002, and included both the Green-Duwamish watershed (Water Resource Inventory Area [WRIA] 9) and the Greater Lake Washington watershed (WRIA 8) (Figure 1).

The Green-Duwamish watershed extends from the crest of the Cascade Mountains at the headwaters of the Green River, west to the mouth of the Duwamish River which empties into Elliott Bay at the City of Seattle. In the Green-Duwamish watershed, the following sub-basins were sampled: Black River, Covington Creek, Deep and Coal creeks, Duwamish River, Jenkins Creek, Lower Green River, Middle Green River, Mill Creek, Newaukum Creek, and Soos Creek (Figure 1).

The Greater Lake Washington-Cedar River drainage encompasses the land area in which water drains to Lake Sammamish, which empties to the Sammamish River and out into Lake Washington, which also drains the Cedar River. The watershed includes the following sampled sub-basins: Bear Creek, Cedar River, East Lake Washington tributaries, Evans Creek, Issaquah Creek, Lake Sammamish tributaries, Little Bear Creek, North and Swamp creeks, Sammamish River tributaries, and West Lake Washington tributaries (Figure 1).

2.2 SAMPLING SITES

In 2003, a total of 130 sites in 20 sub-basins were sampled (Figure 1, Appendix A). Ten sites were sampled twice (i.e., replicate samples), but data from the duplicate sites were not used in this analysis. In all, 120 of the sites sampled in 2003 had also been sampled in 2002 (Table 1).

Data from a total of 29 water quality (WQ) stations and 20 hydrological gauging stations were used for this analysis (Appendix A). In general, WQ and hydrological monitoring stations were not co-located with the benthic sampling stations (Figure 1), and therefore WQ and hydrological monitoring stations were "matched" with benthic sampling sites into "station groups" (as indicated by boundaries shown in Figures 1a to 1c) based on the following criteria:

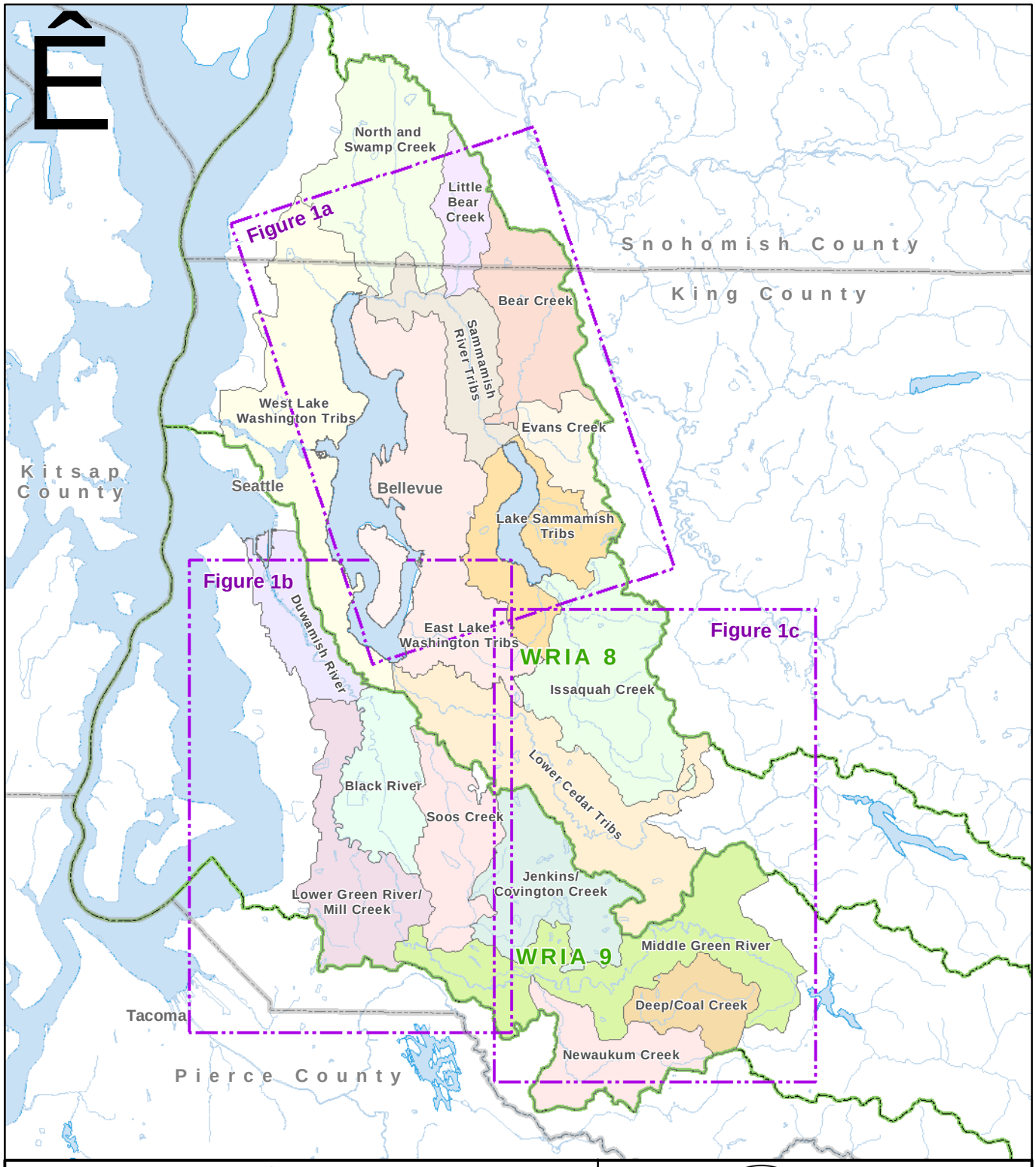
- WQ and/or hydrological monitoring stations were selected at locations with similar gradients to the benthic sampling stations.
- A selected WQ monitoring station was ideally the one closest to the benthic sampling station that was not obviously influenced by potential point and non-point pollution sources (e.g., tributary inflows) between the two stations.

- Although a maximum acceptable distance between the WQ and hydrological monitoring stations and the benthic sampling stations was not explicitly stated, stations within a station group were matched to be as close together as possible. Distances between benthic stations and matched hydrologic stations ranged from 0 ft (i.e., at the same location) to 2.07 miles (3.34 km), whereas distances between benthic stations and the WQ monitoring stations ranged from 0 ft to 1.49 miles (0.92 km).
- If the WQ and/or hydrological monitoring station was sampled in 2002 and had been included in a 2002 station group, data from that station was included in the 2003 analysis.

A total of 20 paired datasets hydrological station/benthic macroinvertebrate station groups and 30 WQ station/benthic macroinvertebrate station groups were created; in one instance, data from a single WQ station were matched with two benthic sampling stations.

Table 1: Numbers of benthic macroinvertebrate stations in sampled in King Country sub-basins in 2002, 2003, and both years. Numbers of sites sampled only during one year or the other are given in parentheses.

Sub-Basin	2002	2003	Both Years
Bear Creek	10 (1)	9	9
Black River	9 (2)	7	7
Covington Creek	6 (5)	2 (1)	1
Deep and Coal creeks	5 (1)	4	4
Duwamish River tribs.	5 (1)	4	4
East Lake Washington tribs.	9 (2)	8 (1)	7
Evans Creek	9 (3)	6	6
Issaquah Creek	7 (1)	8 (1)	6
Jenkins Creek	3	3	3
Lake Sammamish tribs	8 (1)	7	7
Little Bear Creek	7	9 (2)	7
Lower Cedar River tribs	10 (2)	8	8
Lower Green River tribs	5 (1)	4	4
Middle Green River tribs	8	8	8
Mill Creek	4 (1)	3	3
Newaukum Creek	8 (3)	5	5
North and Swamp creeks	5	8 (3)	5
Sammamish River tribs	10 (2)	8	8
Soos Creek	10 (1)	9	9
West Lake Washington tribs	9	10 (1)	9
Total	**147 (27)**	**130 (9)**	**120**



LEGEND

- 1-100K Map Boundary
- WRIA Boundary
- Watershed Sub-basin Boundary *(Color fills used for differentiation between ajacent watersheds)*
- County Boundary
- Water Course
- Open Water

Projection: Lambert Conformal Conic

0 5 10 15 20 Miles

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PROJECT: King County Water Quality Evaluation		
LOCATION: King County, Washington	CLIENT: King County	
TITLE: 2002 and 2003 Study Area Overview		
DWG BY: GGC	CHK BY: PEM	PROJECT No.: 04-1422-022
SCALE: 1:440,000	DATE: 3/2005	FIGURE 1

NOTES:

For station labels:
* = analyzed in 2002 only
** = analyzed in 2003 only
All other stations were analyzed in 2002 and 2003.
Water quality and hydrogauge stations that had data recorded in 2002 and 2003 but were not analyzed, were excluded from maps.

LEGEND

- Benthic Station
- Water Quality Station
- Water Quality and Water Quality Index Station
- Hydrogauge Station
- Station Group Boundary
- Open water
- Wetland
- Water Course
- Watershed Sub-Basin Boundary (Color fills used for differentiation between ajacent watersheds)
- Major Highways
- County Boundary

Projection: Lambert Conformal Conic, NAD 83

0 1 2 3 4 5 Miles

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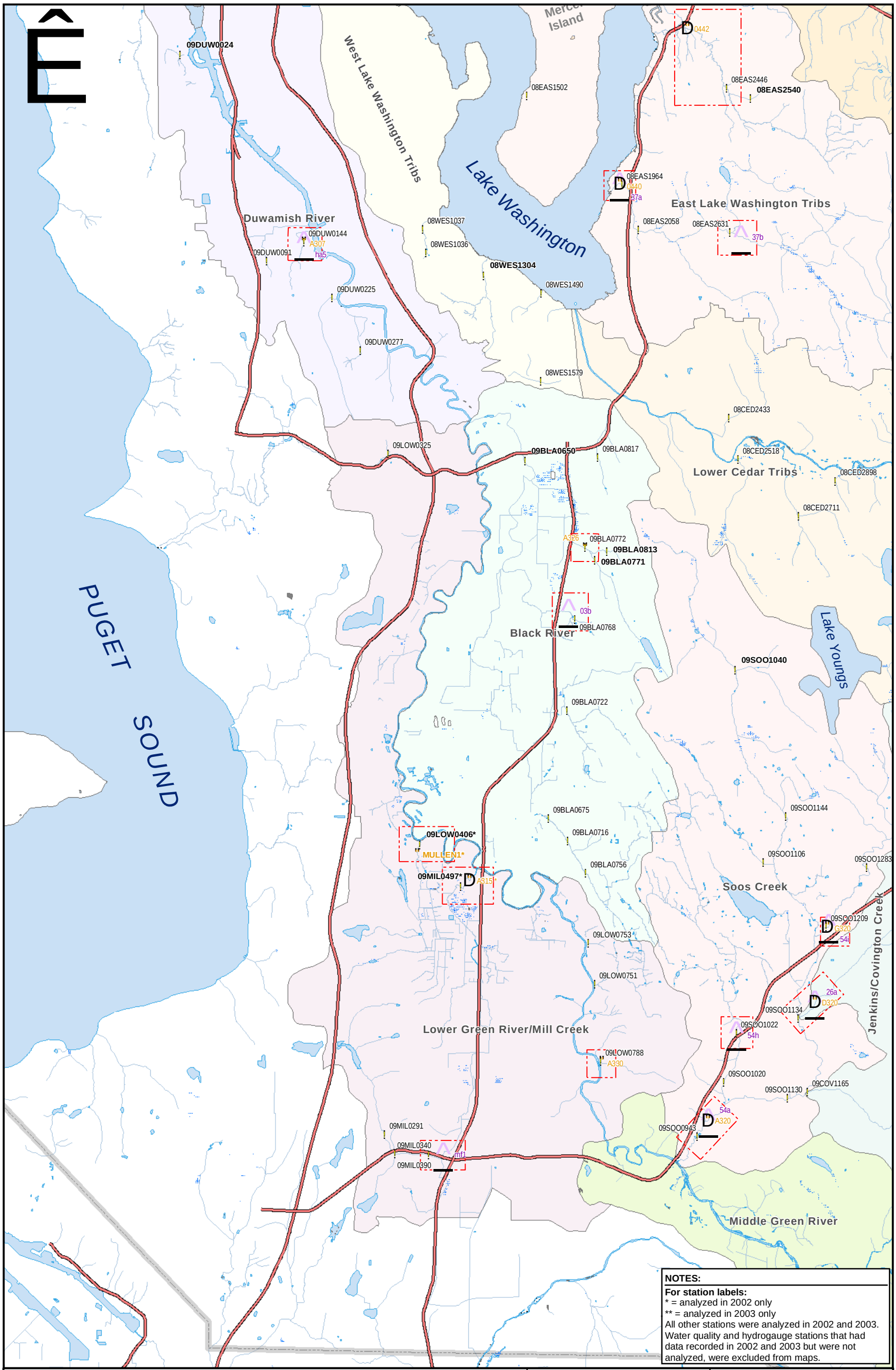
PROJECT: King County Water Quality Evaluation	
LOCATION: King County, Washington	CLIENT: King County
TITLE: Benthic, Water quality and Hydrogauge Stations in Northern Section of 2002 and 2003 Study Area	
DWG BY: GGC	CHK BY: PEM	PROJECT No.: 04-1422-022
SCALE: 1:100,000	DATE: 03/2005	FIGURE 1a



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- Open water
- Wetland
- Water Course
- Watershed Sub-Basin Boundary (Color fills used for differentiation between ajacent watersheds)
- Major Highways
- County Boundary

Projection: Lambert Conformal Conic, NAD 83

0 1 2 3 4 5 Miles

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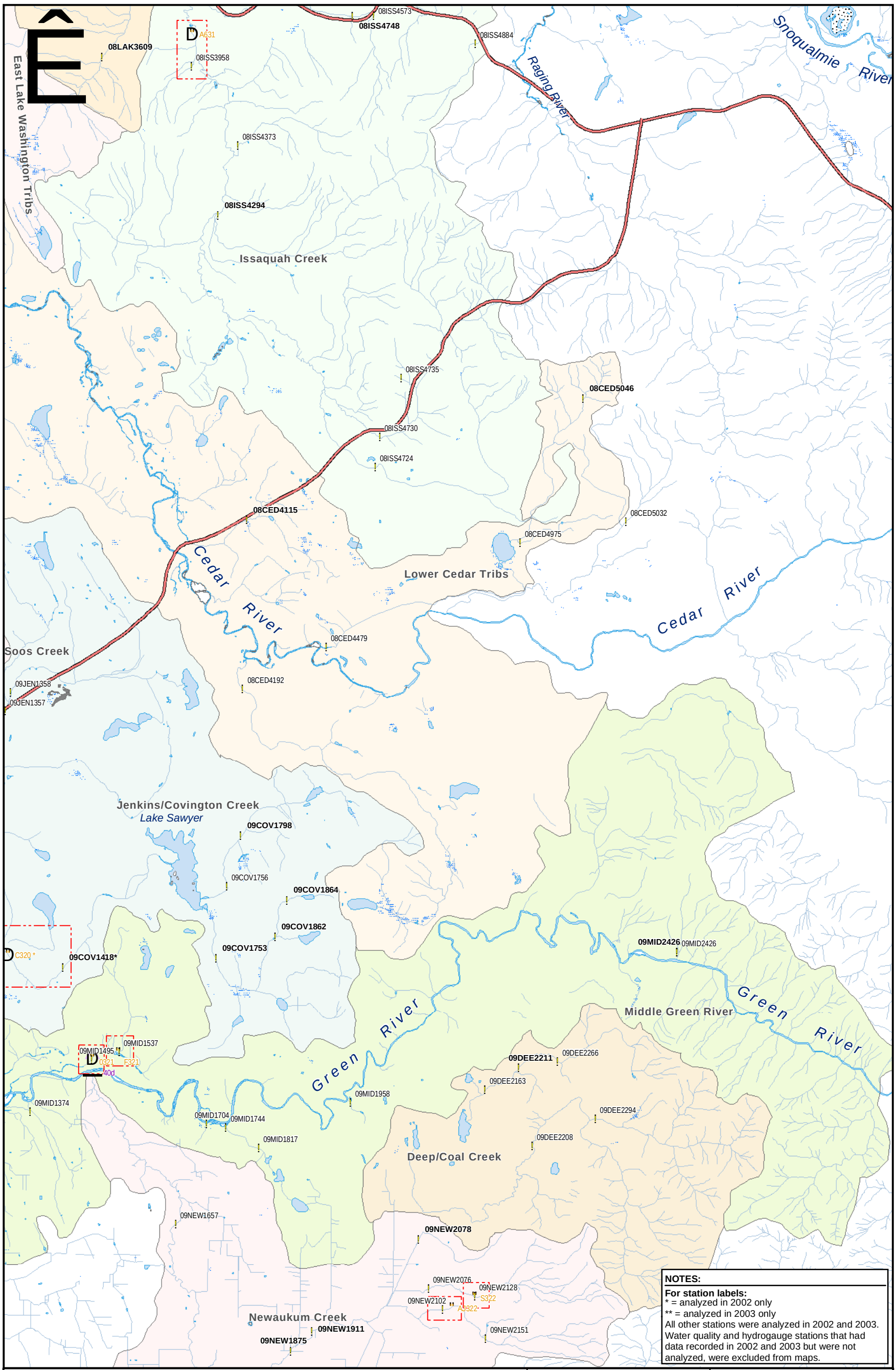
PROJECT:	King County Water Quality Evaluation
LOCATION:	King County, Washington
CLIENT:	King County
TITLE:	Benthic, Water quality and Hydrogauge Stations in Southwestern Section of 2002 and 2003 Study Area

DWG BY:	GGC	CHK BY:	PEM	PROJECT No.:	04-1422-022
SCALE:	1:100,000	DATE:	03/2005		FIGURE 1b



NOTES:

For station labels:
* = analyzed in 2002 only
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Water quality and hydrogauge stations that had data recorded in 2002 and 2003 but were not analyzed, were excluded from maps.

LEGEND

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- Water Quality Station
- Water Quality and Water Quality Index Station
- Hydrogauge Station
- Station Group Boundary
- Open water
- Wetland
- Water Course
- Watershed Sub-Basin Boundary (Color fills used for differentiation between ajacent watersheds)
- Major Highways
- County Boundary

Projection: Lambert Conformal Conic, NAD 83

0 1 2 3 4 5 Miles

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PROJECT: King County Water Quality Evaluation	
LOCATION: King County, Washington	CLIENT: King County
TITLE: Benthic, Water quality and Hydrogauge Stations in Southeastern Section of 2002 and 2003 Study Area	
DWG BY: GGC	CHK BY: PEM	PROJECT No.: 04-1422-022
SCALE: 1:100,000	DATE: 02/2005	**FIGURE 1c**

2.3 DATA SOURCES

2.3.1 Benthic Macroinvertebrate Data

WLRD personnel completed benthic macroinvertebrate sampling and habitat measurements during August and September, 2003. Sample site selection protocols, benthic macroinvertebrate sampling procedures, sample processing, and identification of organisms followed the *Greater Lake Washington and Green-Duwamish River Watersheds Wadeable Freshwater Streams Benthic Macroinvertebrate Sampling and Analysis Plan* (King County, 2002a,b). As was the case in 2002, field invertebrate sampling involved collection of three replicate sub-samples from each site, from which a single pooled sample was created (EVS 2004). This differs from Karr's (1998) sampling protocol, which requires that each of three replicate sub-samples be processed separately. As a result, the taxonomic composition of each individual replicate sub-sample was not determined, nor was it possible to assess intra-site variability of B-IBI scores. Although this deviation from the "standard" protocol did not compromise the quality of our benthic macroinvertebrate data, it makes it difficult to compare the King County WLRD's data with data collected elsewhere using Karr's (1998) protocol.

All benthic macroinvertebrate samples were taxonomically identified by Rhithron Associates of Missoula, Montana. A minimum of 500 organisms per composite sample were identified using appropriate sub-sampling techniques.

2.3.2 Physico-Chemical Data

2.3.2.1 Water Quality Data

Most of the WQ data used in this analysis were collected as part of King County's ongoing ambient monitoring program, and were provided by King County. All mean parameter values provided by King County were calculated as arithmetic means for the 2003 water year. The following water quality monitoring parameters were used in this analysis:

- Temperature (°C) – mean temperature at base-flow and at storm-flow;
- Dissolved oxygen (DO) (mg/L) – mean DO at base-flow;
- Conductivity (µmhos/cm) – mean conductivity at base-flow and at storm-flow;
- pH – mean pH at base-flow;
- Alkalinity (mg/L as $CaCO_3$) – mean alkalinity at base-flow and at storm-flow;
- Turbidity (NTU) – mean turbidity at base-flow and at storm-flow;

- Total Suspended Solids (TSS) (mg/L) – mean TSS at base-flow and at storm-flow;
- Dissolved Organic Carbon (DOC) (mg/L) – mean DOC at base-flow;
- Total Organic Carbon (TOC) (mg/L) – mean TOC at base-flow;
- Total phosphorus (P) – mean total P at base-flow and at storm-flow;
- Total zinc (Zn) – mean total Zn at base-flow and at storm-flow; and
- Total copper (Cu) – mean total Cu at base-flow and at storm-flow.
- Water Quality Index (WQI) – a unitless score from 1 to 100 (higher being better) which combines measurements of temperature, DO, pH, fecal coliform bacteria, total nitrogen, total phosphorus, TSS and turbidity (Hallock, 2002).

2.3.2.2 Hydrology Data

A series of three instantaneous water velocity estimates were made at each benthic sampling site during each sampling event. The average of these values was calculated and recorded. Sampling and velocity estimation methods are described elsewhere (EVS 2004).

As was described in Section 2.2, discharge (Q) data were available for 20 benthic macroinvertebate sampling stations. Discharge data included mean annual daily Q, annual minimum daily Q, annual maximum daily Q, annual minimum instantaneous Q, and annual maximum instantaneous Q. All hydrological data were correlated with site-level B-IBI scores using Spearman rank correlations.

2.3.2.3 Land-Use Data

King County WLRD used its GIS land-use database, which was derived from 1995 Landsat satellite imagery[1], to derive the percent effective impervious area (% EIA) and percent of various land-use types (i.e., bare ground/asphalt, bare rock/concrete, developed - high intensity, developed – medium intensity, developed - low intensity, forest, scrub/shrub, grass, and open water) upstream from each benthic macroinvertebrate sampling site. The same land-use data were used in the 2002 and 2003 data analyses, and are described in Appendix B. Percent EIA and land-use data were correlated with site-level and sub-basin average B-IBI scores using Spearman rank correlations.

2.3.2.4 Habitat Data

Descriptive, semi-quantitative habitat data were collected by King County WLRD field crews at most benthic macroinvertebrate sampling sites at the time of sampling. Dominant and subdominant substrate size classes, and left and right bank riparian tree density were recorded. Because these

[1] see http://metrokc.gov/gis/sdc/raster/landcover/Landcover_Data.htm#1995Landcover

variables were recorded as categorical data, each of which represented a range of values, they were converted to rank values for the purposes of this analysis.

2.4 CALCULATION OF BENTHIC COMMUNITY INDICES

2.4.1 B-IBI

The same 10-metric B-IBI protocol was used for the analysis of the 2003 data as was used in 2002 (EVS 2004). This method uses the sum of ten "metrics" to characterize ecosystem integrity: total taxonomic richness, Ephemeroptera taxonomic richness, Plecoptera taxonomic richness, Trichoptera taxonomic richness, EPT taxonomic richness, percent tolerant individuals, number of clinger taxa, percent predator individuals, percent dominance, and number of long-lived taxa.

To be used effectively, the B-IBI must be calibrated for a region's streams. This typically involves sampling and calculating metrics for a range of stream types that represent a cross-section of the impact conditions in the region (e.g., from watersheds in "excellent" biological condition, to watersheds in "poor" biological condition). Calibration of the B-IBI for streams in the Puget Sound Lowlands was done by Kleindl (1995).

To allow calculation of B-IBI scores from the 2003 dataset, the 2002 master list of benthic taxonomic attribute information was updated with the 24 taxa collected in 2003, but not in 2002. A full description of the B-IBI calculation methodology is provided in Appendix C. Raw benthic macroinvertebrate taxonomy data are provided in Appendix F. As was the case with the 2002 dataset, a spreadsheet was used to calculate the number of distinct taxa present at each sampling station. An independent biologist completed a quality assurance/quality control (QA/QC) check to confirm that all data used in the analysis were consistent with the original data files, and that no calculation or transcription errors had been made. QA/QC checks were performed on 10% of all sections of the dataset. If an error was found on any given section, a full check of the data for that entire section was performed.

2.4.2 Functional Feeding Group Analysis

The functional feeding group (FFG) approach classifies aquatic insects according to their role in processing organic material. Factors considered in assigning an organism to an FFG include the origin and size of food items ingested, the general location from which food is taken, the mechanism of food acquisition, and the organism's trophic role. An organism which has diverse feeding habits is usually placed in more than one functional feeding category. The main groups considered in this analysis were: collectors (filterers), collectors (gatherers), scrapers and grazers, shredders, piercer

herbivores, predators (engulfers), predators (piercers), and scavengers and omnivores. As in 2002 tabular FFG listings based on Merritt and Cummins (1996) were used to assign taxa to categories.

2.4.3 Hilsenhoff Biotic Index

The Hilsenhoff Biotic Index (HBI) is a single-metric scoring system that is widely used for assessing the biotic impacts of organic loading, impoundment, thermal pollution, and certain types of chemical pollution. The HBI score for a given sample is calculated by multiplying the number of individuals of each taxon in the sample by the taxon's assigned tolerance value (Hilsenhoff 1987), totaling these products, and dividing the result by the total number of individuals of each taxon in the sample that have been assigned a tolerance value.

$$HBI = \Sigma\ (n_i a_i)/N$$

Where: n is the number of individuals of the ith taxon;

a is the tolerance index value of that taxon;

N is the total number of individuals in the sample assigned a HBI value.

The range of HBI values is 0-10, with 0 indicating pollution intolerance, and 10 indicating high pollution tolerance (Appendices D, E).

2.4.4 Shannon-Weiner Diversity Index

Numerous diversity indices are available for characterizing the taxonomic diversity of benthic macroinvertebrate communities (e.g., Simpson's Index, Brillouin Index, Shannon-Weiner Index) (Krebs 1989). The Shannon-Weiner index (SWDI, or H) was selected for comparison with the B-IBI because it is simple to calculate and has been used extensively to characterize biological diversity. Unlike B-IBI or HBI values, H-values do not incorporate consideration of pollution tolerance, long-livedness, or feeding group. H simply increases with the number of taxa in a sample, as well as the proportion of the sample that each taxon contributes. It is calculated as follows:

$$H = -\ \Sigma\ (p_i)(\log_2 p i_i)$$

Where: p is the proportion of the total sample belonging to the ith taxon.

H-values were calculated for each benthic macroinvertebrate sample (Appendix E) in order to compare the SWDI to the B-IBI as a means of quantifying the response of the aquatic community to anthropogenic disturbances.

2.5 STATISTICAL ANALYSES

The objectives of the statistical analyses of the 2003 data were:

- To identify differences in B-IBI scores among sub-basins;
- To assess relationships between the B-IBI scores and physical parameters and between B-IBI scores and other invertebrate community measures.

The Shapiro-Wilk test was applied to the B-IBI dataset, and it was determined that not all the sub-basin B-IBI data were normally distributed. For this reason, a non-parametric ANOVA, the Kruskal-Wallace test, was used to identify whether mean B-IBI scores differed significantly ($p<0.05$) among sub-basins. When significant differences were found, *post hoc* comparisons between sub-basin means were made using a non-parametric rank-sum version of the Tukey multiple comparison test (Zar, 1984).

Correlations between B-IBI scores and the individual invertebrate community indices, and between B-IBI scores and the physical parameters that could influence invertebrate communities (i.e., land-use, water quality parameters, hydrological parameters) were calculated as Spearman rank correlation coefficients (Daniel 1990) using SPSS v.12 (2003) statistical software. Correlation coefficients were displayed in tabular matrices, which also indicated the significance of any observed correlations.

Differences were judged to be statistically significant if $p<0.05$, and insignificant if $p\geq 0.05$.

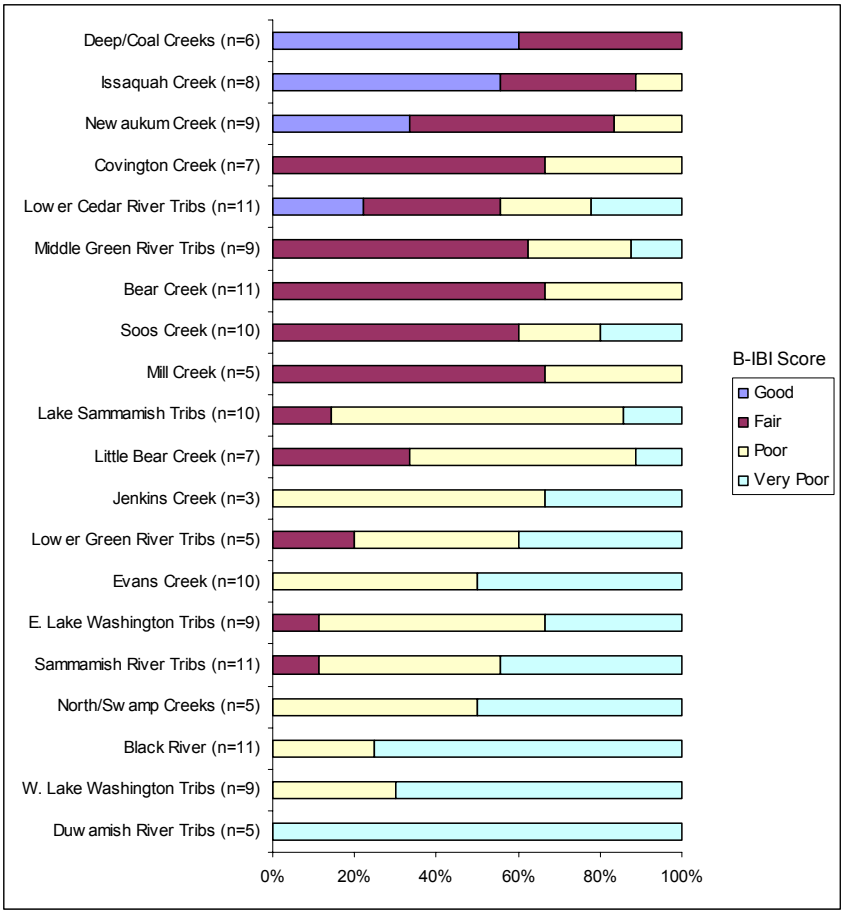
3. RESULTS AND DISCUSSION

3.1 B-IBI SCORES

3.1.1 Individual Station B-IBI-Scores, 2003

Of the 130 sampling stations from which B-IBI scores were obtained in 2003, nine were ranked as having "good" scores (i.e., scores from 38 to 44), 37 had "fair" scores (28 to 36), 44 had "poor" scores (18 to 26), and 40 had "very poor" scores (10 to 16). The proportion of stations ranked as being "good", "fair", "poor", and "very poor" varied dramatically among sub-basins (Figure 2). Stations with "good" B-IBI scores were only found in Deep and Coal creeks, Issaquah Creek, and Lower Cedar River Tribs. sub-basins, whereas the B-IBI scores of most or all of the stations sampled in the North and Swamp creeks, West Lake Washington Tribs., and Duwamish River Tribs. sub-basins were considered "very poor". Most of the sampled sub-basins included a mixture of stations with "fair", "poor", and "very poor" rankings.

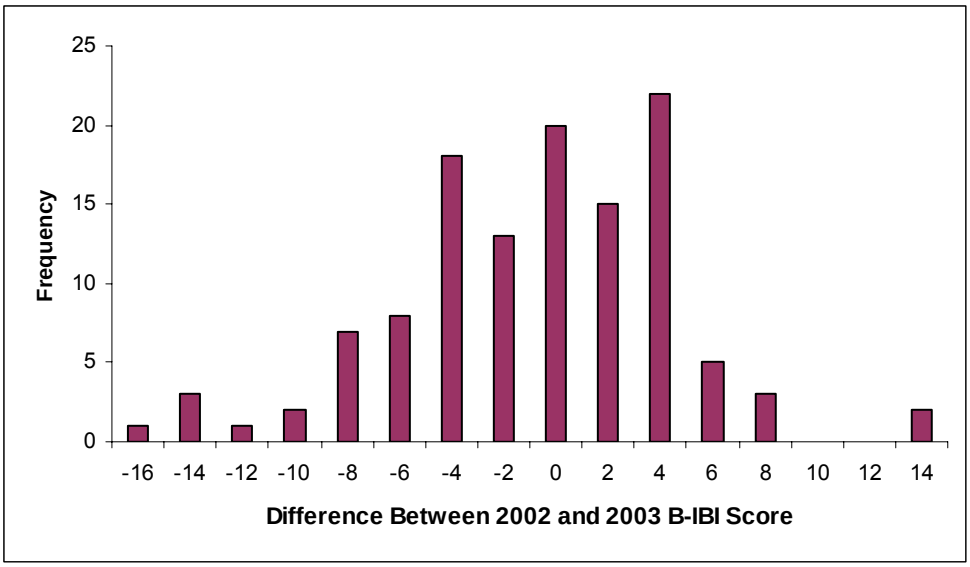
Figure 2: Proportions of stations in 20 sub-basins sampled in 2003 with B-IBI scores ranked as being "good", "fair", "poor", or "very poor". Numbers of stations sampled in each sub-basin are provided in parentheses.



3.1.2 Comparison of 2002 and 2003 Individual Station B-IBI-Scores and Rankings

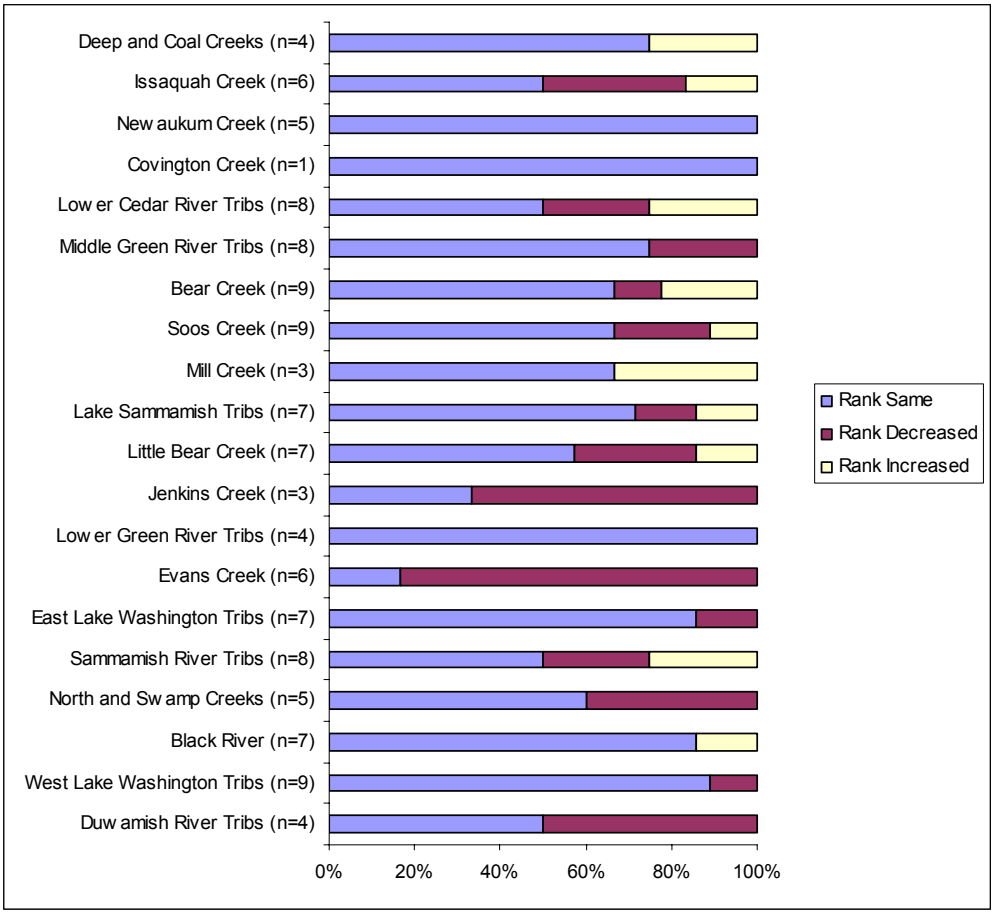
Of the 120 stations sampled in both 2002 and 2003, the B-IBI *scores* of 20 stations were the same in both years, scores decreased between years at 53 stations, and scores increased between years at 47 stations. Overall, however, the differences in B-IBI scores between the two years were minor; 2002 and 2003 scores differed by less than four B-IBI units for 73% of the sampled stations (Figure 3).

Figure 3: Frequency distribution of differences between 2002 and 2003 B-IBI scores for streams sampled in both years (n=120).



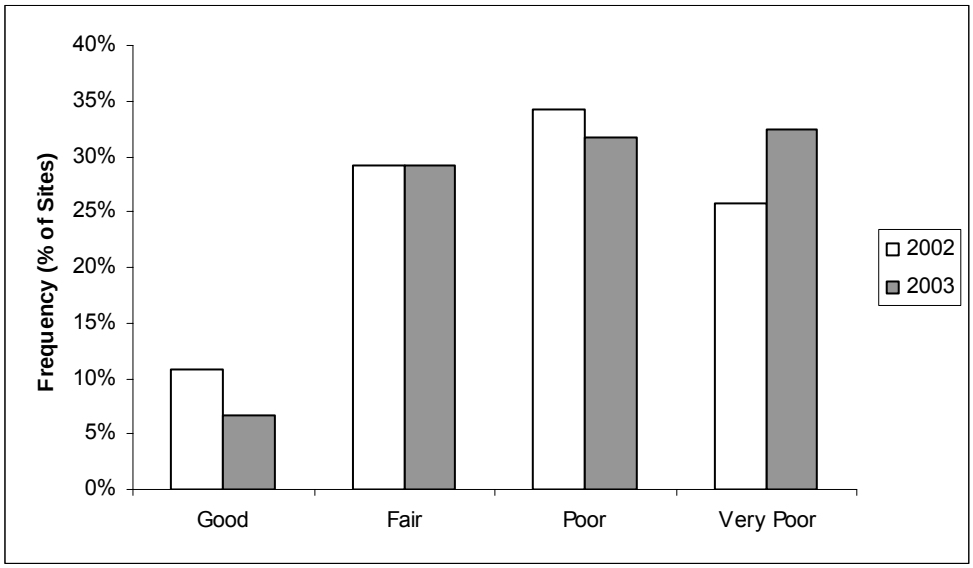
In terms of B-IBI *rankings* (i.e., "excellent", "good", "fair", "poor", and "very poor"), 80 stations retained the same ranking in both years, ranking decreased between years at 27 stations, and the ranking of 13 stations increased between years. At 90% of the sites where the B-IBI ranking changed between the two years of study, it changed by only one category (e.g., from "good" to "fair" or *vice versa*). The extent to which station B-IBI rankings varied between the two years of study, and whether the change was positive or negative, did not appear to be influenced by sub-basin; rankings of stations in sub-basins where B-IBI scores were typically high were as likely to change as the rankings of stations in sub-basins where B-IBI scores were low (Figure 4).

Figure 4: Proportion of sampled sites, by sub-basin, for which B-IBI rankings remained the same, increased, or decreased from 2002 to 2003.



For sites sampled in both 2002 and 2003, the frequency of sub-basins with good, fair, poor, and very poor rankings was similar in both years of study (Figure 5), although the proportion of poor sites was slightly higher in 2002, and the proportion of very poor sites was slightly higher in 2003.

Figure 5: For the 120 stations sampled in both 2002 and 2003, the frequency distribution of stations with good, fair, poor, and very poor B-IBI rankings.



3.1.3 Mean Sub-Basin B-IBI-Scores, 2003

In 2003, mean (± standard deviation) sub-basin B-IBI scores ranged from a high of 38.0 ±5.3 (Deep/Coal Basin) to a low of 14.0 ±2.8 (Duwamish) (Table 2), and differed significantly among sub-basins ($p<0.001$). Pair-wise comparisons identified significant differences among several sub-basins (Table 3). In general, the highest mean sub-basin B-IBI scores (e.g., Deep/Coal creeks, Issaquah Creek) were significantly higher than scores at sub-basins with the lowest mean B-IBI scores (e.g., Duwamish River, West Lake Washington, Black River). Statistically significant differences in mean B-IBI scores between sub-basins indicate that there is greater variability in B-IBI scores between sub-basins than within individual sub-basins.

Of the 20 sub-basins sampled in 2003, one was ranked as having "good" mean B-IBI scores, one "fair-good", five "fair", two "fair-poor", seven "poor", one "poor-very poor" and three "very poor". In 2002, seven sub-basins had been ranked fair, three fair-poor, seven poor and three very poor (EVS 2004).

Table 2: Mean sub-basin B-IBI scores, HBI scores, total numbers of taxa, numbers of EPT taxa, and SWDI values for 20 sub-basins in the Green-Duwamish and Greater Lake Washington watersheds, based on 2003 samples.

		Sub-Basin B-IBI Score			Sub-Basin HBI Score					
Sub-Basin	**n**	**Mean (± Std. Dev.)**	**Range**	**Mean Ranking**	**Mean (± Std. Dev.)**	**Range**	**Mean Ranking**	**Mean Total No. of Taxa (± Std.Dev.)**	**Mean No. of EPT Taxa (± Std.Dev.)**	**Mean SWDI (± Std. Dev.)**
Deep/Coal creeks	5	38.0 ± 5.3	30-44	Good	3.6 ± 0.6	2.9-4.3	Very Good	38.6 ± 4.5	24.8 ± 5.0	3.9 ± 0.2
Issaquah Creek	9	36.7 ± 6.5	24-44	Fair-Good	3.9 ± 1.0	2.3-5.1	Very Good	37.2 ± 4.8	22.6 ± 4.2	4.1 ± 0.4
Newaukum Creek	6	33.3 ± 9.2	18-42	Fair	3.7 ± 0.8	2.8-4.9	Very Good	33.8 ± 7.0	19.2 ± 5.0	3.8 ± 0.4
Covington Basin	3	30.0 ± 3.5	26-32	Fair	3.8 ± 0.6	3.2-4.4	Very Good	29.3 ± 4.6	17.0 ± 2.6	3.8 ± 0.2
Lower Cedar River	9	28.9 ± 10.3	14-44	Fair	4.6 ± 1.3	2.5-6.1	Good	29.7 ± 9.5	15.8 ± 8.3	3.5 ± 0.4
Middle Green River	8	28.3 ± 8.8	10-36	Fair	4.9 ± 1.5	3.0-8.0	Good	28.8 ± 7.9	14.8 ± 6.6	3.3 ± 0.9
Bear Creek	9	28.0 ± 2.2	24-30	Fair	4.0 ± 1.1	2.7-5.7	Good	30.2 ± 5.0	15.7 ± 3.3	3.7 ± 0.2
Soos Creek	10	27.8 ± 7.0	16-36	Fair-Poor	4.3 ± 0.8	2.7-5.5	Good	31.2 ± 6.3	16.3 ± 5.5	3.7 ± 0.4
Mill Creek	3	27.3 ± 3.1	24-30	Fair-Poor	4.2 ± 0.3	3.9-4.4	Good	29.3 ± 1.5	16.0 ± 1.0	3.6 ± 0.3
L. Sammamish tribs	7	24.9 ± 6.5	14-36	Poor	5.0 ± 1.2	2.7-6.3	Good	26.3 ± 7.2	11.1 ± 5.4	3.4 ± 0.6
Little Bear Creek	9	24.2 ± 6.7	16-36	Poor	5.0 ± 0.8	4.0-6.3	Good	28.7 ± 5.8	14.4 ± 5.6	3.6 ± 0.4
Jenkins Creek	3	20.0 ± 5.3	16-26	Poor	5.7 ± 0.9	4.8-6.5	Fair	23.3 ± 5.9	12.3 ± 5.1	3.3 ± 0.4
Lower Green River	5	19.6 ± 7.5	12-32	Poor	5.2 ± 1.5	4.0-7.7	Good	25.6 ± 7.4	12.0 ± 4.7	2.9 ± 0.6
Evans Creek	6	19.0 ± 4.3	14-24	Poor	5.5 ± 0.9	4.5-6.6	Good	23.8 ± 5.7	9.8 ± 4.6	2.9 ± 0.9
E. Lake Washington tribs	9	18.2 ± 6.4	10-30	Poor	5.5 ± 0.7	4.4-6.5	Good	19.7 ± 7.5	8.0 ± 5.4	2.9 ± 0.7
Sammamish River	9	18.0 ± 6.2	10-32	Poor	6.1 ± 1.4	4.0-8.3	Fair	20.6 ± 7.1	7.9 ± 5.3	2.9 ± 0.6
North/Swamp creeks	8	17.8 ± 4.2	10-22	Poor-Very Poor	6.0 ± 1.3	4.7-8.4	Fair	21.5 ± 5.3	8.5 ± 4.2	2.8 ± 0.6
Black River	8	15.8 ± 3.9	10-22	Very Poor	5.9 ± 0.8	4.9-7.3	Fair	19.6 ± 4.7	6.1 ± 2.9	2.9 ± 0.5
W. Lake Washington tribs	10	15.2 ± 4.0	10-22	Very Poor	6.2 ± 1.2	4.7-8.5	Fair	17.2 ± 5.1	5.9 ± 3.9	2.7 ± 0.6
Duwamish River tribs	4	14.0 ± 2.8	10-16	Very Poor	6.4 ± 0.3	6.1-6.8	Fair	17.0 ± 4.7	4.5 ± 3.3	2.6 ± 0.5

B-IBI Rankings:

46-50 – Excellent
38-44 – Good
28-36 – Fair
18-26 – Poor
10-16 – Very Poor

HBI Rankings:

0.00-3.50 – Excellent
3.51-4.50 – Very Good
4.51-5.50 – Good
5.51-6.50 – Fair
6.51-7.50 – Fair-Poor
7.51-8.50 – Poor
8.51-10.00 – Very Poor

Table 3: Results of paired comparisons among sub-basin mean B-IBI scores for 20 sub-basins in the study area, based upon 2002 samples. Pairs of means indicated by ● are significantly different (p<0.05).

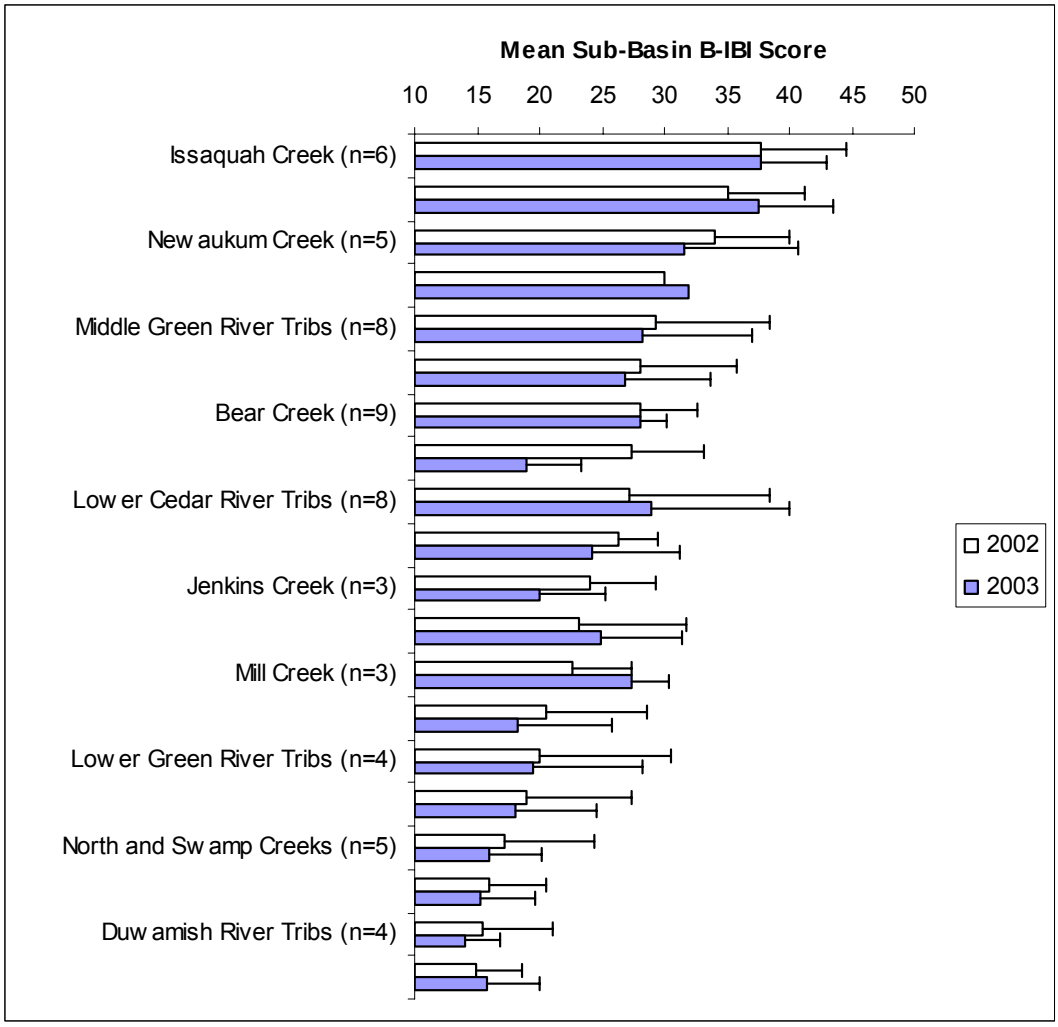
	ISS	DEE	NEW	MID	BEA	COV	CED	SOO	EVA	LIT	JEN	MIL	LAK	EAS	LOW	SAM	NOR	WES	BLA	DUW
ISS									●					●		●	●	●	●	●
DEE									●					●		●	●	●	●	●
NEW																		●	●	●
MID																		●		
BEA																		●	●	
COV																				
CED																		●		
SOO																		●		
EVA																				
LIT																				
JEN																				
MIL																				
LAK																				
EAS																				
LOW																				
SAM																				
NOR																				
WES																				
BLA																				
DUW																				

BEA	Bear Creek	**DUW**	Duwamish River	**LAK**	Lake Sammamish tribs	**NEW**	Newaukum Creek
BLA	Black River	**EAS**	East Lake Washington	**LIT**	Little Bear Creel	**NOR**	North/Swamp creeks
CED	Cedar River	**EVA**	Evans Creek	**LOW**	Lower Green River	**SAM**	Sammamish River tribs
COV	Covington Basin	**ISS**	Issaquah Creek	**MID**	Middle Green River	**SOO**	Soos Creek
DEE	Deep/Coal creeks	**JEN**	Jenkins Creek	**MIL**	Mill Creek	**WES**	West Lake Washington tribs

3.1.4 Comparison of 2002 and 2003 Mean Sub-Basin B-IBI-Scores

If only data from sites sampled in both years are considered, the 2002 and 2003 mean sub-basin B-IBI scores are remarkably similar (Figure 6); 2002 scores were within 2.5 B-IBI units of 2003 scores in 17 of the 20 sub-basins sampled. However, in the Evans Creek and Jenkins Creek sub-basins, the mean 2003 scores were 8.3 and 4.0 units lower, respectively, than the 2002 scores. In contrast, the 2003 mean sub-basin B-IBI score for Mill Creek was 4.7 units higher than the 2002 score. An examination of data regarding land-use, flow, habitat, and water quality data for these three watersheds did not reveal any differences between the Evans Creek, Jenkins Creek, and Mill Creek sub-basins and the other sampled sub-basins, and therefore it is not possible to explain why the B-IBI scores of these basins changed dramatically between years, while the scores of the other sub-basins did not.

Figure 6: Mean sub-basin B-IBI scores (+1 standard deviation) based on 120 stations which were sampled in both 2002 and 2003.



3.2 B-IBI SCORES AND OTHER INDICES

In general, the same correlations between a sample's B-IBI score and other calculated indices were observed in 2002 and 2003. Strong correlations were noted between a sample's B-IBI score and the total number of invertebrate taxa present (r_s = 0.925, p<0.001; in 2002 was r_s = 0.921, p<0.001), and between a sample's B-IBI score and the total number of EPT taxa present (r_s = 0.931, p<0.001; in 2002 was r_s = 0.946, p<0.001). Strong, but slightly weaker, correlations were present between a sample's B-IBI score and its Shannon-Weiner Diversity Index (SWDI; r_s = 0.866, p<0.001; in 2002 was r_s = 0.801, p<0.001) and Hilsenhoff Biotic Index (HBI, r_s =-0.779, p<0.001; in 2002 was r_s = -0.786, p<0.001). The results were very similar between the two years, and for the most part, slightly stronger relationships were observed in 2003.

Like the B-IBI, the HBI is based on pollution sensitivity. HBI rankings of the various sub-basins generally paralleled B-IBI rankings (Table 2), but – as in 2002 – HBI rankings tended to score sub-basins as being in better biological condition than did equivalent B-IBI rankings. HBI rankings improved from 2002 to 2003, with some sub-basins moving up one ranking. At the upper end, Deep/Coal, Newaukum and Covington creeks moved up from "good" to "very good", and at the lower end, the Duwamish River tributaries, North/Swamp creeks and the Sammamish River tributaries moved up from "fair-poor" to "fair").

There were strong significant correlations between mean sub-basin B-IBI score and mean total number of taxa present (r_s = 0.954, p<0.001; in 2002 was r_s = 0.960, p<0.001), mean number of EPT taxa present (r_s = 0.962, p<0.001; same in 2002), mean SWDI (r_s = 0.933, p<0.001; in 2002 was r_s = 0.921, p<0.001), and mean HBI values (r_s = -0.956, p<0.001; in 2002 was r_s = -0.888, p<0.001) for each sub-basin (Figures 7a, 7b, 7c and 7d, respectively; Table 2). Again, results in 2002 and 2003 were similar.

It is not surprising that strong correlations exist between B-IBI score and total number of taxa, and between B-IBI score and number of EPT taxa, because values for these variables were used to calculate B-IBI scores. Similarly, the correlation between B-IBI score and SWDI values is also not surprising, since both of these values measure community diversity. Despite the HBI's relative simplicity compared to the B-IBI, HBI values are significantly correlated with B-IBI values (Figure 7d). Note that B-IBI score is negatively correlated with HBI score, because the B-IBI measures biotic *integrity* (i.e., similarity to biological conditions considered "good"), whereas the HBI measures biotic *perturbation*.

Figure 7a: Sub-basin mean B-IBI scores vs. mean number of taxa (± standard deviation). Filled circles (●) indicate 2003 data, empty circles (○) indicate 2002 data.

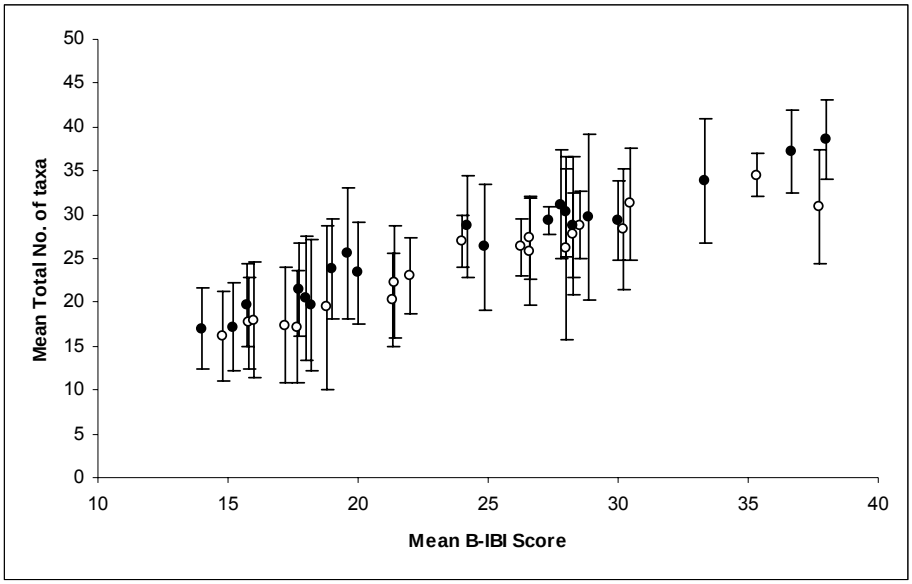


Figure 7b: Sub-basin mean B-IBI scores vs. mean number of EPT taxa (± standard deviation). Filled circles (●) indicate 2003 data, empty circles (○) indicate 2002 data.

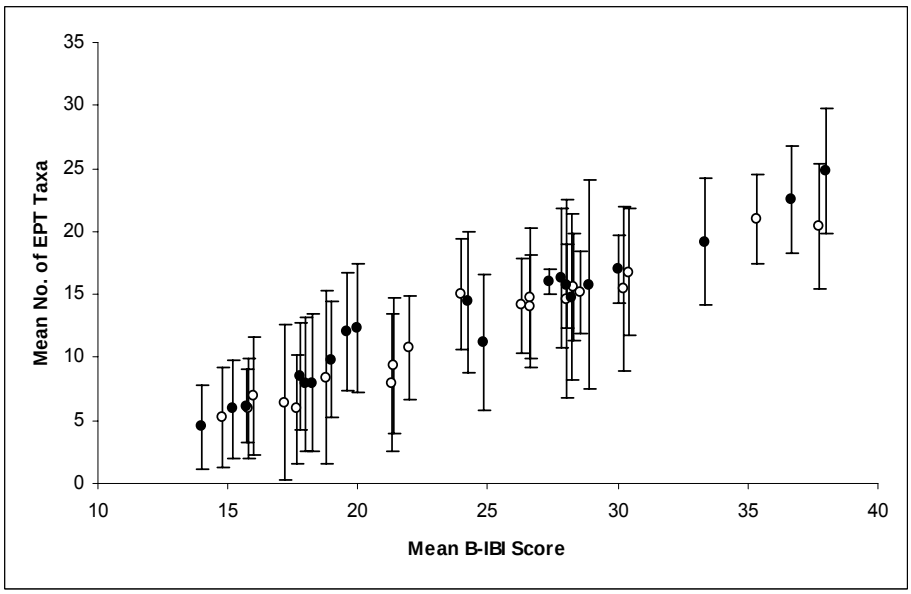


Figure 7c: Sub-basin mean B-IBI score vs. mean Shannon-Weiner Diversity Index (H) score (± standard deviation). Filled circles (●) indicate 2003 data, whereas empty circles (○) indicate 2002 data.

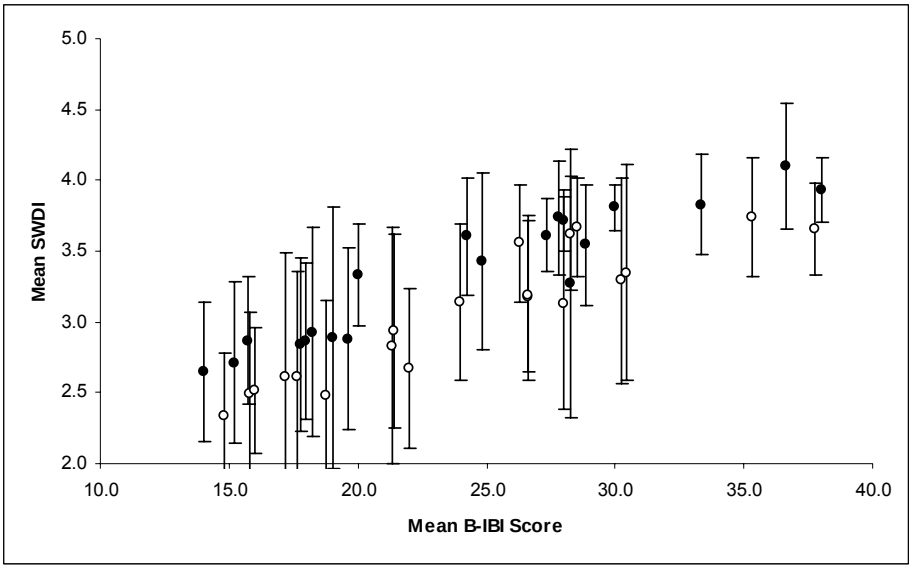
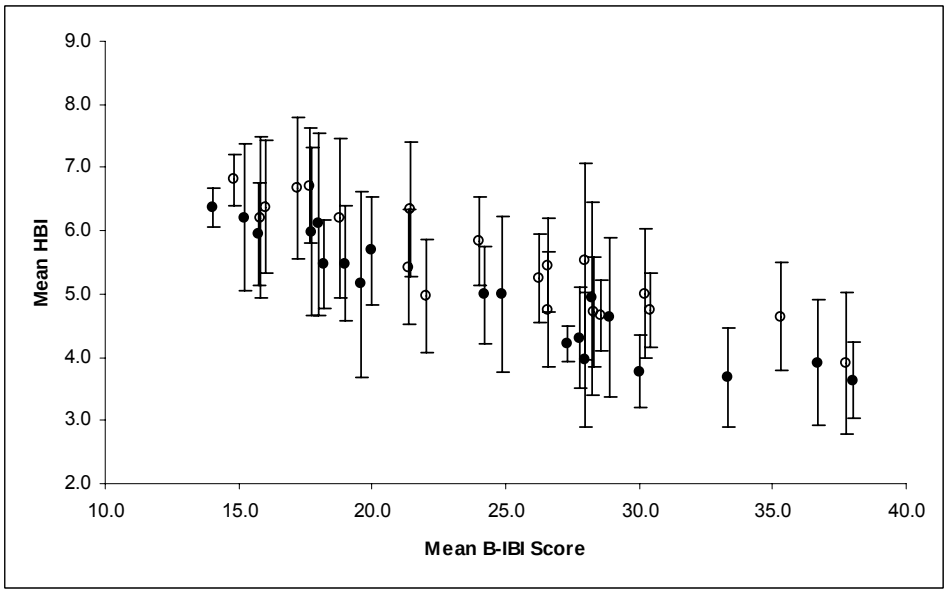


Figure 7d: Sub-basin mean B-IBI score vs. mean Hilsenhoff Biotic Index (HBI) score (± standard deviation). Filled circles (●) indicate 2003 data, empty circles (○) indicate 2002 data.



3.3 B-IBI AND FUNCTIONAL FEEDING GROUPS

3.3.1 Mean Sub-Basin B-IBI-Scores vs. Mean Sub-Basin Proportions of Organisms in Functional Feeding Groups, 2003

Mean sub-basin B-IBI score was significantly negatively correlated with the mean sub-basin proportions of organisms in the "Collectors-Filterers", "Collectors-Gatherers", "Herbivores-Piercers", "Predators-Engulfers", and "Predators-Piercers" functional feeding groups (Table 4). No significant correlation was apparent between mean sub-basin B-IBI score and the mean sub-basin proportions of taxa in "Scrapers and Grazers" and "Shredders" feeding groups.

Table 4: Spearman rank correlation coefficients for site-level B-IBI scores and percentages of organisms at each site in different functional feeding groups (n=143).

	Collectors-Filterers	Collectors-Gatherers	Scrapers and Grazers	Shredders	Herbivores-Piercers	Predators-Engulfers	Predators-Piercers
B-IBI Score	-0.595**	-0.280**	0.113	-0.032	-0.186*	-0.223**	-0.536**
Collectors-Filterers		0.351**	0.157	0.230**	-0.087	0.238**	0.593**
Collectors-Gatherers			0.402**	0.285**	-0.044	0.430**	0.464**
Scrapers and Grazers				0.565**	-0.051	0.356**	0.194*
Shredders					0.134	0.312**	0.252**
Herbivores-Piercers						0.019	0.147
Predators-Engulfers							0.421**
Predators-Piercers							

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

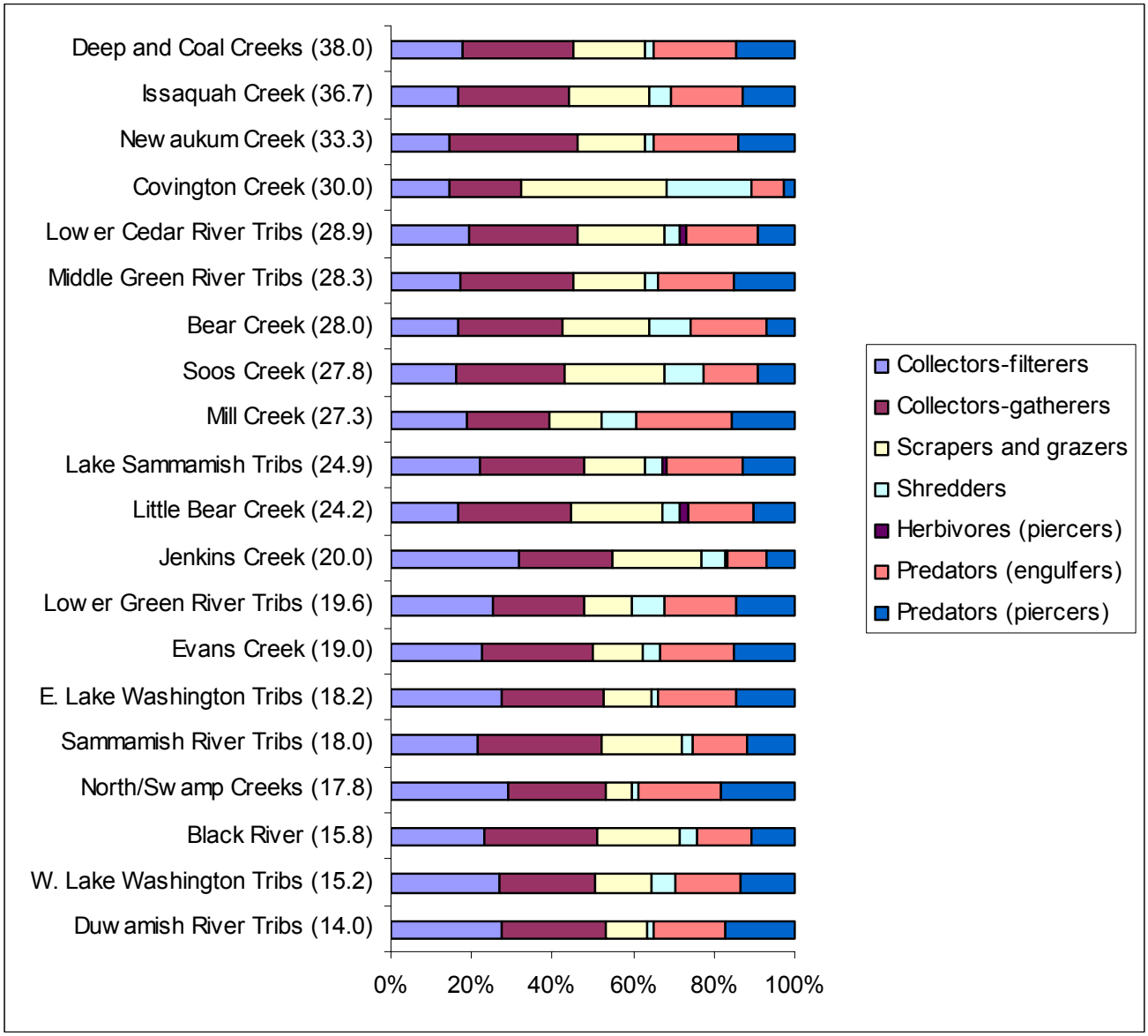
The mean proportions of organisms in the different functional feeding groups varied significantly among sub-basins, and coefficients of variation were all greater than 75%. This level of variability variation is similar to the wide variability noted among sub-basins in mean B-IBI scores and other measures of community diversity (Table 5, Figure 8). Overall, "Collector-Gatherers" was the most abundant functional feeding group in the samples (43.2 ± 7.0%), followed by "Scrapers and Grazers" (37.7 ±8.1%); "Predator-Engulfers" (29.3 ±6.2%), "Collector-Filterers" (19.7 ±6.8%), and "Shredders" (18.8 ±3.9%). "Predator-Piercers" and "Herbivore-Piercers" were relatively uncommon

in the samples, on average comprising 8.6 ±3.5% and 0.9 ±1.3%, respectively, of the classifiable organisms collected.

Table 5: Proportions of organisms in each functional feeding group for 20 sub-basins in the study area, based upon 2003 samples. Note, only taxa assigned to a functional feeding group by Merritt and Cummins (1997) were included in this analysis.

Sub-Basin	B-IBI	Collector-Filterers	Collectors-Gatherers	Scrapers and Grazers	Shredders	Herbivores-Piercers	Predators-Engulfers	Predators-Piercers
Deep/Coal creeks	38.0 ± 5.3	12.9 ± 3.1	49.1 ± 8.8	42.0 ± 5.9	14.8 ± 3.5	0.0 ± 0.0	23.9 ± 3.6	6.8 ± 4.1
Issaquah Creek	36.7 ± 6.5	10.2 ± 7.5	36.2 ± 12.8	38.4 ± 14.7	16.0 ± 7.3	0.2 ± 0.5	20.4 ± 7.6	6.2 ± 3.8
Newaukum Creek	33.3 ± 9.2	11.5 ± 3.4	48.6 ± 8.4	39.4 ± 4.8	16.3 ± 4.5	0.0 ± 0.0	26.4 ± 8.9	6.9 ± 4.1
Covington Creek	30.0 ± 3.5	21.8 ± 3.2	42.7 ± 1.7	44.5 ± 5.4	27.3 ± 8.7	0.0 ± 0.0	20.9 ± 1.9	4.8 ± 1.3
Lower Cedar River tribs	28.9 ± 10.3	14.8 ± 6.9	42.2 ± 16.6	40.0 ± 13.2	22.7 ± 11.6	0.1 ± 0.3	32.8 ± 13.7	5.8 ± 2.6
Middle Green River tribs	28.3 ± 8.8	14.2 ± 7.6	32.6 ± 12.3	33.4 ± 14.0	20.3 ± 13.9	3.1 ± 8.8	27.7 ± 21.1	8.9 ± 7.6
Bear Creek	28.0 ± 2.2	15.1 ± 6.7	36.2 ± 13.2	31.2 ± 13.2	16.8 ± 10.0	0.2 ± 0.7	26.4 ± 10.3	6.3 ± 5.1
Soos Creek	27.8 ± 7.0	16.4 ± 7.6	47.4 ± 10.3	39.1 ± 6.9	19.4 ± 4.3	1.0 ± 2.1	33.3 ± 8.4	7.5 ± 2.9
Mill Creek	27.3 ± 3.1	16.2 ± 0.5	37.6 ± 8.5	36.8 ± 11.8	24.7 ± 4.1	0.0 ± 0.0	33.2 ± 8.1	6.8 ± 3.8
L. Sammamish tribs	24.9 ± 6.5	14.4 ± 7.3	40.1 ± 16.6	35.0 ± 11.7	20.6 ± 10.2	1.4 ± 2.5	29.6 ± 10.6	7.4 ± 3.5
Little Bear Creek	24.2 ± 6.7	14.0 ± 6.4	37.8 ± 19.7	34.6 ± 15.6	12.9 ± 10.0	2.0 ± 3.1	23.0 ± 14.4	4.7 ± 2.7
Jenkins Creek	20.0 ± 5.3	23.2 ± 11.4	34.5 ± 3.6	32.8 ± 3.1	17.1 ± 1.2	4.5 ± 4.5	20.9 ± 9.6	6.2 ± 2.5
Lower Green River	19.6 ± 7.5	19.2 ± 8.6	42.4 ± 16.2	27.5 ± 12.0	21.2 ± 10.0	0.0 ± 0.0	32.0 ± 10.8	6.6 ± 2.8
Evans Creek	19.0 ± 4.3	20.1 ± 7.5	49.5 ± 14.0	37.6 ± 6.7	19.2 ± 3.7	2.8 ± 5.1	40.6 ± 7.5	9.8 ± 7.5
E. Lake Washington tribs	18.2 ± 6.4	31.2 ± 18.6	50.5 ± 8.8	37.8 ± 9.4	16.8 ± 10.6	0.7 ± 2.1	34.6 ± 6.5	12.3 ± 6.8
Sammamish River tribs	18.0 ± 6.2	28.1 ± 7.1	49.7 ± 16.3	44.3 ± 16.8	14.2 ± 10.0	0.9 ± 2.6	27.8 ± 11.8	13.8 ± 8.5
North/Swamp creeks	17.8 ± 4.2	24.1 ± 13.1	33.1 ± 15.1	25.6 ± 14.1	12.7 ± 6.6	1.2 ± 2.1	25.5 ± 14.5	6.9 ± 4.3
Black Creek	15.8 ± 3.9	28.2 ± 12.4	47.0 ± 12.2	37.5 ± 12.1	19.1 ± 16.3	0.0 ± 0.0	41.7 ± 13.5	16.1 ± 8.2
W. Lake Washington tribs	15.2 ± 4.0	30.0 ± 13.6	48.8 ± 13.3	36.6 ± 11.4	20.2 ± 9.2	0.6 ± 2.0	35.1 ± 13.8	14.5 ± 6.4
Duwamish River tribs	14.0 ± 2.8	28.9 ± 11.6	57.3 ± 20.0	35.7 ± 18.3	22.9 ± 19.2	0.0 ± 0.0	30.9 ± 13.2	14.1 ± 5.5

Figure 8: Mean proportions of organisms in each functional feeding group for 20 sub-basins in the study area, based upon 2003 samples. Sub-basins are sorted by mean B-IBI score (in parentheses).



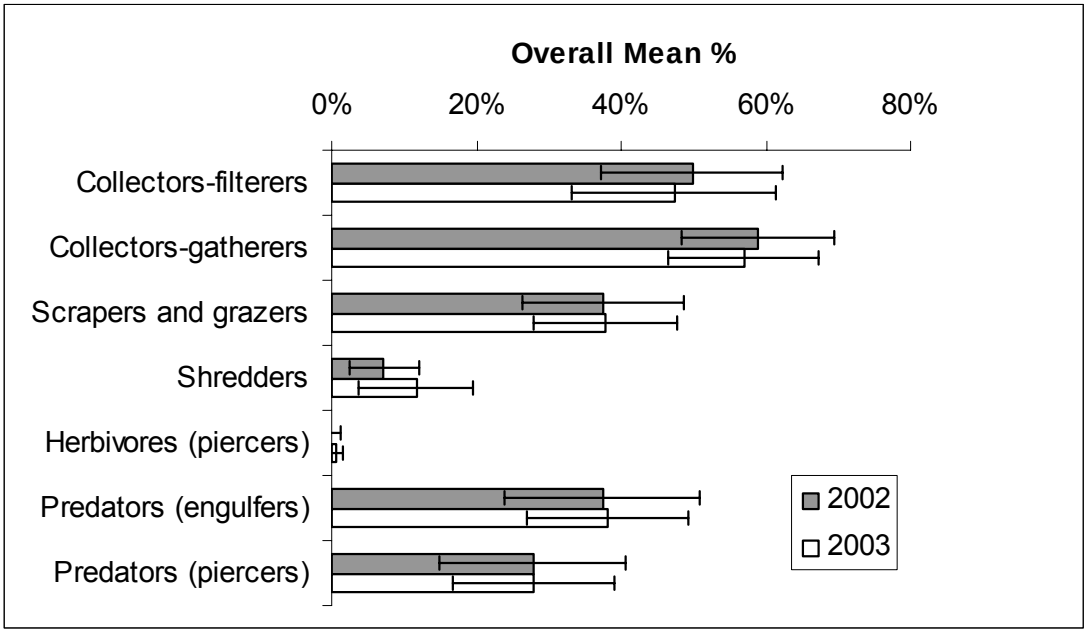
3.3.2 Comparison of 2002 and 2003 Mean Sub-Basin Proportions of Organisms in Various Functional Feeding Groups

When only data from the 120 sites sampled in both 2002 and 2003 are considered, the mean sub-basin proportions of organisms in the various functional feeding groups were remarkably similar in the two years of study (Table 6) and this trend is also reflected in the overall (i.e., for all sub-basins) proportions of organisms in each group in the two years of study (Figure 9).

Table 6: Sub-basin mean proportions of organisms in each functional feeding group for sub-basins sampled in 2002 and 2003.

	Collector-Filterers		Collectors-Gatherers		Scrapers and Grazers		Shredders		Herbivores-Piercers		Predators-Engulfers		Predators-Piercers	
Sub-Basin	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**	**2002**	**2003**
Deep/Coal creeks	31.3	38.5	57.9	59.0	47.7	37.6	2.8	5.0	0.0	0.0	32.5	44.3	16.9	31.0
Issaquah Creek	37.0	36.6	52.6	58.8	47.2	42.9	11.9	12.5	0.0	0.0	37.4	37.8	25.7	28.1
Newaukum Creek	40.0	33.3	75.6	72.4	39.3	38.6	2.0	5.2	0.0	0.0	49.8	48.2	37.5	31.7
Covington Creek	41.0	23.9	30.5	28.7	49.3	59.4	19.6	35.3	0.0	0.0	16.5	13.3	5.1	4.0
Lower Cedar River tribs	50.7	38.2	49.7	52.8	37.7	41.7	5.3	7.9	0.0	2.8	30.8	35.0	20.6	17.6
Middle Green tribs	45.2	42.8	68.2	69.3	40.5	44.0	7.3	8.9	0.0	0.1	49.0	46.5	37.9	37.2
Bear Creek	41.8	31.4	59.1	47.2	37.6	40.2	15.7	19.1	1.9	0.0	38.3	34.1	26.7	13.4
Soos Creek	47.3	32.9	51.9	54.9	37.2	50.2	3.3	19.5	0.0	0.1	40.3	28.2	25.0	18.1
Mill Creek	59.3	44.9	71.4	49.3	23.0	31.3	6.2	20.5	0.0	0.0	70.0	56.3	54.0	38.0
Lake Sammamish tribs	58.4	49.8	60.5	59.9	27.6	33.6	6.2	10.2	0.0	1.7	41.5	43.2	32.0	29.7
Little Bear Creek	37.2	35.7	65.8	59.5	52.4	49.5	4.7	9.2	0.5	4.3	31.2	34.2	23.2	22.1
Jenkins Creek	32.4	56.2	53.3	40.5	53.2	38.8	13.2	10.7	2.5	0.9	17.9	16.7	7.0	12.5
Lower Green	75.7	61.6	58.5	53.5	16.0	29.3	11.1	19.5	0.1	0.0	50.9	42.6	45.7	35.1
Evans Creek	55.8	56.5	50.0	67.3	30.2	31.0	8.6	10.7	2.8	0.1	36.3	45.5	25.6	37.9
E. Lake Washington tribs	54.4	61.9	70.6	57.0	33.7	27.2	4.5	2.7	0.4	0.0	50.6	43.8	39.4	33.0
Samm River tribs	59.7	47.9	50.6	67.8	33.9	45.3	4.2	5.0	0.1	0.0	22.9	30.5	17.6	26.3
North Swamp creeks	65.0	77.0	68.3	64.5	21.1	16.4	2.3	4.7	0.1	0.3	50.8	53.1	44.1	49.0
Black River	41.6	49.6	70.0	60.6	53.7	43.7	6.2	9.3	0.0	0.0	24.7	28.7	21.2	23.4
W Lake Washington tribs	52.8	59.0	55.3	51.6	41.8	30.7	5.2	13.0	0.0	0.1	20.3	35.8	16.5	28.9
Duwamish River tribs	71.3	69.6	57.2	65.3	24.8	25.4	3.9	3.9	0.0	0.0	36.9	45.3	34.9	42.9

Figure 9: Overall mean proportion of organisms in seven functional feeding groups in samples collected in 2002 and 2003.



3.4 B-IBI SCORES AND LAND-USE PARAMETERS

3.4.1 Total Impervious Area (TIA) versus Effective Impervious Area (EIA)

Percent Total Impervious Area (%TIA) measures the total density of impervious cover within a watershed. Percent Effective Impervious Area (%EIA) recognizes that some impervious areas are completely surrounded by pervious areas, and therefore have less impact on aquatic ecosystems; EIA is basically the impervious cover that provides stormwater flows fairly directly and quickly to streams. In general, a watershed's B-IBI score is correlated with the land-use practices within the watershed, whether this is measured in terms of %EIA in the watershed or the proportion of a watershed that is occupied by different types of development.

3.4.2 B-IBI vs. %EIA

At the site level, as %EIA increases, B-IBI scores decreased, and this relationship is significant ($r_s = -0.684$, $p<0.01$; Figure 10a). At the sub-basin level, the relationship between mean B-IBI score and mean % EIA is also significant, and much stronger ($r_s = -0.869$, $p<0.01$; Figure 10b). The relationship observed in 2003 between B-IBI score and %EIA is very similar to that observed in 2002.

In the Greater Vancouver Regional District, British Columbia, Canada, EVS (2000) also found a significant negative relationship between a watershed's %EIA and its B-IBI score (r^2 = -0.959, $p<0.05$ using Pearson's correlation coefficient). The sampled watersheds in King County and Vancouver include a similar range of land-use types, and a similar range of %EIA values.

Figure 10a: Individual site B-IBI scores vs. mean % EIA, 2002 and 2003. Regression lines for 2002 (- - -) and 2003 (—) data are shown.

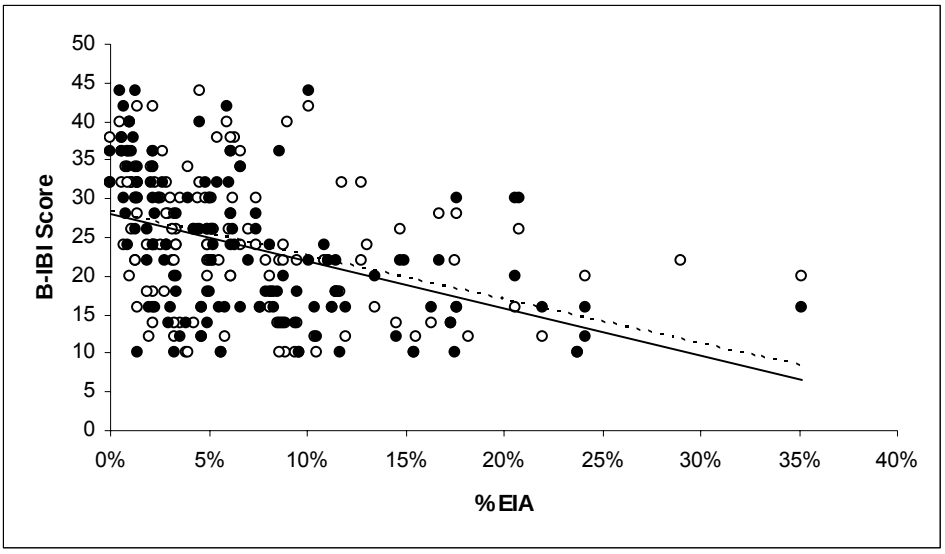
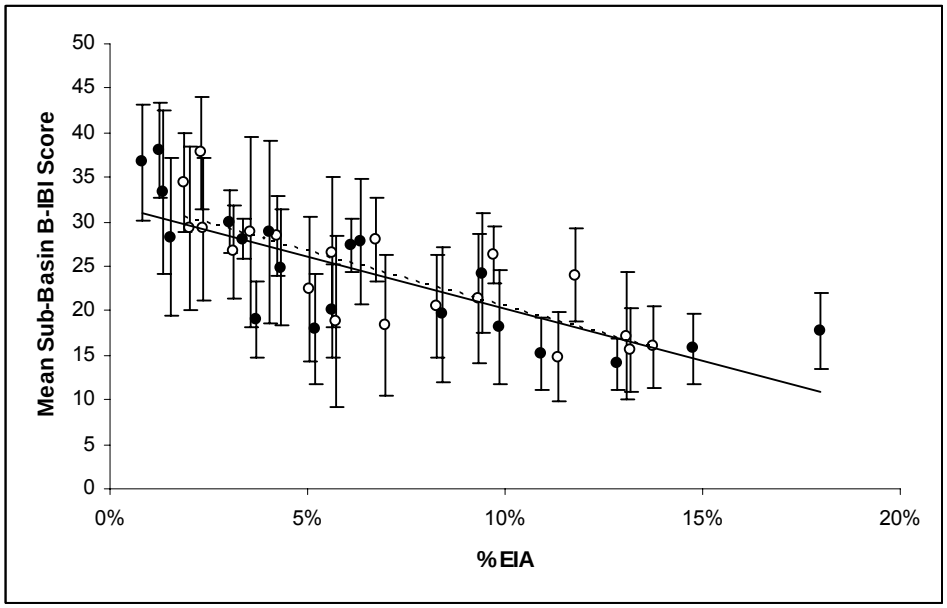


Figure 10b: Mean (± standard deviation) sub-basin B-IBI scores vs. mean % EIA. Regression lines for 2002 (- - -) and 2003 (—) are shown.



3.4.3 B-IBI vs. Upstream Land Use

Upstream land-use significantly affects site- and mean sub-basin-level B-IBI scores (Tables 7 and 8; Figure 11). At both site and sub-basin levels, B-IBI is significantly positively correlated with the amount of forest ($r_s = 0.632$ and $r_s = 0.898$, respectively, $p<0.01$) and scrub/shrub ($r_s = 0.460$ and $r_s = 0.644$, respectively, $p<0.01$) present in a watershed. B-IBI scores were also significantly correlated with these same land use categories in 2002, although the 2003 data do not show as strong a relationship. Conversely, there is a significant negative correlation between B-IBI score and the amount of developed land (i.e., bare ground/asphalt [$r_s = -0.798$, $p<0.01$], bare rock/concrete [$r_s = -0.711$, $p<0.01$], and high [$r_s = -0.786$, $p<0.01$], medium [$r_s = -0.823$, $p<0.01$], and low-intensity development [$r_s = -0.510$, $p<0.05$]) (Tables 7 and 8). The negative correlation coefficients between B-IBI scores and the amount of developed land were also slightly higher in 2002 than in 2003.

Table 7: Spearman rank correlation coefficients for site-level B-IBI scores and percentages of watersheds occupied by various land-use types (n=130).

	Bare Ground/ Asphalt	Bare Rock/ Concrete	Developed - High Intensity	Developed - Medium Intensity	Developed - Low Intensity	Forest	Scrub/ Shrub	Grass	Open Water
B-IBI Score	-0.593**	-0.452**	-0.584**	-0.688**	-0.406**	0.632**	0.460**	-0.241**	0.248**
Bare Ground/Asphalt		0.813**	0.913**	0.821**	0.409**	-0.636**	-0.289**	0.443**	-0.061
Bare Rock/Concrete			0.816**	0.643**	0.355**	-0.535**	-0.145	0.380**	0.022
Developed - High Intensity				0.842**	0.434**	-0.703**	-0.296**	0.434**	-0.017
Developed - Med. Intensity					0.555**	-0.781**	-0.478**	0.369**	-0.152
Developed - Low Intensity						-0.545**	-0.060	0.417**	-0.105
Forest							0.487**	-0.338**	0.303**
Scrub/Shrub								0.288**	0.375**
Grass									-0.049
Open Water									

** correlation is significant at the 0.01 level (2-tailed)

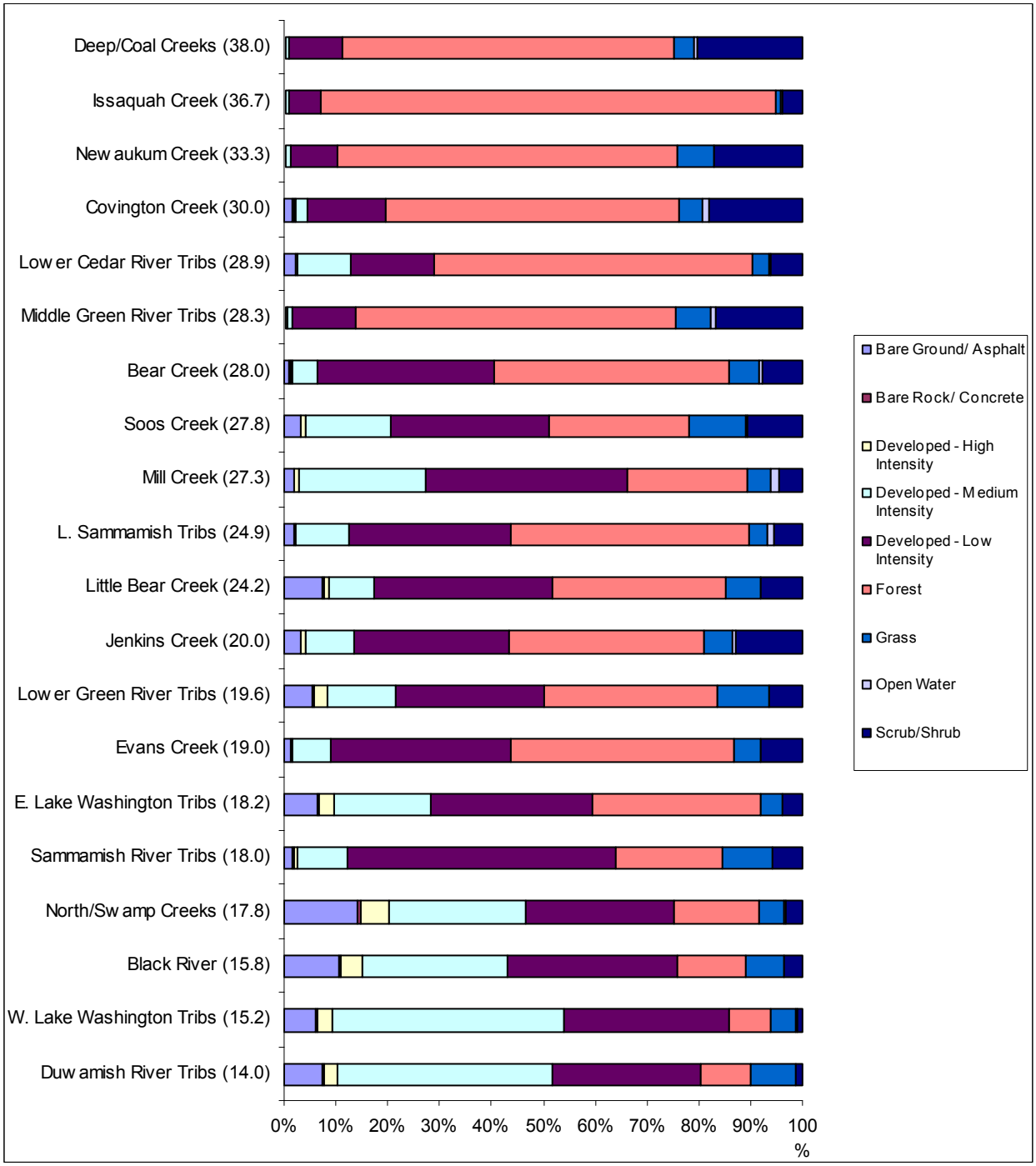
Table 8: Spearman rank correlation coefficients for sub-basin-level mean B-IBI scores and mean percentages of sub-basins occupied by various land-use types (n=20).

	Bare Ground/ Asphalt	Bare Rock/ Concrete	Developed - High Intensity	Developed - Medium Intensity	Developed - Low Intensity	Forest	Scrub/ Shrub	Grass	Open Water
B-IBI Score	-0.798**	-0.711**	-0.786**	-0.823**	-0.510*	0.898**	0.644**	-0.344	0.420
Bare Ground/Asphalt		0.862**	0.929**	0.857**	0.346	-0.815**	-0.541*	0.257	-0.376
Bare Rock/Concrete			0.877**	0.689**	0.253	-0.704**	-0.370	0.311	-0.389
Developed - High Intensity				0.853**	0.392	-0.874**	-0.508*	0.295	-0.289
Developed – Med. Intensity					0.389	-0.898**	-0.689**	0.206	-0.174
Developed - Low Intensity						-0.544*	-0.180	0.299	-0.102
Forest							0.606**	-0.385	0.277
Scrub/Shrub								0.180	0.310
Grass									-0.442
Open Water									

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

Figure 11: Proportions of watersheds in each sampled sub-basins with each land-use type. Sub-basins are sorted in order of mean sub-basin B-IBI score (in parentheses).



At the site and sub-basin levels, the strongest correlations observed were between B-IBI score and the amount of medium-intensity development, and between B-IBI score and the amount of forested land. B-IBI scores are also correlated with most of the other land-use variables, but are least strongly correlated with the amount of grassland (r_s = -0.344, p>0.05) and open water (r_s = 0.420, p>0.05) in a watershed. This mirrors the trend observed in 2002. These results confirm observations of the USGS (Lenz and Rheaume, 2000), that B-IBI scores of forest streams are inversely related with the degree to which a watershed has been logged. These results are also supported by the findings of Bennett and Rysavy (2003), and Yoder (1991), who found that B-IBI scores decrease as watersheds become more urbanized (e.g., more residential and industrial development, more road crossings, more stormflow discharges).

It should be noted that the amount of developed area (bare ground/asphalt, bare rock/concrete, and high, medium, and low-intensity development) in a watershed is inversely proportional to the amount of undeveloped area (forest and shrub/scrub). This is to be expected when forested area is cleared for development. Many of the development-related land-use variables are correlated with one another, which is not surprising since an increase in developed area is accompanied by an increase in paved area, and so on.

3.5 B-IBI SCORES AND WATER QUALITY

As was the case in 2002, water quality data were available for relatively few benthic macroinvertebrate sampling sites (i.e., 16-29 sites, depending on the parameter in question), and it was therefore not possible to correlate mean sub-basin water quality values with mean sub-basin B-IBI scores. At the site level, B-IBI scores are significantly negatively correlated with the following mean base-flow water quality parameters: total phosphorus (r_s = -0.431), total zinc (r_s = -0.718), total copper (r_s =-0.697), alkalinity (r_s = -0.674), conductivity (r_s = -0.663), turbidity (r_s =-0.487), and temperature (r_s = -0.487) (Table 9). B-IBI scores were not significantly correlated with pH, DO, TSS, DOC, or TOC measurements. Site-level correlations between B-IBI scores and water quality measurements were similar to those observed in 2002, with the exception of TSS and temperature. In 2002, B-IBI scores were significantly correlated with TSS, whereas B-IBI scores were not correlated with temperature; the opposite was true in 2003.

Table 9: Spearman rank correlation coefficients for site-level B-IBI scores and selected mean base-flow water quality parameters.

	Temp.	Cond.	pH	DO	Alk.	Turb.	TSS	DOC	TOC	Total P	Total Zn	Total Cu
B-IBI Score (n=29)	-0.487**	-0.663**	-0.217	0.301	-0.674**	-0.487**	-0.269	-0.196	-0.221	-0.431*	-0.718**	-0.697**
Temperature (n=29)		0.396*	-0.281	-0.602**	0.404*	0.153	-0.162	0.081	0.099	-0.024	0.254	0.172
Conductivity (n=29)			0.238	-0.243	0.965**	0.314	0.036	0.308	0.270	0.444*	0.587**	0.429
pH (n=29)				0.604**	0.177	0.167	0.163	-0.281	-0.075	0.075	-0.046	0.084
DO (n=29)					-0.295	-0.141	0.001	-0.541*	-0.433	-0.353	-0.568**	-0.361
Alkalinity (n=29)						0.304	0.001	0.163	0.134	0.429*	0.531*	0.341
Turbidity (n=29)							0.757**	0.423	0.602*	0.497**	0.431	0.765**
TSS (n=29)								0.228	0.405	0.532**	0.348	0.687**
DOC (n=16)									0.938**	0.806**	0.682**	0.653**
TOC (n=16)										0.817**	0.599*	0.678**
Total P (n=29)											0.589**	0.660**
Total Zn (n=21)												0.852**
Total Cu (n=21)												

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

Site-level B-IBI scores were significantly negatively correlated with the following mean storm-flow water quality parameters: total zinc (r_s = -0.565), total copper (r_s = -0.536), and temperature (r_s =- 0.507) (Table 10). In 2002 none of the storm-flow collected parameters were significantly correlated with site-level B-IBI scores.

Table 10: Spearman rank correlation coefficients for site-level B-IBI scores and selected mean storm-flow water quality parameters.

	Temp.	Cond.	Alk.	Turb.	TSS.	Total P	Total Zn	Total Cu
B-IBI Score	-0.507*	-0.359	-0.389	-0.421	-0.196	-0.306	-0.565*	-0.536*
Temp.		0.285	0.224	0.290	0.080	-0.159	0.229	0.329
Cond.			0.791**	0.276	0.266	0.123	0.452	0.325
Alk.				0.094	0.048	0.099	0.266	0.168
Turb.					0.948**	0.696**	0.926**	0.948**
TSS						0.696**	0.855**	0.855**
Total P							0.718**	0.639**
Total Zn								0.909**
Total Cu								

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

Site-level B-IBI scores and Water Quality Index (WQI) scores were available for 19 stations sampled in 2002, and 23 stations sampled in 2003. In both years, WQI scores were significantly positively correlated with B-IBI scores (2002 r_s = 0.681, p = 0.001; 2003 r_s = 0.591, p = 0.002). Since several of the metrics which comprise the B-IBI score measure the response of invertebrate communities to organic enrichment, this correlation is not surprising. A WQI score incorporates several parameters which measure or respond to organic pollution (e.g., DO, fecal coliform bacteria, total nitrogen, total phosphorus).

During analysis of the 2002 data, strong correlations were observed between site-level B-IBI scores and land-use parameters (EVS 2004 Section 4.5.2). This apparent relationship prompted an examination of the data to determine whether water quality values were correlated with land-use data. The most consistent correlations for the 2002 data were observed between land-use and

conductivity, and between land-use and alkalinity, showing a trend that as watersheds become increasingly urbanized, the conductivity and alkalinity of their watercourses increase. Similar results were obtained from the 2003 data, with significant correlations between land use and alkalinity and land use and conductivity (Table 11).

Table 11: Spearman rank correlation coefficients for site-level land use data and selected mean base-flow water quality parameters.

	Bare Ground/ Asphalt	Bare Rock/ Concrete	Developed - High Intensity	Developed - Medium Intensity	Developed - Low Intensity	Forest	Scrub/ Shrub	Grass	Open Water
Temperature	0.205	0.224	0.287	0.406*	0.073	-0.283	-0.518**	-0.048	0.028
Conductivity	0.604**	0.554**	0.620**	.0734**	0.441*	-0.555**	-0.826**	-0.218	-0.150
pH	0.262	0.122	0.149	0.274	-0.102	-0.209	-0.081	0.205	-0.284
DO	-0.109	-0.208	-0.237	-0.209	-0.334	0.276	0.228	0.035	-0.255
Alkalinity	0.564**	0.528**	0.583**	0.725**	0.442*	-0.528**	-0.827**	-0.313	-0.114
Turbidity	0.285	0.163	0.246	0.164	-0.106	-0.105	-0.270	-0.018	-0.161
TSS	0.138	0.026	0.130	-0.057	-0.083	-0.029	-0.064	0.120	-0.031
DOC	0.414	0.490	0.511*	0.155	0.290	-0.287	-0.137	0.184	-0.061
TOC	0.346	0.405	0.461	0.122	0.149	-0.275	-0.146	0.146	0.013

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

3.6 B-IBI SCORES AND HABITAT VARIABLES

In 2003, site-level B-IBI score was significantly correlated with subdominant substrate size class ($r_s = 0.235$, $p<0.01$), but not dominant substrate size class (Table 12), whereas site-level B-IBI score was significantly correlated with both dominant substrate size class ($r_s = 0.192$, $p<0.05$) and subdominant substrate size class ($r_s = 0.236$, $p<0.01$) in 2002.

The lack of a significant correlation between dominant substrate size class in 2003 *versus* 2002 is most likely due to there being more variability in dominant size in 2003. This is likely an artifact of site selection process. Taking into account the two years of results, B-IBI score generally increases

with increasing substrate particle size. This finding is not surprising, because larger particle sizes are typically found at higher elevation, less-developed sites, where B-IBI scores are likely to be greater than at more developed, lower-lying sites where the biological condition has been degraded.

Table 12: Spearman rank correlation coefficients for site-level B-IBI scores and selected habitat parameters.

	Dominant Substrate Size Class	Subdominant Substrate Size Class	Left Bank Riparian Tree Density Class	Right Bank Riparian Tree Density Class
B-IBI Score	0.155	0.235**	0.241**	0.216*
Dominant Substrate Size Class		0.070	0.108	0.164
Subdominant Substrate Size Class			0.274**	0.199*
Left Bank Riparian Tree Density Class				0.671**
Right Bank Riparian Tree Density Class				

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

Significant positive correlations were also found between site-level B-IBI score and riparian tree density ($r_s = 0.241$ and $r_s = 0.216$ for left and right banks, respectively) (Table 12), and this was also the case in 2002. The relationship between B-IBI score and riparian tree density supports the observation that as sub-basins become more developed and their riparian forests cleared, the riparian tree density declines, as does B-IBI score (Booth 2000).

3.7 B-IBI Scores and Hydrological Parameters

Site-level B-IBI score was significantly positively correlated with instantaneous stream velocity during the 2003 late-summer sampling season ($p<0.05$, $r_s = 0.208$) (Table 13). In contrast, the relationship between B-IBI score and stream velocity was negative in 2002.

Table 13: Spearman rank correlation coefficients for 2003 site-level B-IBI scores and discharge (Q) summary data.

	Upstream Watershed Area	Velocity Measured During Field Sampling	Mean Annual Daily Q	Annual Minimum Daily Q	Annual Maximum Daily Q	Annual Minimum Inst. Q	Annual Maximum Inst. Q
B-IBI Score (n=130)	0.265**	0.208*	0.244	-0.020	0.273	-0.017	0.295
Upstream watershed area (n=137)		0.333**	0.609**	0.266	0.563**	0.201	0.612**
Velocity Measured During Field Sampling (n=134)			0.134	0.106	0.211	0.158	0.222
Mean Annual Daily Q (n=20)				0.740**	0.913**	0.707**	0.890**
Annual Minimum Daily Q (n=20)					0.477*	0.982**	0.487*
Annual Maximum Daily Q (n=20)						0.448	0.986**
Annual Minimum Inst. Q (n=19)							0.428
Annual Maximum Inst. Q (n=19)							

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

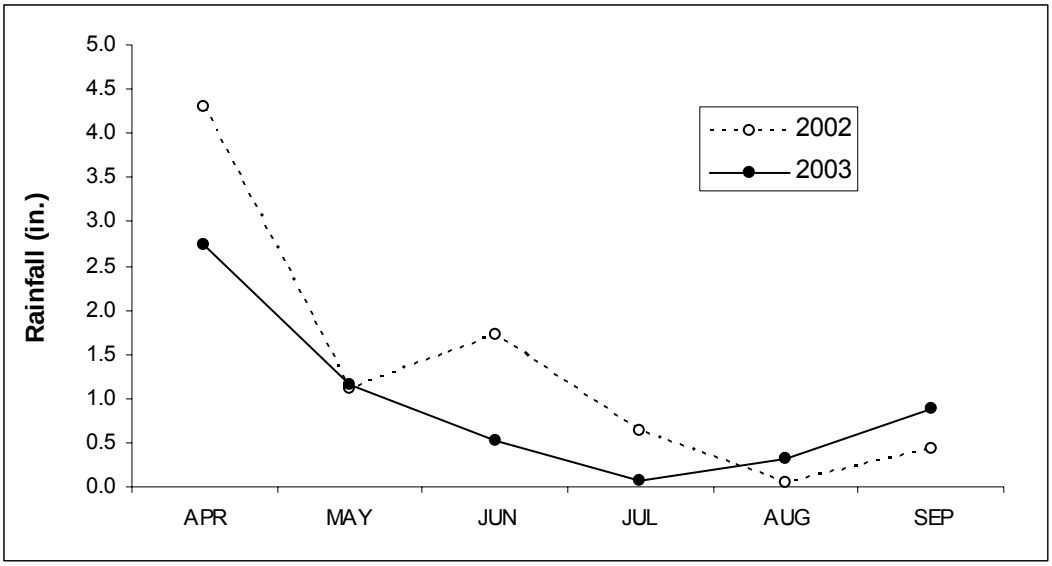
In 2003, B-IBI scores were not significantly correlated with any of the measured discharge (Q) parameters, whereas in 2002, B-IBI scores were significantly ($p>0.05$) positively correlated with annual mean daily discharge ($r_s = 0.539$), annual maximum daily discharge ($r_s = 0.475$), and annual minimum ($r_s = 0.459$) and maximum ($r_s = 0.752$) instantaneous discharges.

This difference in the relationships between the two years in the observed relationships between B-IBI scores and hydrological parameters may be related by inter-annual differences in rainfall; early summer rainfall in 2003 was notably lower than that in 2002 (Figure 12). Although we were not able to specifically investigate the relationship between rainfall and B-IBI score, we investigated the relationships between land-use variables and the hydrological parameters, which may ultimately influence B-IBI scores.

In 2002, instantaneous water velocity was significantly negatively correlated with upstream watershed surface area, percent forest, and percent shrub/scrub, but positively correlated with percent bare ground/asphalt, and percent medium-intensity and high-intensity development. Because rainfall was relatively high in the summer of 2002, water velocities measured in that year

were more likely to be influenced by stormflows than by watershed storage capacity. More developed watersheds, which would be expected to have higher stormwater flows, consequently had higher water velocities than less-developed watersheds. This is consistent with the observations of Booth (2000).

Figure 12: Total monthly rainfall at Seattle Tacoma Airport, April to September, 2002 and 2003. Source National Weather Service.



In contrast summer rainfall was relatively low in 2003, and instantaneous water velocity was significantly positively correlated with a watershed's upstream drainage area ($r_s = 0.333$, $p<0.01$) and with the percentage of the watershed occupied by open water ($r_s = 0.197$, $p<0.05$) (Table 14). All other factors (e.g., site gradient) being equal, during periods of relatively low rainfall, larger watersheds with greater surface-water and groundwater storage capacities can be expected to provide consistently more water and higher water velocities than smaller watersheds or watersheds which have less standing water.

Paradoxically, annual maximum instantaneous Q in 2002 was significantly positively correlated with upstream watershed area ($r_s=0.442$, $p<0.05$), whereas this relationship was not apparent in 2003, when none of the discharge parameters measured (i.e., mean annual daily Q, annual maximum daily Q, annual minimum daily Q, annual maximum instantaneous Q, annual minimum instantaneous Q) were significantly correlated with upstream land-use (Table 14). A probably explanation for this trend is that the discharge parameters for the study streams are calculated based on data for the entire year (including the winter rainy season), whereas instantaneous stream velocity measurements are based solely on summer conditions.

Various discharge measurements (i.e., mean annual daily Q, annual maximum daily Q, annual minimum daily Q, annual maximum instantaneous Q, annual minimum instantaneous Q) were not significantly ($p>0.05$) correlated with upstream land-use (Table 14). In general, this is similar to the 2002 data, except for annual maximum instantaneous Q which was significantly positively correlated with upstream watershed area ($r_s=0.442$, $p<0.05$).

Table 14: Spearman rank correlation coefficients for site-level land use categories and instantaneous flow and discharge (Q) summary data.

	Instant-aneous Flow (ft/s)	Mean Ann. Daily Q	Ann. Min. Daily Q	Ann. Max. Daily Q	Ann. Min. Inst. Q	Ann. Max. Inst. Q
Upstream Area (acres)	0.333**	0.609**	0.266	0.563**	0.201	0.612**
% EIA	0.046	0.010	0.002	0.063	0.014	0.130
% Bare Ground/ Asphalt	0.067	0.053	0.065	0.108	0.056	0.175
% Bare Rock/ Concrete	0.094	-0.197	-0.253	-0.107	-0.265	-0.091
% Developed - High Intensity	0.029	-0.138	-0.160	-0.052	-0.147	-0.039
% Developed - Medium Intensity	-0.025	-0.050	-0.125	0.019	-0.104	0.035
% Developed - Low Intensity	0.120	-0.138	-0.095	-0.167	-0.056	-0.114
% Grass	0.047	0.011	0.044	0.147	0.047	0.182
% Forest	-0.032	0.160	0.106	0.114	0.098	0.102
% Scrub/ Shrub	0.163	0.096	0.235	-0.014	0.220	-0.011
% Open Water	0.197*	-0.068	-0.093	-0.152	-0.183	-0.175

** correlation is significant at the 0.01 level (2-tailed)

* correlation is significant at the 0.05 level (2-tailed)

4. CONCLUSIONS

The B-IBI provides a useful tool for monitoring ecosystem health in King County streams, and provided consistent results for most sites and sub-basins during the two years of study. The following provides responses to the questions posed by the Greater Lake Washington and Green-Duwamish River benthic SAP (King County 2002a):

Question 1 and 2: Do different watershed sub-basins within the Greater Lake Washington Watershed and Green-Duwamish Watershed differ in terms of biological condition?

Summarizing data from sampling sites within a sub-basin into a mean sub-basin score offers a convenient means of simplifying the presentation and discussion of data concerning the biological condition of King County streams. Although differences between mean B-IBI scores were only statistically significant between the sub-basins with the highest and lowest mean B-IBI scores, mean sub-basin scores generally provide an accurate reflection of the overall biological health of the streams in each sub-basin. The sub-basins in the best biological condition were Deep/Coal creeks and Issaquah Creek, where watercourses generally have "good" or "fair" B-IBI scores. In contrast, all of the watercourses in the Duwamish, West Lake Washington, Black, and North/Swamp sub-basins had "poor" or very poor" B-IBI scores. B-IBI scores and rankings were similar in 2002 and 2003 for streams sampled in both years.

Question 4: Do different land use patterns measured at the sub-basin level affect biological conditions differently within the watershed?

In general, differences in land-use patterns within sub-basins closely reflected differences in B-IBI scores among sub-basins. Overall, mean sub-basin B-IBI scores declined with increasing development.

Site and sub-basin level B-IBI scores decline significantly as the percentage of upstream EIA, bare ground/asphalt, bare rock/concrete, and high, medium and low intensity development increases. Conversely, site-level B-IBI scores increase as the amount of upstream forest and scrub/shrub increase. Although limitations in the available data did not permit us to determine precisely which urbanization-related hydrological or water quality parameters are causing invertebrate community integrity to decline with increasing urban development, B-IBI scores are significantly correlated with conductivity, alkalinity, turbidity, total phosphorus, total copper and total zinc, and stream flow.

Question 3: Is the biological condition improving (or declining) over time? Is the trend significant?

Two years of data, which had different levels of rainfall, are of limited value in assessing whether the biological condition of King County streams is improving or declining over time. However, data indicate that the biological conditions in most of the sampled streams were similar during the two years of study.

Based on two years of data, biological condition declined between 2002 and 2003 in the Evans Creek and Jenkins Creek sub-basins, and improved in the Mills Creek sub-basin. Although reasons for these changes were not apparent, these sub-basins should be monitored closely to determine if the observed changes are part of a long-term trend.

Based on these data it is recommended that use of the 10-metric B-IBI for monitoring King County streams be continued. Of the different indices that were tested, the B-IBI provides the most information. If adoption of a "simpler" biotic index is required (e.g., as a cost-saving measure), it is recommended that separation of mayfly, stonefly, and caddisfly (EPT) taxa from benthic macroinvertebrate samples be submitted to the taxonomic laboratory for analysis, and the sum of EPT taxa for each site be determined. This would dramatically reduce the amount of taxonomic identification required, but would yield a score which corresponds very closely to the site's B-IBI score.

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APPENDIX A

2002 and 2003 Benthic Sites with Data Types Available for Each Site

APPENDIX A – 2002 and 2003 Benthic Sites with Data Types Available for Each Site

Watershed	Benthic Station ID (Freshwater Locator)	Site Name	2002 Benthic Data	2003 Benthic Data	2002/2003 Land Use Data	2002 Habitat Data	2003 Habitat Data	2002 WQ Data	2002 WQ Station Code	2003 WQ Data	2003 WQ Station Code	2002 Hydrology Data	2002 Hydrology Station Code	2003 Hydrology Data	2003 Hydrology Station Code
Greater Lk. Wash.	08BEA3312	Tributary to Bear Creek (0119)	x	x	x	x	x								
Greater Lk. Wash.	08BEA3321	Cold Creek	x	x	x	x	x								
Greater Lk. Wash.	08BEA3325	Daniels Creek	x	x	x	x	x								
Greater Lk. Wash.	08BEA3478	Mackey Creek	x	x	x	x	x	x	C484	x	C484				
Greater Lk. Wash.	08BEA3571	Cottage Lake Creek	x	x	x	x	x	x	N484	x	N484				
Greater Lk. Wash.	08BEA3650	Bear Creek	x	x	x	x	x	x	J484	x	J484	x	02E	x	02e
Greater Lk. Wash.	08BEA3737	Seidel Creek	x	x	x	x	x								
Greater Lk. Wash.	08BEA3737	Seidel Creek Replicate	x		x	x									
Greater Lk. Wash.	08BEA3747	Bear Creek	x	x	x	x	x					x	02F	x	02f
Greater Lk. Wash.	08BEA3826	Struve Creek	x	x	x	x	x								
Greater Lk. Wash.	08BEA3914	Colin Creek	x		x	x									
Greater Lk. Wash.	08CED2518	Molasses Creek	x	x	x	x	x								
Greater Lk. Wash.	08CED2433	Maplewood Creek	x	x	x	x	x								
Greater Lk. Wash.	08CED2518	Molasses Creek	x	x	x	x	x								
Greater Lk. Wash.	08CED2711	Madsen Creek - South Fork	x	x	x	x	x								
Greater Lk. Wash.	08CED2898	Tributary to Cedar River	x	x	x	x	x								
Greater Lk. Wash.	08CED4115	Taylor Creek (North)	x		x	x									
Greater Lk. Wash.	08CED4192	Rock Creek (Kent)	x	x	x	x	x								
Greater Lk. Wash.	08CED4479	Walsh Lake Diversion	x	x	x	x	x								
Greater Lk. Wash.	08CED4975	Hotel Creek	x	x	x	x	x								
Greater Lk. Wash.	08CED5032	Rock Creek (SPU)	x	x	x	x	x								
Greater Lk. Wash.	08CED5046	Webster Creek	x		x	x									
Greater Lk. Wash.	08EAS1502	Tributary to Lake Washington (Mercer Island)		x	x										
Greater Lk. Wash.	08EAS1536	Denny Creek	x		x	x						x	16B		
Greater Lk. Wash.	08EAS1964	May Creek	x	x	x	x	x	x	0440	x	0440	x	37A	x	37a
Greater Lk. Wash.	08EAS2058	May Creek	x	x	x	x	x								
Greater Lk. Wash.	08EAS2191	Forbes Creek	x	x	x	x	x	x	0456	x	0456			x	20a
Greater Lk. Wash.	08EAS2272	Kelsey Creek	x	x	x	x	x								
Greater Lk. Wash.	08EAS2446	Coal Creek (A)	x	x	x	x	x	x	0442	x	0442				
Greater Lk. Wash.	08EAS2446	Coal Creek Replicate (B)		x	x										
Greater Lk. Wash.	08EAS2540	Tributary to Coal Creek	x		x	x									
Greater Lk. Wash.	08EAS2546	Tributary to Richards Creek	x	x	x	x	x								
Greater Lk. Wash.	08EAS2631	May Creek	x	x	x	x	x					x	37B	x	37b
Greater Lk. Wash.	08EVA4077	Rutherford Creek	x		x	x									
Greater Lk. Wash.	08EVA3474	Evans Creek	x	x	x	x	x								
Greater Lk. Wash.	08EVA3555	Evans Creek	x	x	x	x	x			x	B484	x	18A	x	18a
Greater Lk. Wash.	08EVA3637	Tributary to Evans Creek (0111E)	x	x	x	x	x								
Greater Lk. Wash.	08EVA3640	Tributary to Evans Creek (0108)	x	x	x	x	x								
Greater Lk. Wash.	08EVA3642	Tributary to Evans Creek (0107)	x		x	x									
Greater Lk. Wash.	08EVA3642	Tributary to Evans Creek (0107) Replicate	x		x	x									
Greater Lk. Wash.	08EVA3813	Tributary to Evans Creek (0108A)	x	x	x	x	x								
Greater Lk. Wash.	08EVA3897	Evans Creek	x		x	x		x	S484			x	18F		
Greater Lk. Wash.	08EVA4249	Tributary to Evans Creek (0111A)	x	x	x	x	x								
Greater Lk. Wash.	08ISS3877	Issaquah Creek		x	x					x	0631				
Greater Lk. Wash.	08ISS3958	Cabin Creek	x	x	x	x	x	x	A631	x	A631				
Greater Lk. Wash.	08ISS4294	Fifteenmile Creek	x		x	x									
Greater Lk. Wash.	08ISS4373	Tributary to Issaquah Creek (0203)	x	x	x	x	x								
Greater Lk. Wash.	08ISS4573	High Point Creek	x	x	x	x	x								
Greater Lk. Wash.	08ISS4724	Carey Creek		x	x		x								
Greater Lk. Wash.	08ISS4730	Holder Creek	x	x	x	x	x								
Greater Lk. Wash.	08ISS4730	Holder Creek - replicate	x		x										
Greater Lk. Wash.	08ISS4735	Tributary to Holder Creek	x	x	x	x	x								
Greater Lk. Wash.	08ISS4735	Tributary to Holder Creek - duplicate		x	x		x								
Greater Lk. Wash.	08ISS4884	Issaquah Creek - East Fork	x	x	x	x	x								
Greater Lk. Wash.	08LAK2827	Vasa Creek	x		x	x									
Greater Lk. Wash.	08LAK2827	Vasa Creek Replicate	x		x	x									
Greater Lk. Wash.	08LAK3121	Idylwood Creek	x	x	x	x	x	x	A620	x	A620				
Greater Lk. Wash.	08LAK3121	Idylwood Creek Replicate	x		x	x									
Greater Lk. Wash.	08LAK3540	Pine Lake Creek	x	x	x	x	x	x	A680	x	A680	x	15B	x	15b
Greater Lk. Wash.	08LAK3616	Tibbetts Creek	x	x	x	x	x	x	X630	x	X630				
Greater Lk. Wash.	08LAK3627	Ebright Creek	x	x	x	x	x	x	A685	x	A685				
Greater Lk. Wash.	08LAK3699	Tibbetts Creek	x	x	x		x								
Greater Lk. Wash.	08LAK3879	Laughing Jacobs Creek	x	x	x	x	x					x	15C	x	15c
Greater Lk. Wash.	08LAK3880	Many Springs Creek	x	x	x	x	x								

Watershed	Benthic Station ID (Freshwater Locator)	Site Name	2002 Benthic Data	2003 Benthic Data	2002/2003 Land Use Data	2002 Habitat Data	2003 Habitat Data	2002 WQ Data	2002 WQ Station Code	2003 WQ Data	2003 WQ Station Code	2002 Hydrology Data	2002 Hydrology Station Code	2003 Hydrology Data	2003 Hydrology Station Code
Greater Lk. Wash.	08LIT2488	Little Bear Creek		x	x		x			x	0478				
Greater Lk. Wash.	08LIT2585	Little Bear Creek	x	x	x	x	x			x	0478				
Greater Lk. Wash.	08LIT2602	Little Bear Creek	x	x	x	x	x								
Greater Lk. Wash.	08LIT2603	Little Bear Creek	x	x	x	x	x								
Greater Lk. Wash.	08LIT2682	Little Bear Creek	x	x	x	x	x								
Greater Lk. Wash.	08LIT2685	Little Bear Creek	x	x	x	x	x								
Greater Lk. Wash.	08LIT2692	Little Bear Creek	x	x	x	x	x			x	S478	x	LB	x	lb
Greater Lk. Wash.	08LIT2781	Little Bear Creek	x	x	x	x	x								
Greater Lk. Wash.	08LIT2876	Tributary to Little Bear Creek (0083)		x	x		x								
Greater Lk. Wash.	08NOR0001	Scriber Lake Creek	x	x	x	x	x								
Greater Lk. Wash.	08NOR1100	Golde Creek	x	x	x	x	x								
Greater Lk. Wash.	08NOR1362	North Creek		x	x		x			x	BB470				
Greater Lk. Wash.	08NOR1370	North Creek	x	x	x	x	x					x	56B	x	56b
Greater Lk. Wash.	08NOR1750	North Creek		x	x		x								
Greater Lk. Wash.	08NOR2028	Silver Creek	x	x	x	x	x								
Greater Lk. Wash.	08NOR2115	Tributary to North Creek	x	x	x	x	x								
Greater Lk. Wash.	08NOR2306	North Creek		x	x		x			x	D474				
Greater Lk. Wash.	08SAM0000	Peters Creek	x	x	x	x	x								
Greater Lk. Wash.	08SAM1914	Tributary to Sammamish River (0068)	x		x	x									
Greater Lk. Wash.	08SAM2674	Tributary to Sammamish River (0096D)	x	x	x	x	x								
Greater Lk. Wash.	08SAM2855	Tributary to Sammamish River (0101)	x		x	x									
Greater Lk. Wash.	08SAM2862	Tributary to Sammamish River (0090)	x	x	x	x	x								
Greater Lk. Wash.	08SAM2865	Gold Creek	x	x	x	x	x								
Greater Lk. Wash.	08SAM2946	Tributary to Sammamish River (0102)	x	x	x	x	x					x	51N	x	51n
Greater Lk. Wash.	08SAM2951	Tributary to Sammamish River (0095B)	x	x	x	x	x								
Greater Lk. Wash.	08SAM3045	Tributary to Sammamish River (0095F)	x	x	x	x	x								
Greater Lk. Wash.	08SAM3045	Tributary to Sammamish River (0095F) Replicate	x	x	x		x								
Greater Lk. Wash.	08SAM3047	Tributary to Sammamish River (0095D)	x	x	x		x								
Greater Lk. Wash.	08WES0622	Ravenna Creek	x	x	x	x	x								
Greater Lk. Wash.	08WES0629	Maple Leaf Creek	x	x	x	x	x								
Greater Lk. Wash.	08WES0903	McAleer Creek	x	x	x	x	x	x	A432	x	A432	x	35C	x	35c
Greater Lk. Wash.	08WES0905	Lyon Creek	x	x	x	x	x			x	0430				
Greater Lk. Wash.	08WES1036	Mapes Creek	x	x	x	x	x								
Greater Lk. Wash.	08WES1037	Mapes Creek	x	x	x	x	x								
Greater Lk. Wash.	08WES1178	Tributary to Lake Washington (0056)	x	x	x	x	x								
Greater Lk. Wash.	08WES1340	Taylor Creek (Lakeridge Park)		x	x		x								
Greater Lk. Wash.	08WES1490	Tributary to Lake Washington (0464B)	x	x	x	x	x								
Greater Lk. Wash.	08WES1579	Tributary to Lake Washington	x	x	x	x	x								
Green-Duwamish	09BLA0675	Mill Creek (Kent)	x	x	x	x	x								
Green-Duwamish	09BLA0716	Mill Creek (Kent)	x	x	x	x	x								
Green-Duwamish	09BLA0716	Mill Creek (Kent)-duplicate		x	x										
Green-Duwamish	09BLA0722	Garrison Creek - South Fork	x	x	x	x	x								
Green-Duwamish	09BLA0756	Mill Creek (Kent)	x	x	x	x	x								
Green-Duwamish	09BLA0768	Springbrook Creek	x	x	x	x	x					x	03B	x	03B
Green-Duwamish	09BLA0768	Springbrook Creek Replicate	x		x	x						x	03B		
Green-Duwamish	09BLA0771	Panther Creek	x		x	x									
Green-Duwamish	09BLA0772	Panther Creek	x	x	x	x	x	x	A326	x	A326				
Green-Duwamish	09BLA0813	Tributary to Panther Creek	x		x	x									
Green-Duwamish	09BLA0817	Tributary to Springbrook Creek (0006B)	x	x	x	x	x								
Green-Duwamish	09BLA0817	Tributary to Springbrook Creek (0006B) Replicate	x		x	x									
Green-Duwamish	09COV1165	Covington Creek	x	x	x	x	x								
Green-Duwamish	09COV1418	Covington Creek	x		x	x		x	C320						
Green-Duwamish	09COV1753	Rock Creek (Black Diamond)	x		x	x									
Green-Duwamish	09COV1756	Covington Creek	x	x	x		x								
Green-Duwamish	09COV1756	Covington Creek Replicate		x	x		x								
Green-Duwamish	09COV1798	Covington Creek	x		x	x									
Green-Duwamish	09COV1862	Tributary to Rock Creek (Covington)	x		x	x									
Green-Duwamish	09COV1864	Tributary to Rock Creek (Covington)	x		x	x									
Green-Duwamish	09DEE2163	Deep Creek	x	x	x	x	x								
Green-Duwamish	09DEE2208	Coal Creek	x	x	x	x	x								
Green-Duwamish	09DEE2211	Deep Creek	x		x	x									
Green-Duwamish	09DEE2266	Deep Creek	x	x	x	x	x								
Green-Duwamish	09DEE2294	Coal Creek	x	x	x	x	x								
Green-Duwamish	09DEE2294	Coal Creek Replicate	x	x	x	x	x								

Watershed	Benthic Station ID (Freshwater Locator)	Site Name	2002 Benthic Data	2003 Benthic Data	2002/2003 Land Use Data	2002 Habitat Data	2003 Habitat Data	2002 WQ Data	2002 WQ Station Code	2003 WQ Data	2003 WQ Station Code	2002 Hydrology Data	2002 Hydrology Station Code	2003 Hydrology Data	2003 Hydrology Station Code
Green-Duwamish	09DUW0091	Tributary to Duwamish River (0001E)	x	x	x	x	x								
Green-Duwamish	09DUW0144	Hamm Creek	x	x	x	x	x	x	A307	x	A307	x	HA5	x	ha5
Green-Duwamish	09DUW0225	Tributary to Duwamish River (0003D)	x	x	x	x	x								
Green-Duwamish	09DUW0277	Riverton Creek	x	x	x		x								
Green-Duwamish	09JEN1318	Jenkins Creek	x	x	x	x	x								
Green-Duwamish	09JEN1357	Jenkins Creek	x	x	x	x	x								
Green-Duwamish	09JEN1358	Jenkins Creek	x	x	x	x	x								
Green-Duwamish	09LOW0325	Tributary to Lower Green River (0036B)	x	x	x	x	x								
Green-Duwamish	09LOW0406	Mullen Slough	x		x	x		x	Mullen1						
Green-Duwamish	09LOW0751	Olson Creek	x	x	x	x	x								
Green-Duwamish	09LOW0753	Tributary to Lower Green River	x	x	x	x	x								
Green-Duwamish	09LOW0753	Tributary to Lower Green River Replicate		x	x		x								
Green-Duwamish	09LOW0788	Tributary to Lower Green River (0069)	x	x	x	x	x	x	A330	x	A330				
Green-Duwamish	09MID1374	O'Grady Creek	x	x	x	x	x								
Green-Duwamish	09MID1495	Crisp Creek	x	x	x	x	x	x	0321	x	0321	x	40D	x	40d
Green-Duwamish	09MID1537	Crisp Creek	x	x	x	x	x	x	F321	x	F321				
Green-Duwamish	09MID1704	Tributary Middle Green River	x	x	x	x	x								
Green-Duwamish	09MID1744	Christy Creek	x	x	x	x	x								
Green-Duwamish	09MID1744	Christy Creek Replicate	x		x	x									
Green-Duwamish	09MID1817	Christy Creek	x	x	x	x	x								
Green-Duwamish	09MID1958	Icy Creek	x	x	x	x	x								
Green-Duwamish	09MID2426	Tributary to Middle Green River	x	x	x	x	x								
Green-Duwamish	09MIL0291	Mill Creek (Auburn)	x	x	x	x	x								
Green-Duwamish	09MIL0340	Mill Creek (Auburn)	x	x	x	x	x								
Green-Duwamish	09MIL0390	Mill Creek (Auburn)	x	x	x	x	x					x	MF1	x	mf1
Green-Duwamish	09MIL0390	Mill Creek (Auburn) Replicate	x		x	x						x	MF1		
Green-Duwamish	09MIL0497	Mill Creek (Auburn)	x		x			x	A315						
Green-Duwamish	09NEW1657	Newaukum Creek	x	x	x	x	x								
Green-Duwamish	09NEW1875	Newaukum Creek	x		x	x									
Green-Duwamish	09NEW1911	Newaukum Creek	x		x	x									
Green-Duwamish	09NEW2076	Newaukum Creek - North Fork	x	x	x	x	x								
Green-Duwamish	09NEW2078	Stonequarry Creek	x		x	x									
Green-Duwamish	09NEW2102	Newaukum Creek	x	x	x	x	x	x	AJ322	x	AJ322				
Green-Duwamish	09NEW2128	Newaukum Creek - North Fork	x	x	x	x	x	x	S322	x	S322				
Green-Duwamish	09NEW2151	Newaukum Creek	x	x	x	x	x								
Green-Duwamish	09NEW2151	Newaukum Creek Replicate	x	x	x	x	x								
Green-Duwamish	09SOO0943	Big Soos Creek	x	x	x	x	x	x	A320	x	A320	x	54A	x	54a
Green-Duwamish	09SOO1020	Soosette Creek	x	x	x	x	x								
Green-Duwamish	09SOO1020	Soosette Creek - duplicate		x	x		x								
Green-Duwamish	09SOO1022	Soosette Creek	x	x	x	x	x					x	54H	x	54h
Green-Duwamish	09SOO1040	Big Soos Creek	x		x	x									
Green-Duwamish	09SOO1106	Meridian Valley Creek	x	x	x	x	x								
Green-Duwamish	09SOO1130	Soos Creek	x	x	x	x	x								
Green-Duwamish	09SOO1134	Soos Creek	x	x	x	x	x	x	D320	x	D320	x	26A	x	26a
Green-Duwamish	09SOO1144	Big Soos Creek	x	x	x	x	x								
Green-Duwamish	09SOO1209	Little Soos Creek	x	x	x	x	x	x	G320	x	G320	x	54I	x	54i
Green-Duwamish	09SOO1283	Little Soos Creek	x	x	x	x	x								
		Totals	161	140	176	154	134	26	26	30	30	23	23	20	20

APPENDIX B

Land Use Data

Appendix B – Land Use Data

Site ID	SiteAcres (total for site)	Bare Ground/Asphalt	Bare Rock/Concrete	Developed - High Intensity	Developed - Low Intensity	Developed - Medium Intensity	Forest	Grass	Open Water	Scrub/Shrub	Shadow	spring fed; surrounding area is forested
08BEA3312	347.0	1.27%		0.63%	36.39%	6.67%	3.93%	15.76%		8.39%		
08BEA3321	1142.4	2.40%	0.13%	0.74%	52.38%	6.47%	25.67%	4.76%	0.37%	7.33%		
08BEA3325	3375.7	2.33%	0.31%	1.24%	36.44%	6.35%	37.95%	6.74%	1.52%	8.15%	0.91%	
08BEA3478	1104.4	0.15%	0.28%	0.55%	3.32%	2.42%	48.83%	8.86%	0.84%	8.78%		
08BEA3571	6913.3	1.77%	0.16%	0.77%	41.87%	6.63%	34.74%	5.48%	1.34%	7.90%	0.45%	
08BEA3650	8860.0	0.50%	0.17%	0.33%	29.83%	3.68%	54.62%	3.50%	0.48%	7.79%	0.52%	
08BEA3737	982.8	0.19%	0.16%	0.17%	15.63%	1.18%	75.73%	2.20%	0.79%	4.90%		
08BEA3747	3163.8	0.39%	0.98%	0.32%	26.78%	2.28%	57.91%	2.51%	1.00%	8.87%		
08BEA3826	500.9	0.74%		0.19%	39.59%	7.46%	41.76%	2.18%	0.14%	7.94%		
08CED2433	1044.3	8.72%	0.18%	1.17%	33.49%	23.61%	22.66%	5.99%		5.51%		
08CED2518	1198.4	5.17%	0.18%	1.38%	32.53%	23.32%	24.72%	7.78%		5.63%		
08CED2711	773.6	3.17%	0.22%	0.90%	29.65%	35.66%	16.54%	9.15%		4.85%		
08CED2898	141.2	0.29%		0.19%	17.72%	5.71%	64.27%	2.19%		9.71%		
08CED4192	9504.6	1.49%	0.81%	0.28%	12.80%	1.26%	61.48%	2.49%	0.68%	19.52%	0.32%	
08CED4479	4208.8	0.63%		0.17%	7.75%	0.86%	84.71%	0.81%	1.66%	3.95%	0.55%	
08CED4975	467.1				2.58%		96.86%			0.55%		
08CED5032	1124.4				1.83%		96.99%	0.63%		0.55%		
08EAS1502	266.5	3.18%	0.25%	1.94%	48.45%	35.84%	5.66%	3.19%		1.52%		
08EAS1964	9227.7	2.93%	0.88%	0.82%	24.56%	1.89%	48.47%	5.64%	0.37%	6.23%	0.33%	
08EAS2058	8893.5	2.84%	0.79%	0.82%	23.94%	1.52%	49.34%	5.75%	0.39%	6.35%	0.35%	
08EAS2191	1908.5	6.85%	0.42%	4.21%	44.41%	24.74%	14.46%	2.87%	0.18%	2.69%	0.89%	
08EAS2272	3472.2	1.88%	0.77%	6.52%	43.13%	18.43%	12.41%	5.12%	0.16%	3.84%		
08EAS2446	4137.4	2.76%	0.15%	0.93%	22.55%	17.15%	51.42%	2.94%		2.34%		
08EAS2546	125.4	24.42%	1.98%	11.57%	28.88%	24.99%	3.92%	3.23%		1.40%		
08EAS2631	6975.2	1.65%	0.49%	0.65%	22.12%	6.44%	55.41%	6.71%	0.49%	7.12%	0.44%	
08EVA3474	9758.9	2.85%	0.90%	0.61%	3.94%	7.14%	44.81%	5.93%	0.14%	7.52%	0.16%	
08EVA3555	9289.1	2.38%	0.89%	0.54%	31.92%	7.27%	45.67%	5.43%	0.14%	7.39%	0.17%	
08EVA3637	93.0				32.12%	13.19%	52.42%	0.66%		1.61%		
08EVA3640	402.4	0.33%	0.38%	0.47%	4.98%	4.22%	31.85%	11.14%		11.16%		
08EVA3813	199.7	0.28%		0.23%	46.57%	6.78%	3.44%	2.89%		12.81%		
08EVA4249	1413.7	1.70%	0.22%	0.64%	26.81%	4.76%	52.99%	4.62%	0.44%	8.28%	0.19%	
08ISS3877	32054.0	1.16%	0.26%	0.24%	13.36%	1.99%	73.79%	2.97%	0.11%	6.38%	0.18%	
08ISS3958	364.4				9.34%	0.61%	88.38%	0.72%		1.25%		
08ISS4373	931.3			0.92%	3.64%	0.12%	93.96%	0.36%	0.63%	1.54%	0.42%	
08ISS4573	811.6	0.02%		0.08%	2.22%	0.28%	96.03%	0.02%		1.35%		
08ISS4724	3601.1	0.13%		0.14%	7.52%	0.43%	83.72%	1.95%	0.43%	6.94%		
08ISS4730	3758.6	0.51%		0.34%	4.18%	0.28%	9.49%	0.55%	0.12%	3.93%	0.42%	
08ISS4735	0.0											SPRING FED
08ISS4884	513.8		0.61%	0.12%	3.16%	0.11%	88.87%	0.35%		7.89%		

Site ID	SiteAcres (total for site)	Bare Ground/Asphalt	Bare Rock/Concrete	Developed - High Intensity	Developed - Low Intensity	Developed - Medium Intensity	Forest	Grass	Open Water	Scrub/Shrub	Shadow	spring fed; surrounding area is forested
08LAK3121	402.1	2.26%	0.18%	0.79%	44.53%	39.52%	9.95%	1.55%		1.27%		
08LAK3540	1219.9	1.38%	0.48%	1.25%	39.84%	5.36%	32.62%	5.76%	5.60%	8.44%		
08LAK3616	2972.0	2.24%	0.28%	0.22%	8.86%	2.59%	81.52%	2.42%	0.52%	2.16%		
08LAK3627	494.5	0.43%		0.20%	39.72%	3.20%	38.82%	6.86%		11.58%		
08LAK3699	2276.7	1.15%	0.68%	0.15%	9.65%	1.53%	83.19%	2.42%	0.68%	2.46%		
08LAK3879	3594.2	3.79%	0.15%	0.74%	3.49%	11.62%	38.12%	5.71%	1.62%	7.76%	0.17%	
08LAK3880	305.8	1.48%	0.55%	0.20%	44.58%	8.72%	37.62%	1.84%		5.61%		
08LIT2488	9602.4	6.18%	0.44%	1.59%	37.29%	8.99%	32.47%	5.94%	0.84%	7.70%	0.32%	
08LIT2585	9419.2	5.63%	0.41%	1.54%	37.34%	8.47%	33.14%	5.96%	0.82%	7.68%	0.33%	
08LIT2602	1125.5	13.62%	0.32%	1.33%	27.55%	11.73%	28.63%	7.90%		1.18%		
08LIT2603	636.1	2.38%	0.30%	1.55%	23.74%	15.86%	25.15%	6.18%		6.85%		
08LIT2682	9046.8	5.42%	0.37%	1.37%	37.29%	7.82%	33.83%	6.23%	0.79%	7.86%	0.34%	
08LIT2685	7928.4	4.83%	0.16%	0.93%	37.38%	7.17%	35.84%	6.91%	0.19%	8.35%	0.39%	
08LIT2692	3733.6	4.63%	0.12%	0.69%	34.52%	6.47%	36.59%	6.97%	0.41%	1.18%	0.83%	
08LIT2781	7322.3	3.84%	0.12%	0.74%	38.11%	6.55%	35.90%	6.19%	0.22%	8.56%	0.42%	
08LIT2876	609.2	2.38%	0.52%	0.51%	37.49%	4.94%	41.25%	7.36%		6.62%		
08NOR0001	3048.4	15.23%	1.11%	8.00%	27.49%	34.99%	9.13%	2.85%	0.45%	1.29%		
08NOR1100	381.5	31.81%	1.74%	14.16%	13.00%	24.67%	9.54%	3.53%		1.64%		
08NOR1362	13587.4	11.25%	0.86%	4.89%	31.36%	24.78%	18.12%	5.69%	0.47%	2.90%		
08NOR1370	14761.5	1.73%	0.84%	4.63%	31.48%	25.34%	18.39%	5.60%	0.44%	2.86%		
08NOR1750	3997.0	12.78%	0.56%	4.51%	28.52%	29.46%	18.73%	3.14%	0.43%	2.30%		
08NOR2028	776.3	4.43%	0.75%	0.94%	34.67%	45.55%	7.53%	3.80%	0.20%	3.00%		
08NOR2115	131.3	19.68%	1.53%	4.98%	27.20%	13.74%	21.60%	6.30%		5.26%		
08NOR2306	16872.3	7.54%	0.37%	2.67%	34.46%	22.33%	19.75%	6.93%	0.59%	5.44%	0.18%	
08SAM0000	1080.8	5.57%	1.95%	3.87%	46.19%	29.69%	6.52%	3.73%	0.57%	2.77%		
08SAM2674	143.2	2.99%	0.18%	0.18%	27.16%	16.57%	27.50%	21.65%	0.22%	5.32%		
08SAM2862	606.6	0.48%	0.13%	0.57%	54.28%	6.87%	15.39%	13.68%		8.61%		
08SAM2865	168.7			0.91%	52.84%	2.25%	33.71%	3.52%		7.59%		
08SAM2946	141.5	5.97%		1.77%	38.45%	11.79%	22.35%	17.28%		3.17%		
08SAM2951	1318.4	1.55%	0.27%	0.70%	48.20%	8.48%	21.77%	12.73%		6.31%		
08SAM3045	100.7				69.77%	3.66%	21.32%	1.47%		4.49%		
08SAM3047	294.1	0.21%		0.26%	58.57%	4.00%	17.44%	11.38%		8.14%		
08WES0622	0.0											SPRING FED
08WES0629	1349.5	19.48%	0.67%	7.74%	25.34%	42.16%	2.86%	2.15%		0.35%		
08WES0903	5295.8	12.36%	0.71%	5.86%	33.59%	34.82%	5.86%	3.12%	1.72%	1.95%		
08WES0905	2661.3	3.42%	0.23%	1.61%	44.20%	34.69%	11.39%	2.89%	0.13%	2.92%		
08WES1036	583.9	5.57%	0.53%	1.96%	26.38%	54.93%	5.89%	4.99%		0.75%		
08WES1037	583.9	5.57%	0.53%	1.96%	26.38%	54.93%	5.89%	4.99%		0.75%		
08WES1178	800.1	1.92%	0.19%	1.26%	42.49%	37.69%	9.73%	4.25%	0.58%	2.85%		
08WES1340	720.5	4.24%	0.43%	2.26%	23.83%	51.98%	12.69%	5.12%	0.37%	0.72%		
08WES1490	125.1	1.41%	0.12%	2.86%	25.86%	55.31%	12.21%	1.85%		0.37%		
08WES1579	247.1	2.77%	0.19%	2.55%	37.88%	36.69%	5.59%	13.53%		0.88%		

Site ID	SiteAcres (total for site)	Bare Ground/Asphalt	Bare Rock/Concrete	Developed - High Intensity	Developed - Low Intensity	Developed - Medium Intensity	Forest	Grass	Open Water	Scrub/Shrub	Shadow	spring fed; surrounding area is forested
09BLA0675	1605.0	12.11%	0.76%	4.39%	33.93%	26.68%	11.75%	7.32%		3.65%		
09BLA0716	1605.0	12.11%	0.76%	4.39%	33.93%	26.68%	11.75%	7.32%		3.65%		
09BLA0722	1831.3	9.12%	0.12%	2.62%	32.52%	33.44%	7.99%	1.69%		3.50%		
09BLA0756	939.0	14.14%	0.70%	4.99%	33.55%	21.79%	13.20%	8.29%		3.40%		
09BLA0768	847.8	5.18%	0.53%	1.53%	3.67%	28.92%	22.89%	7.35%		2.99%		
09BLA0772	1142.4	9.55%	0.95%	3.73%	31.51%	27.99%	13.47%	8.38%	0.13%	5.76%		
09BLA0817	1009.9	1.86%	0.30%	4.99%	32.17%	33.86%	1.87%	4.33%		2.65%		
09COV1165	13891.8	2.92%	0.14%	0.89%	23.40%	4.52%	45.66%	4.99%	2.48%	15.75%	0.89%	
09COV1756	2530.9	0.80%	0.33%	0.42%	1.85%	1.15%	62.46%	4.27%	0.67%	20.00%		
09DEE2163	2567.3	0.67%	0.60%	0.17%	1.67%	0.61%	71.60%	2.22%	1.49%	13.16%	0.18%	
09DEE2208	9039.4	0.16%	0.15%	0.43%	1.12%	0.42%	58.67%	4.82%	0.25%	24.95%	0.34%	
09DEE2266	2567.3	0.67%	0.60%	0.17%	1.67%	0.61%	71.60%	2.22%	1.49%	13.16%	0.18%	
09DEE2294	9039.4	0.16%	0.15%	0.43%	1.12%	0.42%	58.67%	4.82%	0.25%	24.95%	0.34%	
09DEE2294	9039.4	0.16%	0.15%	0.43%	1.12%	0.42%	58.67%	4.82%	0.25%	24.95%	0.34%	
09DUW0091	988.2	12.76%	0.94%	4.53%	27.65%	41.44%	4.70%	7.23%		0.78%		
09DUW0144	517.0	6.94%	0.36%	2.27%	3.75%	33.52%	7.64%	17.52%	0.44%	1.91%		
09DUW0225	630.0	2.74%		1.17%	31.62%	53.61%	3.29%	6.26%	0.59%	1.43%		
09DUW0277	111.4	7.54%		2.32%	24.55%	37.75%	22.72%	5.27%		0.55%		
09JEN1318	5159.4	3.23%	0.87%	0.93%	3.46%	1.62%	35.79%	5.91%	0.84%	12.73%	0.27%	
09JEN1357	4516.6	2.81%	0.51%	0.87%	29.67%	7.45%	39.34%	5.77%	0.97%	13.43%	0.38%	
09JEN1358	2771.4	3.99%	0.78%	1.98%	29.88%	9.22%	38.14%	4.38%	0.17%	13.19%		
09LOW0325	3627.9	19.12%	1.20%	1.66%	21.31%	31.76%	8.16%	6.45%	0.34%	1.21%		
09LOW0751	991.0	1.28%	0.84%	1.87%	36.29%	7.21%	21.46%	17.93%		14.65%		
09LOW0753	453.0	0.27%		0.17%	25.18%	3.15%	57.16%	8.98%	0.23%	5.24%		
09LOW0788	537.7	6.51%	0.29%	0.83%	35.56%	2.12%	24.48%	6.84%		5.63%		
09MID1374	851.9	0.28%		0.44%	19.00%	1.29%	26.88%	26.86%		25.32%		
09MID1495	1455.0	0.43%	0.75%	0.20%	16.39%	2.12%	56.65%	5.86%	1.34%	16.95%	0.53%	
09MID1537	1455.0	0.43%	0.75%	0.20%	16.39%	2.12%	56.65%	5.86%	1.34%	16.95%	0.53%	
09MID1704	44219.4	0.33%	0.16%	0.37%	9.70%	0.52%	66.42%	3.68%	1.25%	17.56%	0.16%	
09MID1744	44219.4	0.33%	0.16%	0.37%	9.70%	0.52%	66.42%	3.68%	1.25%	17.56%	0.16%	
09MID1817	44219.4	0.33%	0.16%	0.37%	9.70%	0.52%	66.42%	3.68%	1.25%	17.56%	0.16%	
09MID1958	44219.4	0.33%	0.16%	0.37%	9.70%	0.52%	66.42%	3.68%	1.25%	17.56%	0.16%	
09MID2426	578.7	0.81%		0.27%	7.46%	0.77%	86.12%	0.37%	0.53%	4.78%	0.88%	
09MIL0291	2391.2	1.87%	0.32%	0.96%	38.95%	24.31%	23.42%	4.45%	1.35%	4.65%	0.64%	
09MIL0340	2391.2	1.87%	0.32%	0.96%	38.95%	24.31%	23.42%	4.45%	1.35%	4.65%	0.64%	
09MIL0390	2391.2	1.87%	0.32%	0.96%	38.95%	24.31%	23.42%	4.45%	1.35%	4.65%	0.64%	
09NEW1657	17304.4	1.11%	0.15%	0.73%	18.73%	4.25%	28.98%	26.72%	0.25%	19.28%	0.15%	
09NEW2076	1678.8	0.14%	0.37%	0.13%	1.31%	0.37%	64.50%	6.32%	0.18%	18.12%	0.65%	
09NEW2102	1245.0	0.12%		0.15%	8.39%	0.16%	67.74%	5.82%		17.69%	0.98%	
09NEW2128	1312.2	0.12%	0.48%	0.15%	6.13%	0.75%	75.79%	1.44%	0.24%	16.34%	0.83%	
09NEW2151	892.8				5.14%	0.13%	77.95%	1.57%		15.22%	0.12%	

Site ID	SiteAcres (total for site)	Bare Ground/Asphalt	Bare Rock/Concrete	Developed - High Intensity	Developed - Low Intensity	Developed - Medium Intensity	Forest	Grass	Open Water	Scrub/Shrub	Shadow	spring fed; surrounding area is forested
09SOO0943	42550.6	3.37%	0.13%	0.98%	28.77%	11.64%	32.99%	7.54%	1.47%	13.16%	0.62%	
09SOO1020	3508.2	3.85%	0.19%	1.27%	32.94%	18.93%	2.54%	13.26%	0.44%	9.73%		
09SOO1022	3508.2	3.85%	0.19%	1.27%	32.94%	18.93%	2.54%	13.26%	0.44%	9.73%		
09SOO1106	1613.5	4.87%	0.48%	0.66%	3.75%	36.52%	1.89%	12.28%	0.95%	4.64%		
09SOO1130	38038.6	3.32%	0.12%	0.93%	28.55%	11.66%	34.18%	7.92%	1.65%	13.13%	0.70%	
09SOO1134	22206.4	3.56%	0.12%	1.13%	31.84%	15.58%	27.14%	8.38%	1.30%	11.57%	0.63%	
09SOO1144	4823.5	1.97%	0.19%	1.25%	29.39%	18.50%	33.12%	8.54%	0.16%	7.63%		
09SOO1209	2367.1	2.45%	0.12%	0.88%	3.82%	8.24%	31.79%	11.34%	0.19%	14.27%		
09SOO1283	1841.1	0.79%	0.75%	0.49%	29.77%	4.66%	38.28%	11.56%	0.14%	14.94%		

APPENDIX C

B-IBI Calculation

APPENDIX C – B-IBI Calculation

This Appendix provides a more detailed description of the methodology used to calculate B-IBI scores for the 2003 field season. During the first season (Year 2002), the initial step in calculation of the B-IBI scores was compilation of complete and updated sources of benthic attribute information. Benthic attributes are descriptors given to benthic macroinvertebrate taxa that relate to their life histories, feeding guilds, lifespan, etc.. In the B-IBI, these attributes are provided in four categories: "pollution tolerance" (tolerant or intolerant), "clinger" (yes or no), "predator" (yes or no) and "voltinism, or long-livedness" (yes or no). Three sources of benthic attribute information were used to compile the King County Master Taxa List:

- Wisseman (2002) – Appendix B from *Characterization of Benthic Invertebrate Communities in the Clackamas River Watershed, Oregon. Portland General Electric, Clackamas Hydroelectric Relicensing Project, Water Quality 3 (WQ3) Studies*;
- Wisseman (1998) – a database compiled by Robert W. Wisseman, Aquatic Biology Associates Inc. (with an additional clinger database compiled by Leska Fore), posted on the SalmonWeb website (http:// www. cbr. washington.edu /salmonweb/taxon); and
- Barbour *et al*. (1999) – Appendix B: Regional Tolerance Values, Functional Feeding Groups and Habit/Behavior Assignments for Benthic Macroinvertebrates from: *The Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition* (regional tolerance information derived only from the Northwest column, which originally came from the Idaho Department of Environmental Protection);

Initially a master taxa list of all benthic macroinvertebrate attribute data derived from all three of our references was developed. In the master taxa list, the attribute data assigned to each taxon was further identified by assigning a source identifier: aW02 = Wisseman 2002, bW98 = Wisseman 1998, cB99 = Barbour 1999.

For the 2002 data, four separate datasets were compiled: Green watershed, Greater Lake Washington watershed, five additional sites (09MIL0497, 08LAK3616, 08LAK3540, 08LAK3627, 09SOO1209), and one additional site (08LAK3699), to create a list of all taxa found in King County. To update the taxa list for 2003 data, which was in three separate datasheets (King County Lab 2003 - 2 separate sheets; and City of Issaquah 2003), the taxa were compared to the 2002 list. There were 24 new taxa which were added to the King County master list. After all duplicate taxa were removed, the attribute information for each taxa on the master taxa list was placed on the King County list of all

organisms found in King County in 2002 using the VLOOKUP function in Excel. Duplicate taxa were common, as all four datasets often contained the same taxa.

Because the attribute data provided from each of the three sources in the master taxa list were not equivalent (e.g., some taxa were considered tolerant in one source, and intolerant in another, etc.), it was necessary to select specific attribute data sources *a priori* for analysis of the King County dataset.

Using the VLOOKUP function in Excel, the master taxa list was sorted into sub-sections based on the source of attribute data (i.e., Wisseman 2002 data first (aW02), then Wisseman 1998 data (bW98), then Barbour et al. data (cB99)) and one or two sub-sections were selected to pull attribute data from for use on the King County list. The following sources were used for each attribute:

- Pollution Tolerance: Wisseman 2002 employs a new system for assigning pollution tolerance; Robert Wisseman developed a new index called the Community Tolerance Index (CTI), which expands upon the commonly used Hilsenhoff Biotic Index (HBI). According to Wisseman (2002), the HBI pollution tolerance values were subjectively derived, and primarily based on nutrient enrichment tolerance found by Hilsenhoff in the Midwest area. In addition, because the HBI is based on taxa from the Midwest, the tolerance scaling does not incorporate the full spectrum of habitat types and fauna encompassed in montane western North America. As described in Section 2.3.1.1, it was determined that the CTI index was more appropriate for the King County program because the original Karr protocol (on the SalmonWeb website) which uses the HBI as compiled by Robert Wisseman in 1998 was written before the CTI was developed, and for this study it was important to capture tolerance to more urban-related types of pollution, and not just nutrient enrichment. Data on the presence/absence of a particular taxon that is nutrient tolerant will not necessarily provide information on a taxon's tolerance to the pollution types covered by the CTI, which is based on primary and secondary factors including: sensitivity to warm water and low levels of dissolved oxygen; sensitivity to fouling of surfaces with filamentous algae or bacteria; sensitivity to siltation; sensitivity to disturbance (whether physical disturbance of substrates or chemical disturbance from toxins); and sensitivity to nutrient enrichment, (which is auto-correlated with dissolved oxygen and fouling) (Wisseman, 2002). The metrics of "percent tolerant individuals" and "number of intolerant taxa" comprise 2 of 10 metrics and make up 1/5th of a site's B-IBI score. This makes measurement of pollution tolerance important to the overall B-IBI score and underscores the need to accurately reflect the types of pollution encountered.

- Clingers and Predators: To remain as consistent as possible with the B-IBI protocol, the clinger database from Wisseman 98 (which was compiled by Ms. Leska Fore) and the Barbour et al. (1999) databases were used. The additional source (Barbour et al.) was used in an effort to create the most comprehensive database possible for the King County project. When both databases contained values, the Wisseman 98 database was given preference.
- Voltinism (Long-Livedness): The Wisseman 2002 database was used for assigning long-livedness or voltinism. The system of classifying voltinism in the Wisseman 1998 database is not equivalent to the Wisseman 2002 system, (the 1998 version had separate columns for uni/multi/semi-voltinism, with varying percentages assigned, whereas the 2002 version uses values from 1-10). Based on email correspondence with Robert Wisseman, it was determined that the Wisseman 2002 system of assigning voltinism was most appropriate for the King County project. Mr. Wisseman cited the lack of correspondence between his two voltinism classification systems, and the lower quality of the 1998 coding system (it was a pilot project he never used) as reasons to disregard the older 1998 version of the voltinism coding system (Wisseman, *pers. comm*., 2003).

Once the King County taxa list was compiled (with all four categories of attributes assigned, i.e., each taxa was classified according to pollution tolerance (CTI), whether or not they are a "clinger", whether or not they are a "predator", and their voltinism, or long-livedness), the taxa were sorted phylogenetically (in order of Phylum, Class, Order, Family, Genus and Species) and the counts from each benthic collection station were pulled onto the main King County worksheet from the individual taxonomist count worksheets (using the VLOOKUP function). This was labeled "Table One" (See Figure C-1).

At this stage it was necessary to determine the numbers of "distinct" taxa. An artifact of benthic taxonomy known as "phantom taxa" occurs when taxonomists are only able to identify some damaged or immature specimens to a higher level of taxonomy (e.g., to family instead of genus or species). When counting the number of taxa present in a sample, a false or "phantom" taxon will be enumerated if, within a single family, there are counts for specimens identified to family in addition to specimens identified further to genus or species.

A duplicate table was created below the table containing counts of all taxa that determined the numbers of taxa present (instead of numbers of individuals) and also performed counts of uniqueness (i.e., determined the number of distinct taxa) using a series of IF statements. This was labeled "Table Two" (See Figure C-1). For example, if a station in Table One had 6 individuals enumerated in the family Empidae, Table Two

would display “1” (as it only displays the number of taxa present, not the number of individuals within each taxon). The IF statement was then further nested to determine “phantom taxa”. For example, for immature or damaged specimens identified to the family-level, we determined if there were genera or species within that family. If genus- or species-level specimens were present in the sample, the family specimen was not included in the count of total number of taxa, and if there were no genus- or species-level specimens present, the family specimen was included in the count and was displayed as “l”.

The formula used to perform counts of the number of taxa present when there were specimens identified to the family-level was:

if(genera>0, 0, (if(family>0,1,0)))

Where: if(specimens within the family are identified to genus, value if TRUE = family specimen not included and is “0”, value if FALSE = if(specimens within the family are identified to family, value if TRUE = family specimen is included and is “1”, value if FALSE = total count for family is “0”)

Once the two tables were completed and counts of the number of taxa present were performed for all stations, the cells for performing B-IBI calculations were added below Table Two using the scoring criteria outlined in Tables C-1 and C-2 (From the SalmonWeb website / Karr’s Protocol):

Table C 1: Ten metrics used to calculate the Species/Family Level 10 Metric B-IBI and associated scoring categories.

METRIC	SCORING CATEGORY		
	1	3	5
Taxa Richness and Composition			
Total number of taxa	0 – <15	≥ 15 – ≤ 28	> 28
Number of mayfly (Ephemeroptera) taxa	0 – ≤ 4	> 4 – ≤ 8	> 8
Number of stonefly (Plecoptera) taxa	0 – ≤ 3	> 3 – ≤ 7	> 7
Number of caddisfly (Trichoptera) taxa	0 – < 5	≥ 5 – <10	≥ 10
Number of long-lived taxa	0 – ≤ 2	> 2 – ≤ 4	> 4
Pollution Tolerance			
Number of intolerant taxa (not including Chironomids)	0 – ≤ 2	> 2 – ≤ 3	> 3
Tolerant individuals (not including Chironomids)(%)*	≥ 50	> 19 – < 50	0 – ≥ 19

METRIC	SCORING CATEGORY		
	1	3	5
Feeding Ecology			
Predator individuals (%)*	0 – < 10	≤ 10 – < 20	≥ 20
Population Attributes			
Number of clinger taxa	0 – ≤ 8	> 8 – ≤ 18	> 18
Dominance (3 taxa) %*	≥ 80	≤ 60 – < 80	0 – < 60

*All percentage metrics must be reported as percentages, not decimals (the number of individuals divided by the total number of individuals multiplied by 100)

Table C 2: Interpretation of stream B-IBI scores.

10- METRIC B-IBI SCORE	STREAM CONDITION
46 – 50	Excellent
38 – 44	Good
28 – 36	Fair
18 – 26	Poor
10 – 16	Very poor

To calculate the values of the individual 10 metrics for each sample, a table was created with the following equations (See Table C-3 below):

Table C 3: Source of benthic data (i.e., Table One or Two) and the equations used to calculate B-IBI values for each station.

METRIC	EQUATION USED TO DETERMINE STATION'S METRIC VALUE
TOTAL number of taxa	Sum of station's total number of taxa in Table Two (Summed down the entire column of cells containing taxa presence within each station/sample).
Number of mayfly (Ephemeroptera) taxa	Sum of station's number of mayfly taxa present within the Ephemeroptera sub-section of Table Two (which is arranged phylogenetically) (Summed down the column of cells containing Ephemeroptera taxa presence within each station/sample).
Number of stonefly (Plecoptera) taxa	Sum of station's number of stonefly taxa present within the Plecoptera sub-section of Table Two (which is arranged phylogenetically) (Summed down the column of cells containing Plecoptera taxa presence within each station/sample).
Number of caddisfly (Trichoptera) taxa	Sum of station's number of caddisfly taxa present within the Trichoptera sub-section of Table Two (which is arranged phylogenetically) (Summed down the column of cells containing Trichoptera taxa presence within each station/sample).
% Tolerant individuals (as a percentage, not decimal)	Sum of station's number of pollution tolerant individuals (CTI score 7-10) in Table One, divided by the sum of individuals classified for pollution tolerance (CTI scores 1-10), multiplied by 100. (Summed across the cells containing numbers of individuals classified as "tolerant" within a station, then divided by the sum of the cells containing numbers of individuals that had been CTI classified within the same station, multiplied by 100 (repeated for each station)).
% Predators (as a percentage, not decimal)	Sum of station's number of predator individuals in Table One, divided by the total abundance of the sample, multiplied by 100. Summed across the cells containing numbers of individuals classified as "predator", then divided by the entire column of cells containing numbers of individuals present within a station, multiplied by 100 (repeated for each station)).
Number of clinger taxa	Sum of station's clinger taxa in Table Two. (Summed across the cells containing clinger taxa presence within each station/sample)

% Dominance (top 3 taxa) (as a percentage)	Summed the number of individuals within the 1st, 2nd, and 3rd most abundant taxa within a station in Table One, divided by 100, using the formula: ((LARGE(Q4:Q316,1)+LARGE(Q4:Q316,2)+LARGE(Q4:Q316,3))/Q317)*100 where Q4:Q316 = the range of cells containing taxa presence for a single station/sample. Repeated for each station.
Number of long-lived taxa	Sum of station's long-lived taxa in Table Two. (Summed across the cells containing "long-lived" taxa presence within each station/sample).
Number of intolerant/sensitive taxa	Sum of station's intolerant taxa (CTI score 1-4) in Table Two. (Summed across cells containing taxa with CTI scores 1-4 presence for each station/sample).

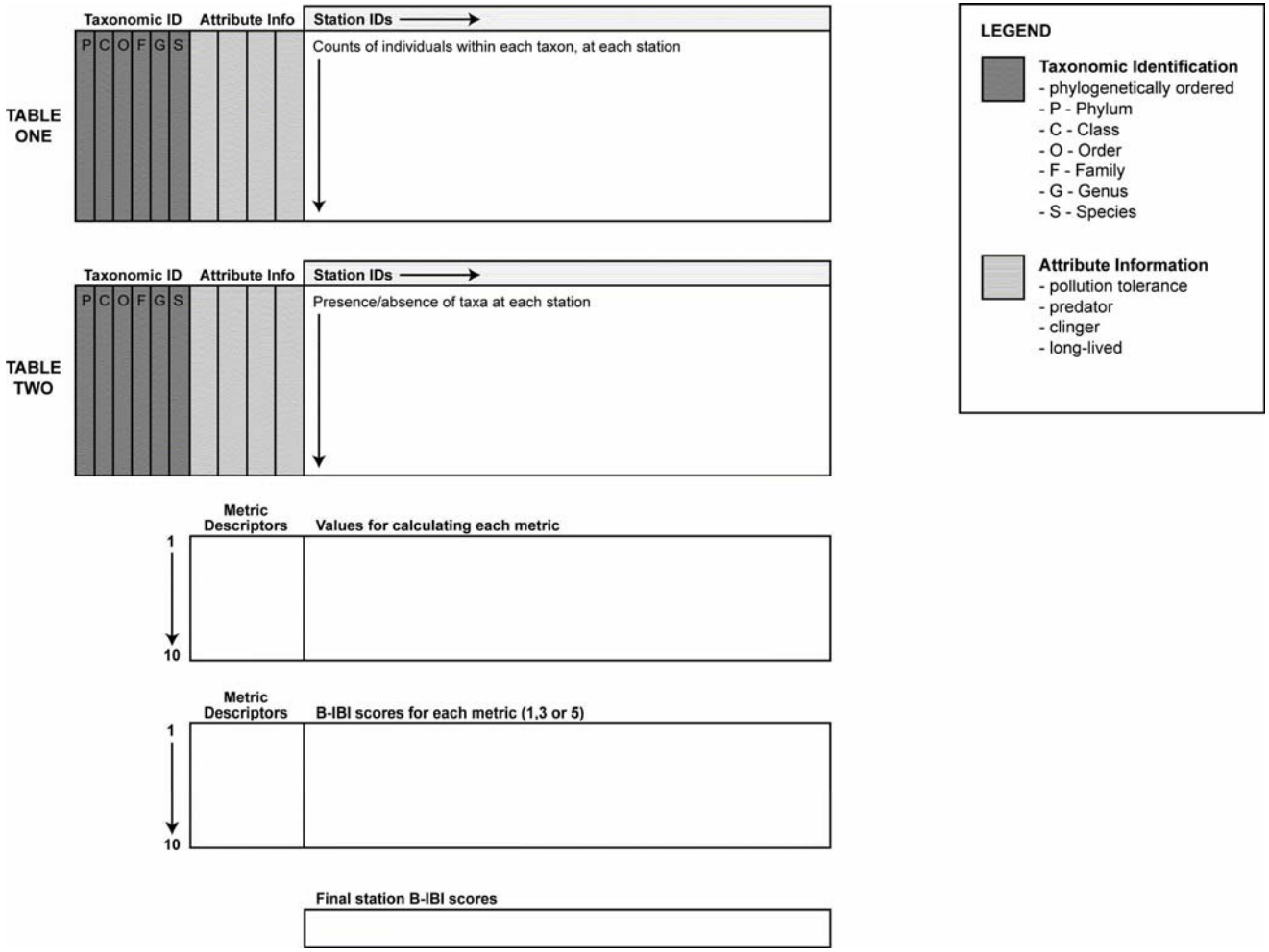
Below the calculations of B-IBI metric values, a second table with equations to calculate B-IBI scores for each metric was created, with bins set up to calculate scores using the Species/Family Level 10-metric scoring system. Bins were created to calculate B-IBI scores of 1, 3 or 5 from the cells containing individual metric value as shown in Table C- 4.

Table C 4: Scoring bins used to calculate B-IBI scores.

METRIC	B-IBI SCORING BINS
TOTAL number of taxa	=IF(cell value<15,1,IF(cell value<=28,3,IF(cell value>28,5)))
Number of mayfly (Ephemeroptera) taxa	=IF(cell value<=4,1,IF(cell value<=8,3,IF(cell value>8,5)))
Number of stonefly (Plecoptera) taxa	=IF(cell value<=3,1,IF(cell value<=7,3,IF(cell value>7,5)))
Number of caddisfly (Trichoptera) taxa	=IF(cell value<5,1,IF(cell value<10,3,IF(cell value>=10,5)))
% Tolerant individuals (as a percentage)	=IF(cell value>=50,1,IF(cell value>19,3,IF(cell value<=19,5)))
% Predator individuals (as a percentage)	=IF(cell value<10,1,IF(cell value<20,3,IF(cell value>=20,5)))
Number of clinger taxa	=IF(cell value<=8,1,IF(cell value<=18,3,IF(cell value>18,5)))
% Dominance (top 3 taxa) (as a percentage)	=IF(cell value>=80,1,IF(cell value =60,3,IF(cell value<60,5)))
Number of long-lived taxa	=IF(cell value<=2,1,IF(cell value<=4,3,IF(cell value>4,5)))
Number of intolerant taxa	=IF(cell value<=2,1,IF(cell value<=3,3,IF(cell value>3,5)))
TOTAL (Station B-IBI Score)	=SUM(Scoring Bins)

The station B-IBI score was then used in evaluations of the correlation of B-IBI scores with the various WQ, habitat, land use and other parameters of interest. The layout of the master King County B-IBI calculation sheet is shown in Figure C-1.

Figure C 1: Layout of the King County Master Taxa List and B-IBI calculation spreadsheet.



APPENDIX D

HBI Pollution Tolerance Values

APPENDIX D - HBI Pollution Tolerance Values

Primary Level	Secondary Level	Tertiary Level (Family)	Quarternary Level	Hilsenhoff Value
Insecta	Coleoptera	Dryopidae		5
Insecta	Coleoptera	Dytiscidae		5
Insecta	Coleoptera	Elmidae		5
Insecta	Coleoptera	Gyrinidae		4
Insecta	Coleoptera	Psephenidae		4
Insecta	Coleoptera	Ptilodactylidae		5
Insecta	Diptera	Athericidae		2
Insecta	Diptera	Chironomidae (red)		10
Insecta	Diptera	Chironomidae(other)		6
Insecta	Diptera	Dixidae		1
Insecta	Diptera	Dolichopodidae		4
Insecta	Diptera	Empididae		6
Insecta	Diptera	Other Diptera		6+
Insecta	Diptera	Psychodidae		10
Insecta	Diptera	Simuliidae		6
Insecta	Diptera	Tabanidae		6
Insecta	Diptera	Tipulidae		4
Insecta	Ephemeroptera	Ameletidae		0
Insecta	Ephemeroptera	Baetidae		6
Insecta	Ephemeroptera	Baetiscidae		3
Insecta	Ephemeroptera	Caenidae		7
Insecta	Ephemeroptera	Ephemerellidae		2
Insecta	Ephemeroptera	Ephemeridae		4
Insecta	Ephemeroptera	Heptageniidae		3
Insecta	Ephemeroptera	Isonychiidae		3
Insecta	Ephemeroptera	Leptophlebiidae		4
Insecta	Ephemeroptera	Neoephemeridae		3
Insecta	Ephemeroptera	Polymitarcyidae		2
Insecta	Ephemeroptera	Potamanthidae		4
Insecta	Ephemeroptera	Siphlonuridae		7
Insecta	Ephemeroptera	Tricorythidae		4
Insecta	Lepidoptera	Lepidoptera		5
Insecta	Megaloptera	Corydalidae	Corydalus	4
Insecta	Megaloptera	Corydalidae	Nigronia	2
Insecta	Megaloptera	Corydalidae		3
Insecta	Megaloptera	Sialidae		6
Insecta	Neuroptera	Sisyridae		1
Insecta	Odonata	Aeshnidae		3
Insecta	Odonata	Calopterygidae		5
Insecta	Odonata	Coenagrionidae		8
Insecta	Odonata	Cordulegastridae	Macromiinae	3
Insecta	Odonata	Cordulegastridae		3
Insecta	Odonata	Corduliidae		5
Insecta	Odonata	Gomphidae		4
Insecta	Odonata	Lestidae		9
Insecta	Odonata	Libellulidae		9
Insecta	Plecoptera	Capniidae		3

Primary Level	Secondary Level	Tertiary Level (Family)	Quarternary Level	Hilsenhoff Value
Insecta	Plecoptera	Chloroperlidae		0
Insecta	Plecoptera	Leuctridae		0
Insecta	Plecoptera	Nemouridae		2
Insecta	Plecoptera	Perlodidae		2
Insecta	Plecoptera	Pteronarcydae		0
Insecta	Plecoptera	Taeniopterygidae		2
Insecta	Trichoptera	Brachycentridae		1
Insecta	Trichoptera	Glossosomatidae		0
Insecta	Trichoptera	Helicopsychidae		3
Insecta	Trichoptera	Hydrophilidae		5
Insecta	Trichoptera	Hydropsychidae		5
Insecta	Trichoptera	Hydroptilidae		4
Insecta	Trichoptera	Lepidostomatidae		1
Insecta	Trichoptera	Leptoceridae		4
Insecta	Trichoptera	Limnephilidae		4
Insecta	Trichoptera	Molannidae		6
Insecta	Trichoptera	Odontoceridae		0
Insecta	Trichoptera	Philopotamidae		3
Insecta	Trichoptera	Phryganeidae		4
Insecta	Trichoptera	Polycentropodidae		6
Insecta	Trichoptera	Psychomyiidae		2
Insecta	Trichoptera	Rhyacophilidae		1
Insecta	Trichoptera	Uenoidae		3
Annelida	Hirudinea			8
Annelida	Other Worms			9
Annelida	Oligochaeta	Tubificidae		10
Annelida	Oligochaeta			9
Annelida	Oligochaeta			10
Bryozoa				4
Crustacea	Amphipoda	Crangonyctidae		4
Crustacea	Amphipoda	Gammaridae		4
Crustacea	Amphipoda	Talitridae		8
Crustacea	Decapoda	Cambaridae		6
Crustacea	Isopoda	Asellidae		8
Hydracarina				7
Mollusca	Bivalvia	Corbiculidae		4
Mollusca	Bivalvia	Sphaeriidae		8
Mollusca	Bivalvia	Unionidae		4
Mollusca	Gastropoda	Ancylidae		7
Mollusca	Gastropoda	Hydrobiidae		8
Mollusca	Gastropoda	Lymnaeidae		7
Mollusca	Gastropoda	Physidae		8
Mollusca	Gastropoda	Planorbidae		6
Mollusca	Gastropoda	Pleuroceridae		7
Mollusca	Gastropoda	Valvatidae		2
Mollusca	Gastropoda	Viviparidae		8
Platyhelminthes	Turbellaria			9

APPENDIX E

Benthic Indices for All Sites

APPENDIX E – Benthic Indices for All Sites

Watershed	Code	Benthic Station Name	Phithron B-IBI scores	EVS B-IBI scores	SWDI	HBI	TOTAL abundance	TOTAL number of taxa	% dominance (top 3 taxa) (as whole number)	number of EPT Taxa	number of mayfly (Ephemeroptera) taxa	number of stonefly (Plecoptera) taxa	number of caddisfly (Trichoptera) taxa	% tolerant individuals (as whole number)1	number of intolerant /sensitive taxa	% predator individuals (as whole number)	number of clinger taxa	number of long-lived taxa
Greater Lk. Wash.	08BEA3312	Tributary to Bear Creek (0119)	32	30	3.91	2.67	500	31	43.40	16	5	4	7	6.37	0	16.60	5	1
Greater Lk. Wash.	08BEA3321	Cold Creek	28	24	3.64	3.37	114	19	45.61	8	2	2	4	21.28	2	36.84	3	4
Greater Lk. Wash.	08BEA3325	Daniels Creek	30	26	3.85	3.01	511	29	44.03	16	3	6	7	27.70	0	15.07	4	2
Greater Lk. Wash.	08BEA3478	Mackey Creek	34	28	4.06	5.73	530	37	43.58	20	6	7	7	59.47	1	8.11	5	8
Greater Lk. Wash.	08BEA3571	Cottage Lake Creek	32	26	3.78	3.96	701	30	48.36	14	4	4	6	38.19	1	5.14	6	3
Greater Lk. Wash.	08BEA3650	Bear Creek	34	30	3.66	4.53	503	35	50.50	17	6	5	6	31.19	1	6.36	3	5
Greater Lk. Wash.	08BEA3737	Seidel Creek	36	30	3.68	3.02	657	31	50.68	16	4	5	7	26.84	1	24.81	5	4
Greater Lk. Wash.	08BEA3747	Bear Creek	32	28	3.52	4.16	536	30	55.41	18	5	7	6	48.25	0	9.70	4	3
Greater Lk. Wash.	08BEA3826	Struve Creek	34	30	3.34	5.29	276	30	60.14	16	2	6	8	49.33	1	20.65	5	5
		BEAR Mean	32.4	28.0	3.7	4.0	480.9	30.2	49.1	15.7	4.1	5.1	6.4	34.3	0.8	15.9	4.4	3.9
		BEAR Std Dev	2.4	2.2	0.2	1.1	181.4	5.0	5.8	3.3	1.5	1.6	1.1	16.3	0.7	10.3	1.0	2.0
Greater Lk. Wash.	08CED2433	Maplewood Creek	20	14	3.13	6.04	558	23	61.11	10	3	3	4	91.28	1	3.41	4	2
Greater Lk. Wash.	08CED2518	Molasses Creek	24	24	3.26	4.87	170	18	54.71	6	2	3	1	50.00	0	31.76	0	5
Greater Lk. Wash.	08CED2711	Madsen Creek - South Fork	18	16	2.81	6.08	530	18	64.15	6	2	2	2	68.80	0	0.94	1	3
Greater Lk. Wash.	08CED2898	Tributary to Cedar River	28	24	3.66	5.69	434	26	49.31	10	4	4	2	58.10	1	21.20	3	3
Greater Lk. Wash.	08CED4192	Rock Creek (Kent)	42	36	3.85	3.66	552	41	51.09	23	6	8	9	19.76	6	8.51	7	8
Greater Lk. Wash.	08CED4479	Walsh Lake Diversion	36	36	4.07	4.13	502	31	43.43	20	4	8	8	44.42	4	19.32	4	7
Greater Lk. Wash.	08CED4479	Walsh Lake Diversion-duplicate	36	28	3.88	5.31	555	34	48.11	19	4	7	8	53.90	1	19.10	5	9
Greater Lk. Wash.	08CED4975	Hotel Creek	38	38	3.36	2.53	443	31	63.21	18	7	6	5	7.83	4	39.05	4	9
Greater Lk. Wash.	08CED5032	Rock Creek (SPU)	48	44	3.88	3.44	500	45	53.00	30	10	9	11	37.24	10	12.40	10	10
		LOWER CEDAR RIVER Mean	32.2	28.9	3.5	4.6	471.6	29.7	54.2	15.8	4.7	5.6	5.6	47.9	3.0	17.3	4.2	6.2
		LOWER CEDAR RIVER Std Dev	10.3	10.3	0.4	1.3	122.1	9.5	7.2	8.3	2.6	2.6	3.6	25.0	3.4	12.6	3.0	3.0
Greater Lk. Wash.	08EAS1502	Tributary to Lake Washington (Mercer Island)	22	18	3.03	5.94	206	20	63.59	4	2	1	1	80.00	1	22.82	3	2
Greater Lk. Wash.	08EAS1964	May Creek	28	22	3.00	4.89	547	25	65.08	10	5	3	2	28.85	1	17.18	1	4
Greater Lk. Wash.	08EAS2058	May Creek	28	24	3.94	4.43	479	26	43.42	11	4	4	3	35.03	1	13.36	2	4
Greater Lk. Wash.	08EAS2191	Forbes Creek	16	12	2.23	6.50	540	12	81.85	2	1	1	0	75.80	0	12.41	0	0
Greater Lk. Wash.	08EAS2272	Kelsey Creek	14	10	1.77	6.08	501	11	88.22	2	1	0	1	97.60	0	0.00	1	1
Greater Lk. Wash.	08EAS2446A	Coal Creek	22	18	2.80	5.37	510	19	73.53	9	2	3	4	38.06	1	4.12	1	4
Greater Lk. Wash.	08EAS2446B	Coal Creek-duplicate	22	18	3.09	5.28	500	22	61.60	12	4	3	5	26.40	2	3.80	1	2
Greater Lk. Wash.	08EAS2546	Tributary to Richards Creek	16	12	2.46	6.00	75	10	74.67	4	1	0	3	80.95	0	8.00	0	0
Greater Lk. Wash.	08EAS2631	May Creek	36	30	4.03	4.79	510	32	43.92	18	4	7	7	39.26	1	13.92	6	6
		EAST LAKE WASHINGTON TRIBS Mean	22.7	18.2	2.9	5.5	429.8	19.7	66.2	8.0	2.7	2.4	2.9	55.8	0.8	10.6	1.7	2.6
		EAST LAKE WASHINGTON TRIBS Std Dev	7.1	6.4	0.7	0.7	168.5	7.5	15.4	5.4	1.6	2.2	2.2	27.3	0.7	7.3	1.9	2.1
Greater Lk. Wash.	08EVA3474	Evans Creek	20	16	2.05	5.79	552	20	84.06	6	2	2	2	44.32	1	3.80	2	3
Greater Lk. Wash.	08EVA3555	Evans Creek	32	24	4.18	4.53	538	33	35.50	17	4	7	6	56.33	2	4.46	5	4
Greater Lk. Wash.	08EVA3637	Tributary to Evans Creek (0111E)	18	14	2.50	6.38	517	17	79.69	6	2	2	2	91.85	0	4.84	2	1
Greater Lk. Wash.	08EVA3640	Tributary to Evans Creek (0108)	28	24	3.02	6.61	248	27	67.74	14	2	5	7	67.41	3	8.87	4	6
Greater Lk. Wash.	08EVA3813	Tributary to Evans Creek (0108A)	20	20	3.70	4.54	170	25	50.59	9	2	4	3	75.78	1	6.47	2	3
Greater Lk. Wash.	08EVA4249	Tributary to Evans Creek (0111A)	16	16	1.87	5.03	554	21	85.02	7	3	3	1	12.24	1	5.96	0	2
		EVANS CREEK Mean	22.3	19.0	2.9	5.5	429.8	23.8	67.1	9.8	2.5	3.8	3.5	58.0	1.3	5.7	2.5	3.2
		EVANS CREEK Std Dev	6.3	4.3	0.9	0.9	173.3	5.7	20.2	4.6	0.8	1.9	2.4	27.7	1.0	1.8	1.8	1.7
Greater Lk. Wash.	08ISS3877	Issaquah Creek	36	24	3.21	5.06	535	35	72.34	19	7	5	7	67.09	1	2.99	4	4
Greater Lk. Wash.	08ISS3958	Cabin Creek	36	34	4.11	4.64	309	30	35.60	19	4	7	8	12.38	7	4.21	3	9
Greater Lk. Wash.	08ISS4373	Tributary to Issaquah Creek (0203)	32	30	3.90	5.02	211	32	50.71	17	7	7	3	35.17	3	5.21	7	5
Greater Lk. Wash.	08ISS4573	High Point Creek	44	40	4.24	4.19	501	40	44.51	25	11	9	5	33.97	4	7.98	10	7
Greater Lk. Wash.	08ISS4724	Carey Creek	44	38	4.25	3.71	515	39	37.09	23	9	5	9	27.12	5	14.17	7	6
Greater Lk. Wash.	08ISS4730	Holder Creek	38	36	3.75	4.20	612	36	52.61	21	10	5	6	24.62	3	6.70	12	6
Greater Lk. Wash.	08ISS4735	Tributary to Holder Creek	42	42	4.52	2.32	375	40	33.60	25	8	10	7	8.01	7	28.53	8	7
Greater Lk. Wash.	08ISS4735	Tributary to Holder Creek-duplicate	42	42	4.73	2.51	379	37	22.69	23	7	9	7	5.52	6	25.07	6	6
Greater Lk. Wash.	08ISS4884	Issaquah Creek - East Fork	48	44	4.22	3.57	511	46	43.44	31	9	13	9	7.58	11	20.55	7	12
		ISSAQUAH CREEK Mean	40.2	36.7	4.1	3.9	438.7	37.2	43.6	22.6	8.0	7.8	6.8	24.6	5.2	12.8	7.1	6.9
		ISSAQUAH Std Dev	5.0	6.5	0.4	1.0	127.7	4.8	14.2	4.2	2.1	2.7	1.9	19.7	2.9	9.7	2.8	2.4
Greater Lk. Wash.	08LAK3121	Idylwood Creek	16	14	2.35	6.27	423	12	79.43	2	1	1	0	93.26	0	1.18	0	3
Greater Lk. Wash.	08LAK3540	Pine Lake Creek	30	26	4.07	3.95	370	29	40.54	12	3	4	5	33.88	1	5.68	2	3
Greater Lk. Wash.	08LAK3616	Tibbetts Creek	26	22	3.46	5.81	507	29	53.85	6	2	2	2	54.92	1	9.27	2	5
Greater Lk. Wash.	08LAK3627	Ebright Creek	26	26	2.87	5.25	509	22	73.08	14	5	5	4	41.62	1	42.63	4	3
Greater Lk. Wash.	08LAK3699	Tibbetts Creek	32	24	3.73	5.35	529	28	52.36	14	5	4	5	61.62	1	9.64	3	4
Greater Lk. Wash.	08LAK3879	Laughing Jacobs Creek	30	26	3.50	5.59	540	30	58.52	12	3	4	5	53.37	0	6.85	4	6
Greater Lk. Wash.	08LAK3880	Many Springs Creek	38	36	4.02	2.72	316	34	43.67	18	3	7	8	24.23	7	44.30	3	6
		LAKE SAMMAMISH TRIBS Mean	28.3	24.9	3.4	5.0	456.3	26.3	57.4	11.1	3.1	3.9	4.1	51.8	1.6	17.1	2.6	4.3
		LAKE SAMMAMISH TRIBS Std Dev	6.8	6.5	0.6	1.2	87.4	7.2	14.4	5.4	1.5	2.0	2.5	22.4	2.4	18.2	1.4	1.4
Greater Lk. Wash.	08LIT2488	Little Bear Creek	20	18	2.89	6.25	228	19	67.98	3	2	0	1	92.75	1	1.32	3	6
Greater Lk. Wash.	08LIT2585	Little Bear Creek	28	22	3.47	5.34	588	26	54.59	13	6	2	5	78.86	1	7.65	4	4
Greater Lk. Wash.	08LIT2602	Little Bear Creek	36	30	4.08	5.03	519	35	35.65	16	5	5	6	37.80	1	9.83	7	7
Greater Lk. Wash.	08LIT2603	Little Bear Creek	26	18	3.31	5.15	520	26	61.35	12	3	1	8	74.12	1	8.27	4	3
Greater Lk. Wash.	08LIT2682	Little Bear Creek	28	22	3.65	5.15	603	28	51.24	15	6	3	6	68.97	1	6.80	5	3
Greater Lk. Wash.	08LIT2685	Little Bear Creek	24	16	3.24	5.69	500	25	65.20	12	3	3	6	78.26	2	5.60	4	2
Greater Lk. Wash.	08LIT2692	Little Bear Creek	36	36	3.84	3.98	560	36	47.86	21	7	5	9	25.87	3	27.32	6	5
Greater Lk. Wash.	08LIT2781	Little Bear Creek	30	26	3.80	4.06	516	27	41.67	16	4	6	6	23.68	1	13.18	3	3
Greater Lk. Wash.	08LIT2876	Tributary to Little Bear Creek (0083)	36	30	4.15	4.26	538	36	45.54	22	8	6	8	25.65	1	14.50	7	4
		LITTLE BEAR CREEK Mean	29.3	24.2	3.6	5.0	508.0	28.7	52.3	14.4	4.9	3.4	6.1	56.2	1.3	10.5	4.8	4.1
		LITTLE BEAR CREEK Std Dev	5.7	6.7	0.4	0.8	110.6	5.8	10.9	5.6	2.0	2.2	2.3	27.5	0.7	7.4	1.6	1.6
Greater Lk. Wash.	08NOR0001	Scriber Lake Creek	18	16	2.93	5.82	520	19	63.27	7	2	2	3	67.50	0	7.50	1	3
Greater Lk. Wash.	08NOR1100	Golde Creek	14	10	1.56	8.44	562	10	94.31	2	0	0	2	99.22	1	3.38	0	1
Greater Lk. Wash.	08NOR1362	North Creek	26	22	3.14	4.74	500	24	66.20	12	2	4	6	26.78	1	2.80	3	3
Greater Lk. Wash.	08NOR1370	North Creek	28	22	3.42	4.71	619	25	56.87	12	4	4	4	26.65	1	3.88	2	3
Greater Lk. Wash.	08NOR1750	North Creek	28	22	3.50	5.51	551	26	56.08	14	4	4	6	53.56	2	9.07	2	3
Greater Lk. Wash.	08NOR2028	Silver Creek	18	16	2.79	7.57	572	21	66.96	4	0	0	4	86.01	1	1.05	1	3
Greater Lk. Wash.	08NOR2115	Tributary to North Creek	22	16	2.90	5.55	606	21	64.03	7	1	2	4	86.01	0	1.16	3	3
Greater Lk. Wash.	08NOR2306	North Creek	20	18	2.52	5.57	525	26	75.43	10	2	2	6	85.23	1	4.00	3	3
		NORTH AND SWAMP CREEKS Mean	21.8	17.8	2.8	6.0	556.9	21.5	67.9	8.5	1.9	2.3	4.4	66.4	0.9	4.1	1.9	2.8
		NORTH AND SWAMP CREEKS Std Dev	5.2	4.2	0.6	1.3	41.7	5.3	12.3	4.2	1.6	1.7	1.5	28.1	0.6	2.8	1.1	0.7
Greater Lk. Wash.	08SAM0000	Peters Creek	18	14	2.65	7.60	511	17	72.02	5	2	1	2	95.24	0	3.91	3	1
Greater Lk. Wash.	08SAM2674	Tributary to Sammamish River (0096D)	20	16	2.90	4.88	523	21	65.58	9	2	2	5	66.52	1	1.72	1	1
Greater Lk. Wash.	08SAM2862	Tributary to Sammamish River (0090)	38	32	3.72	4.79	438	33	50.68	19	5	5	9	32.44	3	18.26	5	3
Greater Lk. Wash.	08SAM2865	Gold Creek	24	18	2.99	6.81	133	18	69.92	6	1	1	4	88.29	2	10.53	5	3
Greater Lk. Wash.	08SAM2946	Tributary to Sammamish River (0102)	16	14	2.48	6.38	500	15	78.80	2	0	1	1	93.80	0	4.00	0	2
Greater Lk. Wash.	08SAM2951	Tributary to Sammamish River (0095B)	14	10	1.83	8.32	95	12	84.21	3	1	1	1	83.33	0	0.00	2	1
Greater Lk. Wash.	08SAM3045	Tributary to Sammamish River (0095F)	26	20	2.70	5.24	542	25	72.32	13	3	4	6	81.40	2	13.84	6	2
Greater Lk. Wash.	08SAM3045	Tributary to Sammamish River (0095F)-duplicate	22	18	3.08	4.03	106	15	61.32	6	2	2	2	53.66	0	33.96	4	1
Greater Lk. Wash.	08SAM3047	Tributary to Sammamish River (0095D)	24	20	3.45	6.94	251	29	61.35	8	4	0	4	87.68	3	3.19	6	3
		SAMMAMISH RIVER Mean	22.4	18.0	2.9	6.1	344.3	20.6	68.5	7.9	2.2	1.9	3.8	75.8	1.2	9.9	3.6	1.9
		SAMMAMISH RIVER Std Dev	7.1	6.2	0.6	1.4	195.0	7.1	10.1	5.3	1.6	1.6	2.6	21.0	1.3	10.9	2.2	0.9

Watershed	Code	Benthic Station Name	Rhithron B-IBI scores	EVS B-IBI scores	SWDI	HBI	TOTAL abundance	TOTAL number of taxa	% dominance (top 3 taxa) (as whole number)	number of EPT Taxa	number of mayfly (Ephemeroptera) taxa	number of stonefly (Plecoptera) taxa	number of caddisfly (Trichoptera) taxa	% tolerant individuals (as whole number)1	number of intolerant /sensitive taxa	% predator individuals (as whole number)	number of clinger taxa	number of long-lived taxa
Greater Lk. Wash.	08WES0622	Ravenna Creek	16	12	2.64	6.25	158	14	74.05	4	1	2	1	69.64	0	1.27	0	0
Greater Lk. Wash.	08WES0629	Maple Leaf Creek	14	10	1.57	6.06	506	10	90.91	1	1	0	0	98.48	0	0.99	0	0
Greater Lk. Wash.	08WES0903	McAleer Creek	26	20	3.35	5.27	522	23	55.17	13	3	4	6	54.95	0	5.56	3	2
Greater Lk. Wash.	08WES0905	Lyon Creek	26	22	3.03	4.74	247	16	65.18	5	1	3	1	39.62	1	20.65	3	3
Greater Lk. Wash.	08WES1036	Mapes Creek	22	18	3.53	5.76	221	22	54.30	8	2	2	4	63.79	1	14.93	5	1
Greater Lk. Wash.	08WES1037	Mapes Creek	26	16	2.92	5.85	583	24	69.81	11	3	3	5	79.58	1	4.80	4	2
Greater Lk. Wash.	08WES1178	Tributary to Lake Washington (0056)	18	16	2.69	7.52	577	18	67.24	5	2	1	2	81.58	0	0.52	4	3
Greater Lk. Wash.	08WES1340	Taylor Creek (Lakeridge Park)	18	14	2.78	5.16	300	15	65.67	6	2	2	2	56.47	0	0.33	2	0
Greater Lk. Wash.	08WES1490	Tributary to Lake Washington (0464B)	18	14	2.48	7.05	230	20	78.70	5	2	2	1	74.54	2	1.30	3	2
Greater Lk. Wash.	08WES1579	Tributary to Lake Washington	14	10	2.13	8.47	195	10	86.67	1	1	0	0	62.03	0	1.03	1	1
		WEST LAKE WASHINGTON TRIBS Mean	19.8	15.2	2.7	6.2	353.9	17.2	70.8	5.9	1.8	1.9	2.2	68.1	0.5	5.1	2.5	1.4
		WEST LAKE WASHINGTON TRIBS Std Dev	4.8	4.0	0.6	1.2	171.5	5.1	12.1	3.9	0.8	1.3	2.1	16.5	0.7	7.0	1.7	1.2
Green-Duwamish	09BLA0675	Mill Creek (Kent)	20	16	2.71	6.05	553	19	72.69	5	2	1	2	75.93	0	3.98	2	3
Green-Duwamish	09BLA0716	Mill Creek (Kent)	22	20	3.03	5.67	526	22	67.11	6	3	1	2	71.18	0	12.55	2	6
Green-Duwamish	09BLA0716	Mill Creek (Kent)-duplicate	18	16	3.19	6.20	371	26	60.11	8	3	2	3	80.84	1	3.77	5	3
Green-Duwamish	09BLA0722	Garrison Creek - South Fork	20	16	3.20	4.92	534	19	55.81	6	2	3	1	55.68	0	0.37	2	2
Green-Duwamish	09BLA0756	Mill Creek (Kent)	14	10	2.09	7.27	533	13	86.87	3	1	2	0	98.74	0	0.56	1	0
Green-Duwamish	09BLA0768	Springbrook Creek	24	22	3.38	4.82	389	24	55.53	12	2	6	4	66.46	1	18.51	3	3
Green-Duwamish	09BLA0772	Panther Creek	18	14	3.01	6.07	527	21	64.52	6	2	2	2	67.64	0	1.90	5	2
Green-Duwamish	09BLA0817	Tributary to Springbrook Creek (0006B)	16	12	2.34	6.54	535	13	76.82	3	1	1	1	97.56	0	0.37	0	0
		BLACK RIVER Mean	19.0	15.8	2.9	5.9	496.0	19.6	67.4	6.1	2.0	2.3	1.9	76.8	0.3	5.3	2.5	2.4
		BLACK RIVER Std Dev	3.2	3.9	0.5	0.8	72.2	4.7	10.9	2.9	0.8	1.7	1.2	15.1	0.5	6.7	1.8	1.9
Green-Duwamish	09COV1165	Covington Creek	38	32	3.95	3.22	521	32	42.03	18	5	6	7	25.87	2	12.09	6	9
Green-Duwamish	09COV1756	Covington Creek	36	32	3.63	3.74	518	32	50.97	19	5	8	6	20.50	2	5.41	6	5
Green-Duwamish	09COV1756	Covington Creek-duplicate	28	26	3.85	4.36	354	24	42.94	14	3	4	7	54.25	1	10.17	4	5
		COVINGTON Mean	34.0	30.0	3.8	3.8	464.3	29.3	45.3	17.0	4.3	6.0	6.7	33.5	1.7	9.2	5.3	6.3
		COVINGTON Std Dev	5.3	3.5	0.2	0.6	95.6	4.6	4.9	2.6	1.2	2.0	0.6	18.1	0.6	3.4	1.2	2.3
Green-Duwamish	09DEE2163	Deep Creek	38	30	3.92	3.90	333	31	49.85	16	8	3	5	24.29	2	23.42	6	4
Green-Duwamish	09DEE2208	Coal Creek	40	36	3.99	3.91	584	38	46.06	26	12	4	10	45.17	3	4.79	9	4
Green-Duwamish	09DEE2266	Deep Creek	50	44	4.17	3.11	506	42	47.43	27	9	7	11	10.72	3	34.39	11	5
Green-Duwamish	09DEE2294	Coal Creek	42	40	3.56	4.33	541	41	56.75	28	11	7	10	27.87	7	7.95	11	7
Green-Duwamish	09DEE2294	Coal Creek-duplicate	38	40	4.01	2.94	541	41	42.51	27	12	6	9	13.26	5	12.20	10	3
		DEEP AND COAL Mean	41.6	38.0	3.9	3.6	501.0	38.6	48.5	24.8	10.4	5.4	9.0	24.3	4.0	16.6	9.4	4.6
		DEEP AND COAL Std Dev	5.0	5.3	0.2	0.6	97.9	4.5	5.3	5.0	1.8	1.8	2.3	13.7	2.0	12.2	2.1	1.5
Green-Duwamish	09DUW0091	Tributary to Duwamish River (0001E)	14	10	2.27	6.77	169	11	81.07	2	1	1	0	97.08	0	0.59	2	1
Green-Duwamish	09DUW0144	Hamm Creek	16	14	2.24	6.12	551	16	80.04	2	1	0	1	38.36	0	0.54	1	1
Green-Duwamish	09DUW0225	Tributary to Duwamish River (0003D)	20	16	2.78	6.13	552	19	68.84	5	1	1	3	87.02	1	4.17	2	3
Green-Duwamish	09DUW0277	Riverton Creek	20	16	3.28	6.41	219	22	61.64	9	1	2	6	79.52	0	9.59	4	1
		DUWAMISH Mean	17.5	14.0	2.6	6.4	372.8	17.0	72.9	4.5	1.0	1.0	2.5	75.5	0.3	3.7	2.3	1.5
		DUWAMISH Std Dev	3.0	2.8	0.5	0.3	207.4	4.7	9.3	3.3	0.0	0.8	2.6	25.8	0.5	4.3	1.3	1.0
Green-Duwamish	09JEN1318	Jenkins Creek	22	18	3.42	4.84	338	21	56.51	11	3	4	4	69.96	0	7.40	2	2
Green-Duwamish	09JEN1357	Jenkins Creek	32	26	3.64	5.69	577	30	50.43	18	5	5	8	63.68	1	2.08	5	3
Green-Duwamish	09JEN1358	Jenkins Creek	18	16	2.94	6.54	536	19	65.49	8	3	1	4	95.86	0	0.37	0	3
		JENKINS Mean	24.0	20.0	3.3	5.7	483.7	23.3	57.5	12.3	3.7	3.3	5.3	76.5	0.3	3.3	2.3	2.7
		JENKINS Std Dev	7.2	5.3	0.4	0.9	127.8	5.9	7.6	5.1	1.2	2.1	2.3	17.1	0.6	3.7	2.5	0.6
Green-Duwamish	09LOW0325	Tributary to Lower Green River (0036B)	16	12	2.24	7.73	84	14	77.38	5	3	0	2	92.00	2	3.57	2	2
Green-Duwamish	09LOW0751	Olson Creek	34	32	3.73	4.04	555	34	47.21	18	5	8	5	21.09	2	5.41	3	5
Green-Duwamish	09LOW0753	Tributary to Lower Green River	22	18	2.60	4.85	504	27	75.79	11	4	4	3	33.48	2	5.95	3	2
Green-Duwamish	09LOW0753	Tributary to Lower Green River-duplicate	24	20	3.39	4.38	523	29	61.57	13	4	5	4	38.20	1	4.21	2	2
Green-Duwamish	09LOW0788	Tributary to Lower Green River (0069)	22	16	2.45	4.75	577	24	79.90	13	4	6	3	61.29	0	7.63	5	2
		LOWER GREEN RIVER Mean	23.6	19.6	2.9	5.2	448.6	25.6	68.4	12.0	4.0	4.6	3.4	49.2	1.4	5.4	3.0	2.6
		LOWER GREEN RIVER Std Dev	6.5	7.5	0.6	1.5	205.8	7.4	13.8	4.7	0.7	3.0	1.1	28.0	0.9	1.6	1.2	1.3
Green-Duwamish	09MID1374	O'Grady Creek	30	26	3.64	4.82	502	28	54.78	15	3	5	7	56.04	3	14.54	5	4
Green-Duwamish	09MID1495	Crisp Creek	24	22	3.60	3.44	503	27	52.68	13	4	5	4	38.56	1	1.39	4	3
Green-Duwamish	09MID1537	Crisp Creek	32	30	2.30	5.68	527	31	81.21	16	5	5	6	59.80	6	11.01	5	5
Green-Duwamish	09MID1704	Tributary Middle Green River	14	10	1.37	8.01	603	11	95.02	0	0	0	0	98.31	0	1.82	1	1
Green-Duwamish	09MID1744	Christy Creek	36	32	3.66	5.07	301	32	52.49	15	3	6	6	55.32	4	19.27	6	6
Green-Duwamish	09MID1817	Christy Creek	40	34	4.26	2.95	528	37	33.52	22	6	8	8	10.50	1	16.29	5	4
Green-Duwamish	09MID1958	Icy Creek	38	36	3.46	4.50	490	30	58.98	19	6	6	7	46.23	8	12.04	3	7
Green-Duwamish	09MID2426	Tributary to Middle Green River	40	36	3.84	4.97	521	34	47.41	18	4	5	9	22.78	8	19.00	9	8
		MIDDLE GREEN RIVER Mean	31.8	28.3	3.3	4.9	496.9	28.8	59.5	14.8	3.9	5.0	5.9	48.4	3.9	11.9	4.8	4.8
		MIDDLE GREEN RIVER Std Dev	9.0	8.8	0.9	1.5	86.4	7.9	19.5	6.6	2.0	2.3	2.8	26.5	3.2	7.0	2.3	2.3
Green-Duwamish	09MIL0291	Mill Creek (Auburn)	32	28	3.68	4.41	571	31	50.26	17	2	4	11	35.31	1	12.08	6	1
Green-Duwamish	09MIL0340	Mill Creek (Auburn)	30	24	3.33	4.35	534	28	56.37	16	3	5	8	27.50	2	13.30	6	1
Green-Duwamish	09MIL0390	Mill Creek (Auburn)	32	30	3.83	3.89	547	29	47.90	15	3	5	7	20.16	1	29.25	4	3
		MILL Mean	31.3	27.3	3.6	4.2	550.7	29.3	51.5	16.0	2.7	4.7	8.7	27.7	1.3	18.2	5.3	1.7
		MILL Std Dev	1.2	3.1	0.3	0.3	18.8	1.5	4.4	1.0	0.6	0.6	2.1	7.6	0.6	9.6	1.2	1.2
Green-Duwamish	09NEW1657	Newaukum Creek	24	18	3.48	4.90	507	24	54.64	11	6	2	3	72.55	1	2.76	5	2
Green-Duwamish	09NEW2076	Newaukum Creek - North Fork	38	36	4.02	3.62	506	32	46.64	20	8	5	7	17.14	2	23.12	6	5
Green-Duwamish	09NEW2102	Newaukum Creek	36	34	3.52	3.85	560	32	57.32	20	8	7	5	12.20	5	8.75	8	3
Green-Duwamish	09NEW2128	Newaukum Creek - North Fork	32	28	3.71	4.04	535	31	51.03	16	8	6	2	20.00	2	14.39	6	3
Green-Duwamish	09NEW2151	Newaukum Creek	44	42	4.43	2.87	508	41	36.42	24	9	8	7	20.07	9	21.46	8	7
Green-Duwamish	09NEW2151	Newaukum Creek-duplicate	42	42	3.82	2.79	544	43	54.04	24	9	7	8	11.22	8	26.10	8	7
		NEWAUKUM Mean	36.0	33.3	3.8	3.7	526.7	33.8	50.0	19.2	8.0	5.8	5.3	25.5	4.5	16.1	6.8	4.5
		NEWAUKUM Std Dev	7.3	9.2	0.4	0.8	23.0	7.0	7.6	5.0	1.1	2.1	2.4	23.3	3.4	9.1	1.3	2.2
Green-Duwamish	09SOO0943	Big Soos Creek	34	28	3.79	5.46	527	35	52.94	20	11	6	3	61.36	1	7.78	4	5
Green-Duwamish	09SOO1020	Soosette Creek	32	26	3.62	5.18	553	30	45.21	17	6	7	4	53.65	2	8.50	4	5
Green-Duwamish	09SOO1020	Soosette Creek-duplicate	38	36	4.12	4.16	509	34	44.99	19	5	8	6	29.24	3	18.86	5	7
Green-Duwamish	09SOO1022	Soosette Creek	36	32	3.79	4.30	563	36	53.29	19	5	6	8	45.26	2	16.52	7	7
Green-Duwamish	09SOO1106	Meridian Valley Creek	18	16	3.32	5.13	414	21	54.59	8	3	2	3	64.55	0	1.69	2	2
Green-Duwamish	09SOO1130	Soos Creek	40	34	3.99	3.81	567	41	50.97	26	9	6	11	24.94	2	6.53	5	6
Green-Duwamish	09SOO1134	Soos Creek	34	32	4.01	3.73	504	32	41.27	17	5	5	7	38.44	3	7.14	7	7
Green-Duwamish	09SOO1144	Big Soos Creek	28	26	3.84	4.28	517	30	45.65	13	3	5	5	49.25	1	18.96	1	2
Green-Duwamish	09SOO1209	Little Soos Creek	18	16	2.82	2.74	539	21	70.69	8	2	2	4	25.38	0	1.67	4	1
Green-Duwamish	09SOO1283	Little Soos Creek	32	32	4.05	4.31	409	32	36.92	16	5	4	7	45.59	0	16.14	6	5
		SOOS Mean	31.0	27.8	3.7	4.3	510.2	31.2	49.7	16.3	5.4	5.1	5.8	43.8	1.4	10.4	4.5	4.7
		SOOS Std Dev	7.6	7.0	0.4	0.8	56.3	6.3	9.3	5.5	2.8	2.0	2.5	14.2	1.2	6.7	2.0	2.3

APPENDIX F

2003 Benthic Macroinvertebrate Raw Data

APPENDIX F – 2003 Benthic Macroinvertebrate Raw Data

Phylum	Class	Order	Family	Final Identification / SITE NAME	08LIT2488	08BEA3312	08BEA3321	08BEA3325	08BEA3478	08BEA3571	08BEA3650	08BEA3737	08BEA3747	08BEA3826	09BLA0675	09BLA0716 DUPLICATE	09BLA0716	09BLA0722	09BLA0756	09BLA0768	09BLA0772	09BLA0817	08CED2433	08CED2518	08CED2711	08CED2898	08CED4192	08CED4479 DUPLICATE	08CED4479	08CED4975	08CED5032	09COV1165	09COV1756 REPLICATE	09COV1756	09DEE2163	09DEE2208	09DEE2266	09DEE2294 DUPLICATE	09DEE2294	09DUW0091	09DUW0144	09DUW0225	09DUW0277	08EAS1964	08EAS2058	08EAS2191	08EAS2272	08EAS2446A	08EAS2446B	08EAS2546	08EAS2631	08EVA3474	08EVA3555	08EVA3637	08EVA3640	08EVA3813	08EVA4249	08ISS3958	08ISS4373	08ISS4573
				sample date	9/25/2003	8/7/2003	8/7/2003	8/7/2003	8/6/2003	8/7/2003	8/12/2003	8/6/2003	8/7/2003	8/12/2003	8/15/2003	9/20/2003	8/15/2003	8/28/2003	8/15/2003	8/20/2003	8/28/2003	8/28/2003	8/11/2003	8/11/2003	8/11/2003	8/11/2003	8/14/2003	9/24/2003	9/24/2003	8/11/2003	8/14/2003	9/25/2003	9/22/2003	9/22/2003	8/13/2003	8/18/2003	8/13/2003	9/20/2003	8/18/2003	8/1/2003	8/1/2003	8/1/2003	9/2/2003	8/8/2003	8/8/2003	8/27/2003	8/21/2003	8/21/2003	8/21/2003	8/21/2003	8/8/2003	8/19/2003	9/30/2003	8/19/2003	8/12/2003	8/19/2003	8/21/2003	8/5/2003	8/12/2003	8/4/2003
Arthropoda		Coleoptera	Dytiscidae	Dytiscidae																																																								
Arthropoda		Coleoptera		Dytiscidae (early instar, pupa or damaged)							1											2																																					1	2
Arthropoda		Coleoptera	Dytiscidae	Agabus																																																								
Arthropoda		Coleoptera	Dytiscidae	Hydroporus																																																								
Arthropoda		Coleoptera	Dytiscidae	Liodessus																																																								
Arthropoda		Coleoptera	Dytiscidae	Oreodytes											1																				2																	17									
Arthropoda		Coleoptera	Dytiscidae	Rhantus																																																								
Arthropoda		Coleoptera	Elmidae	Elmidae																																																								
Arthropoda		Coleoptera		Elmidae (early instar, pupa or damaged)	2	5	6		9																				27	2			28	12		17	10							5	51			21	46		20		16			1			4	4
Arthropoda		Coleoptera	Elmidae	Ampumixis dispar																																																								
Arthropoda		Coleoptera	Elmidae	Cleptelmis				2		1		1		1													2	3					4	13	3		1															3								
Arthropoda		Coleoptera	Elmidae	Heterlimnius	3		11		40	3	29												1				26	27	20	10	4	15			51	15	9	48	6					56	40			14	55		35	81	10		4	4		30	4	5
Arthropoda		Coleoptera	Elmidae	Lara avara	2		2	2	5								2			3			3	1	1	16	1	2				1	1	1						1								1						1	1	8	1	26		
Arthropoda		Coleoptera	Elmidae	Narpus	1		1		8	1	2	3		5	4	4	5	6	12		6			17	4	8	4	30	10	17	1	2			3	2	3		2		13	1		1	10			9	5				5		27		4		1	3
Arthropoda		Coleoptera	Elmidae	Optioservus	3	8		15	59	28	11	75	175	1			1							4				5	8	1		2	78	31	6									2	4						8	35	66			21				
Arthropoda		Coleoptera	Elmidae	Zaitzevia							3	1																23	38			1					7							2	8			1			8	3						1		2
Arthropoda		Coleoptera	Hydraenidae	Hydraenidae																																																								
Arthropoda		Coleoptera	Hydraenidae	Hydraena																																																								
Arthropoda		Coleoptera	Haliplidae	Haliplidae																																																								
Arthropoda		Coleoptera	Haliplidae	Haliplidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Haliplidae	Haliplus																																																								
Arthropoda		Coleoptera	Haliplidae	Brychius																																																								
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae																																																								
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Hydrophilidae	Anacaena																																																								
Arthropoda		Coleoptera	Hydrophilidae	Tropisternus																																																								
Arthropoda		Coleoptera	Hydrophilidae	Laccobius																																																								
Arthropoda		Coleoptera	Limnichidae	Limnichidae																																																								
Arthropoda		Coleoptera	Psephenidae	Psephenidae																																																								
Arthropoda		Coleoptera		Psephenidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Ptilodactylidae	Ptilodactylidae																																																								
Arthropoda		Diptera	Blephariceridae	Blephariceridae																																																								
Arthropoda		Diptera	Blephariceridae	Blephariceridae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Blephariceridae	Blepharicera																																																								
Arthropoda		Diptera	Ceratopogonidae	Ceratopogoninae									1			2	1				1			3		17				1	4				1	1	4	26	2		1		3	4					5					3		3	1			4
Arthropoda		Diptera	Ceratopogonidae	Forcipomyiinae		1																															1														1									1
Arthropoda		Diptera	Chironomidae	Chironomidae	60	62	6	91	42	31	38	15	27	24	210	29	166	74	48	28	38	121	136	26	152	58	26	6	4	23	42	14	9	22	63	87	115	45	211	31	287	188	12	242	69	216	37	54	72	26	64	348	18	50	18	17	390	39	38	97
Arthropoda		Diptera	Culicidae	Culicidae																																																								
Arthropoda		Diptera	Dixidae	Dixidae																																																								
Arthropoda		Diptera	Dixidae	Dixa		1		5				2		1	1	1	5				3			1		3	2			6	1	1		2					1		1	1	3	1										3		1	27	10	14	10
Arthropoda		Diptera	Dixidae	Dixella																																																								
Arthropoda		Diptera	Dixidae	Meringodixa																																																	1				3			
Arthropoda		Diptera	Dolichopodidae	Dolichopodidae																																																								
Arthropoda		Diptera	Empididae	Empididae																																																								
Arthropoda		Diptera		Empididae (early instar, pupa or damaged)																																																1								
Arthropoda		Diptera	Empididae	Chelifera		4	1	4	12	1	2	2		2	1	1			1	10		1	8	10		1	2	14	30			8	1		12		10	1		1	1	19	2	15	9	2			1	5	3	1	6	3	3	1	12		2	3
Arthropoda		Diptera	Empididae	Clinocera																								1																	5															
Arthropoda		Diptera	Empididae	Hemerodromia	2	1			2		2		7			1															1								1														2				1			
Arthropoda		Diptera	Empididae	Oreogeton																									1																										1					
Arthropoda		Diptera	Ephydridae	Ephydridae																																																								
Arthropoda		Diptera		Ephydridae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Muscidae	Muscidae																																																								
Arthropoda		Diptera	Pelecorhynchidae	Pelecorhynchidae																																																								
Arthropoda		Diptera	Pelecorhynchidae	Glutops			1									1				1							6			4					2	1	14																						2	
Arthropoda		Diptera	Psychodidae	Psychodidae																																																								
Arthropoda		Diptera	Psychodidae	Psychodidae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Psychodidae	Maruina										1																																					3									
Arthropoda		Diptera	Psychodidae	Pericoma	1						1	1		1											1			4		5		8			9	10		75	2				2		1					1				6						
Arthropoda		Diptera	Ptychopteridae	Ptychopteridae																																																								
Arthropoda		Diptera	Ptychopteridae	Ptychoptera		1																																																						
Arthropoda		Diptera	Simuliidae	Simuliidae																																																								
Arthropoda		Diptera	Simuliidae	Simulium	2	3	1		10	5	25	2	15	1	16	3	29	51	2	128	149	193	39		108	92	16	18	2		2	62	5	11	7	94	1		22	60		134	20	3	3	5	311	17		24	27		8	183	31	4	6	2	1	
Arthropoda		Diptera	Stratiomyidae	Stratiomyidae																																																								
Arthropoda		Diptera	Stratiomyidae	Nemotelus																																																								
Arthropoda		Diptera	Tabanidae	Tabanidae																																																								
Arthropoda		Diptera	Thaumaleidae	Thaumaleidae																																																								
Arthropoda		Diptera	Thaumaleidae	Thaumalea																							1																																1	4
Arthropoda		Diptera	Tipulidae	Tipulidae																																																								
Arthropoda		Diptera	Tipulidae	Antocha		1					1												2								3	1		1		14		2			1				2															
Arthropoda		Diptera	Tipulidae	Dicranota		7		6	3	2	1	1					13	2		2	2		7	2	1	7	2			2	3						1	5			1		2	11	4	65			2		1	2	1	8	1	4	5			5
Arthropoda		Diptera	Tipulidae	Hesperoconopa																											1																													
Arthropoda		Diptera	Tipulidae	Hexatoma																											4							2	2																					
Arthropoda		Diptera	Tipulidae	Limnophila																																																								
Arthropoda		Diptera	Tipulidae	Limonia																																						2																		
Arthropoda		Diptera	Tipulidae	Ormosia																																																								
Arthropoda		Diptera	Tipulidae	Pedicia																																																								
Arthropoda		Diptera	Tipulidae	Pilaria					1																																																			
Arthropoda		Diptera	Tipulidae	Rhabdomastix																						1																																		
Arthropoda		Diptera	Tipulidae	Tipula	3				3					2		2	1	1			1			3	1	3		6		2												1					1								6				1	
Arthropoda		Diptera	Tipulidae	Molophilus																																																							1	
Arthropoda		Ephemeroptera	Ameletidae	Ameletidae																																																								
Arthropoda		Ephemeroptera	Ameletidae	Ameletus																										3								3																						
Arthropoda		Ephemeroptera	Baetidae	Baetidae																																																								
Arthropoda		Ephemeroptera	Baetidae	Acentrella																			4												4	1																								
Arthropoda		Ephemeroptera	Baetidae	Baetis tricaudatus	33	2	12	5	46	52	52	38	18		122	129	112	36	191	58	53	70	112	23	48	14	46	104	72	1	122	52	15	20	29	82	17	3	36	22	38	58	35	53	88	6	73	119	69	4	96		71	123	4		7		4	38
Arthropoda		Ephemeroptera	Baetidae	Caenis																																																								
Arthropoda		Ephemeroptera	Baetidae	Centroptilum																																																								
Arthropoda		Ephemeroptera	Baetidae	Diphetor hageni		3			7	9	5	28	5											1		1	1			2	1			3		1		2						8	31			15	20		29	1			3			1	1	4
Arthropoda		Ephemeroptera	Baetidae	Pseudocloeon																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerellidae																																																								
Arthropoda		Ephemeroptera		Ephemerellidae (early instar, pupa or damaged)																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella																																																								
Arthropoda		Ephemeroptera		Attenella (early instar, pupa or damaged)																											4	2			18			10																					1	34
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella delantala																															2	1			1																					7
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella margarita																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella																																																								
Arthropoda		Ephemeroptera		Caudatella (early instar, pupa or damaged)																																																								1
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella hystrix																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella																																																								
Arthropoda		Ephemeroptera		Drunella (early instar, pupa or damaged)																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella coloradensis																																			1																					
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella doddsi																										1	11	15				15		12	29																				1	64
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella grandis																																1			1																					
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella spinifera																											3						3	1	1																					4
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerella																																																								
Arthropoda		Ephemeroptera		Ephemerella (early instar, pupa or damaged)					3							7	1										1					2			10			5															5						3	
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerella inermis																																	1																							
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella teresa																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella tibialis					2		2																			1	3				4	12	7	1	3					1	1											1				
Arthropoda		Ephemeroptera	Ephemerellidae	Timpanoga hecuba							1																																	1					4											1

Phylum	Class	Order	Family	Final Identification	SITE NAME	08LIT2488	08BEA3312	08BEA3321	08BEA3325	08BEA3478	08BEA3571	08BEA3650	08BEA3737	08BEA3747	08BEA3826	09BLA0675	09BLA0716 DUPLICATE	09BLA0716	09BLA0722	09BLA0756	09BLA0768	09BLA0772	09BLA0817	08CED2433	08CED2518	08CED2711	08CED2898	08CED4192	08CED4479 DUPLICATE	08CED4479	08CED4975	08CED5032	09COV1165	09COV1756 REPLICATE	09COV1756	09DEE2163	09DEE2208	09DEE2266	09DEE2294 DUPLICATE	09DEE2294	09DUW0091	09DUW0144	09DUW0225	09DUW0277	08EAS1964	08EAS2058	08EAS2191	08EAS2272	08EAS2446A	08EAS2446B	08EAS2546	08EAS2631	08EVA3474	08EVA3555	08EVA3637	08EVA3640	08EVA3813	08EVA4249	08ISS3958	08ISS4373	08ISS4573
					sample date	9/25/2003	8/7/2003	8/7/2003	8/7/2003	8/6/2003	8/7/2003	8/12/2003	8/6/2003	8/7/2003	8/12/2003	8/15/2003	9/20/2003	8/15/2003	8/28/2003	8/15/2003	8/20/2003	8/28/2003	8/28/2003	8/11/2003	8/11/2003	8/11/2003	8/11/2003	8/14/2003	9/24/2003	9/24/2003	8/11/2003	8/14/2003	9/25/2003	9/22/2003	9/22/2003	8/13/2003	8/18/2003	8/13/2003	9/20/2003	8/18/2003	8/1/2003	8/1/2003	8/1/2003	9/2/2003	8/8/2003	8/8/2003	8/27/2003	8/21/2003	8/21/2003	8/21/2003	8/21/2003	8/8/2003	8/19/2003	9/30/2003	8/19/2003	8/12/2003	8/19/2003	8/21/2003	8/5/2003	8/12/2003	8/4/2003
Arthropoda		Ephemeroptera	Heptageniidae	Heptageniidae																																																									
Arthropoda		Ephemeroptera		Heptageniidae (early instar, pupa or damaged)										1																																														
Arthropoda		Ephemeroptera	Heptageniidae	Cinygma			15		11	3			1	1		2	6	2				2					2									2		11																2			1		8		
Arthropoda		Ephemeroptera	Heptageniidae	Cinygmula			3	7			1																	16			122	4				3	19	25	5	11																			5	9
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus																																																								
Arthropoda		Ephemeroptera		Epeorus (early instar, pupa or damaged)																																	3		1	6																					1
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus albertae																																																								
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus deceptivus																												4																													
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus grandis																												3																													
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus longimanus																					1														4		1																					
Arthropoda		Ephemeroptera	Heptageniidae	Nixe																																																								
Arthropoda		Ephemeroptera	Heptageniidae	Ironodes																							3	1	1	6					3		1	1																	3				9	5		
Arthropoda		Ephemeroptera	Heptageniidae	Rhithrogena								16		2															36	79		92	41	29	5		4		3	24					17	26						2									1	6
Arthropoda		Ephemeroptera	Leptophlebiidae	Leptophlebiidae																																																								
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia		1	93		37	7	38	2	44	1	6				32		1					1		3	9	9	10			7	33	1	3	16	35	3										4		3		53				6	7		26
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia bicornuta																																																1									
Arthropoda		Hemiptera	Corixidae	Corixidae																																																								
Arthropoda		Hemiptera		Corixidae (early instar, pupa or damaged)																																																								
Arthropoda		Hemiptera	Corixidae	Trichorixa																																																								
Arthropoda		Megaloptera	Sialidae	Sialidae																																																								
Arthropoda		Megaloptera	Sialidae	Sialis		1										8		11																				1																							
Arthropoda		Odonata	Gomphidae	Gomphidae																																																								
Arthropoda		Odonata		Gomphidae (early instar, pupa or damaged)																																																								
Arthropoda		Plecoptera	Capniidae	Capniidae																																																								
Arthropoda		Plecoptera		Capniidae (early instar, pupa or damaged)																																																								
Arthropoda		Plecoptera	Chloroperlidae	Chloroperlidae																																																								
Arthropoda		Plecoptera		Chloroperlidae (early instar, pupa or damaged)																												7													2	5									2				1			
Arthropoda		Plecoptera	Chloroperlidae	Suwallia																																	7									6															2
Arthropoda		Plecoptera	Chloroperlidae	Kathroperla																												1																													
Arthropoda		Plecoptera	Chloroperlidae	Paraperla																												8								1																					4
Arthropoda		Plecoptera	Chloroperlidae	Sweltsa			45	29	51	8	20	11	110	8	34	12	8	41		2	27	6			36	4	3	21	5	4	133	1	22	21	22	52		84	18	11					5	8			8	3		25		4	1	10	1	14	2	4	5
Arthropoda		Plecoptera	Leuctridae	Leuctridae																																																								
Arthropoda		Plecoptera		Leuctridae (early instar, pupa or damaged)																										8					3																										
Arthropoda		Plecoptera	Leuctridae	Despaxia augusta											3																	1								1												1								4	3
Arthropoda		Plecoptera	Leuctridae	Moselia infuscata																											2	1						2																				1		
Arthropoda		Plecoptera	Nemouridae	Nemouridae																																																								
Arthropoda		Plecoptera		Nemouridae (early instar, pupa or damaged)																																																								
Arthropoda		Plecoptera	Nemouridae	Malenka			20		48	14	157	1	19	57	15						1		2				29				1							3													2	3	1			4		2	1	9
Arthropoda		Plecoptera	Nemouridae	Soyedina																	3																																			1	2		
Arthropoda		Plecoptera	Nemouridae	Visoka cataractae																																																								
Arthropoda		Plecoptera	Nemouridae	Zapada																																																								
Arthropoda		Plecoptera		Zapada (early instar, pupa or damaged)																																																							10
Arthropoda		Plecoptera	Nemouridae	Zapada cinctipes			62		64	14	29	14	148						141		13	13		8	1	18	3	7	17	25		4	23	16	23		13	12	2	8	3		23	2	21	14	1		5	8		24	1	21	13	1	3	54	2	9	19
Arthropoda		Plecoptera	Nemouridae	Zapada columbiana																																																								
Arthropoda		Plecoptera	Nemouridae	Zapada frigida																																																								
Arthropoda		Plecoptera	Nemouridae	Zapada Oregonensis Gr.					5	4		2			3				1		4			1			10	2	1	1			4		1		2	1	1	4														1						1	1
Arthropoda		Plecoptera	Peltoperlidae	Peltoperlidae																																																								
Arthropoda		Plecoptera	Peltoperlidae	Yoraperla																								19						23	200																								5		
Arthropoda		Plecoptera	Perlidae	Perlidae																																																								
Arthropoda		Plecoptera		Perlidae (early instar, pupa or damaged)																																																								
Arthropoda		Plecoptera	Perlidae	Calineuria californica						1				1														5	27	11	7	23	7	9	5	1																17					2			2	2	1
Arthropoda		Plecoptera	Perlidae	Claassenia sabulosa																																																								
Arthropoda		Plecoptera	Perlidae	Doroneuria																												1							1	15																					
Arthropoda		Plecoptera	Perlidae	Hesperoperla pacifica				9					23	4	2													8	13	9	3		8					4					4								2		1		1					5
Arthropoda		Plecoptera	Perlodidae	Perlodidae																																																								
Arthropoda		Plecoptera		Perlodidae (early instar, pupa or damaged)			1		1		5								1	3										2	1				1	1	1	1														1		3						1	
Arthropoda		Plecoptera	Perlodidae	Isoperla										1															14	12			5																				2			1				
Arthropoda		Plecoptera	Perlodidae	Kogotus					2					1							30			2															1																					
Arthropoda		Plecoptera	Perlodidae	Megarcys																												1																													
Arthropoda		Plecoptera	Perlodidae	Skwala			16		6	2	3	11	2	17			1								3			1	1	4	12					2	12	6	2						58	31			6	7		9		1		1					
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcyidae																																																								
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella																																																								
Arthropoda		Plecoptera		Pteronarcella (early instar, pupa or damaged)						1																																																		
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella badia																															10																										
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys																																																								
Arthropoda		Plecoptera		Pteronarcys (early instar, pupa or damaged)																																																								
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys californica																																																								
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys princeps											4													1												1																					
Arthropoda		Trichoptera	Apataniidae	Apataniidae																																																								
Arthropoda		Trichoptera	Apataniidae	Apatania																								1																																	
Arthropoda		Trichoptera	Apataniidae	Pedomoecus sierra																																																								
Arthropoda		Trichoptera	Brachycentridae	Brachycentridae																																																								
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus																																																								
Arthropoda		Trichoptera		Brachycentrus (early instar, pupa or damaged)																																																								
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus americanus											1													167					2				2																								
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus occidentalis																																																								
Arthropoda		Trichoptera	Brachycentridae	Micrasema				1		2																	23	3			2	5	11	15		1	1	3	1				4										7								
Arthropoda		Trichoptera	Calamoceratidae	Calamoceratidae																																																								
Arthropoda		Trichoptera	Calamoceratidae	Heteroplectron californicum																											2																														
Arthropoda		Trichoptera	Glossosomatidae	Glossosomatidae																																																								
Arthropoda		Trichoptera		Glossosomatidae (early instar, pupa or damaged)																																																								
Arthropoda		Trichoptera	Glossosomatidae	Agapetus																																12																								
Arthropoda		Trichoptera	Glossosomatidae	Anagapetus																																																						17		
Arthropoda		Trichoptera	Glossosomatidae	Glossosoma			21	5		4	3	50	21	14						11			1		1		5	2	9	6	51	88	4	5	13	88	41	51	60				9		20						17		18		6				14	7
Arthropoda		Trichoptera	Goeridae	Goeridae																																																								
Arthropoda		Trichoptera	Goeridae	Goeracea																																																					6		
Arthropoda		Trichoptera	Goeridae	Goera archaon																																																								
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae																																																								
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae (early instar, pupa or damaged)																																			2																					
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae																																																								
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae (early instar, pupa or damaged)																	1																																							
Arthropoda		Trichoptera	Hydropsychidae	Arctopsyche grandis																									1			3	2																												
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche																																																								
Arthropoda		Trichoptera		Parapsyche (early instar, pupa or damaged)																				2													1																				26		
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche almota																		1		1			64	1							1			1					4	2											10	1					4
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche elsis																																																					6		
Arthropoda		Trichoptera	Hydropsychidae	Cheumatopsyche																																																								
Arthropoda		Trichoptera		Hydroptilidae (early instar, pupa or damaged)																																												3												
Arthropoda		Trichoptera	Hydroptilidae	Hydroptila		1								1										93																										3			1	1							
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostomatidae																																																								
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma																																																								
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (panel case)											1			6																				1																			1				
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (turret case)																																																		5				
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma cascadense																								1											104																	2					
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma Pluviale Gr.									2			3	1		4					2				5								2	4		2	3		1									1						1			1		
Arthropoda		Trichoptera	Leptoceridae	Leptoceridae																																																								
Arthropoda		Trichoptera	Leptoceridae	Ceraclea																																																								
Arthropoda		Trichoptera	Limnephilidae	Limnephilidae																																																								
Arthropoda		Trichoptera		Limnephilidae (early instar, pupa or damaged)																											1																														
Arthropoda		Trichoptera	Limnephilidae	Cryptochia																																																								

Phylum	Class	Order	Family	Final Identification	SITE NAME	08LIT2488	08BEA3312	08BEA3321	08BEA3325	08BEA3478	08BEA3571	08BEA3650	08BEA3737	08BEA3747	08BEA3826	09BLA0675	09BLA0716 DUPLICATE	09BLA0716	09BLA0722	09BLA0756	09BLA0768	09BLA0772	09BLA0817	08CED2433	08CED2518	08CED2711	08CED2898	08CED4192	08CED4479 DUPLICATE	08CED4479	08CED4975	08CED5032	09COV1165	09COV1756 REPLICATE	09COV1756	09DEE2163	09DEE2208	09DEE2266	09DEE2294 DUPLICATE	09DEE2294	09DUW0091	09DUW0144	09DUW0225	09DUW0277	08EAS1964	08EAS2058	08EAS2191	08EAS2272	08EAS2446A	08EAS2446B	08EAS2546	08EAS2631	08EVA3474	08EVA3555	08EVA3637	08EVA3640	08EVA3813	08EVA4249	08ISS3958	08ISS4373	08ISS4573
					sample date	9/25/2003	8/7/2003	8/7/2003	8/7/2003	8/6/2003	8/7/2003	8/12/2003	8/6/2003	8/7/2003	8/12/2003	8/15/2003	9/20/2003	8/15/2003	8/28/2003	8/15/2003	8/20/2003	8/28/2003	8/28/2003	8/11/2003	8/11/2003	8/11/2003	8/11/2003	8/14/2003	9/24/2003	9/24/2003	8/11/2003	8/14/2003	9/25/2003	9/22/2003	9/22/2003	8/13/2003	8/18/2003	8/13/2003	9/20/2003	8/18/2003	8/1/2003	8/1/2003	8/1/2003	9/2/2003	8/8/2003	8/8/2003	8/27/2003	8/21/2003	8/21/2003	8/21/2003	8/21/2003	8/8/2003	8/19/2003	9/30/2003	8/19/2003	8/12/2003	8/19/2003	8/21/2003	8/5/2003	8/12/2003	8/4/2003
Arthropoda		Trichoptera	Limnephilidae	Dicosmoecus gilvipes												3		1							2																											2									
Arthropoda		Trichoptera	Limnephilidae	Ecclisomyia																												3							2																						
Arthropoda		Trichoptera	Limnephilidae	Eocosmoecus																																							1																		
Arthropoda		Trichoptera	Limnephilidae	Hydatophylax																																																									
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus						3																																								1											
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus unicolor																																																									
Arthropoda		Trichoptera	Limnephilidae	Psychoglypha																																														1											
Arthropoda		Trichoptera	Limnephilidae	Ecclisocosmoecus																																																									
Arthropoda		Trichoptera	Philopotamidae	Philopotamidae																																																									
Arthropoda		Trichoptera		Philopotamidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Philopotamidae	Wormaldia			48		2			5		30							1									2		1		1	1			3																				1	1		
Arthropoda		Trichoptera	Polycentropodidae	Polycentropodidae																																																									
Arthropoda		Trichoptera	Polycentropodidae	Polycentropus																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophilidae																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila																																																									
Arthropoda		Trichoptera		Rhyacophila (early instar, pupa or damaged)					7		1						1										1				2				3																	2									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Angelita Gr.					1				1																									1		1																					
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila arnaudi								2		5																																								5							
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Betteni Gr.			3	1	3		5	1			3														1	1	11	1		1		1	1	9	2	2				5	1	1			2		1	7	1			1			3		1
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila blarina			3		3	10	1		20		1														1	1				2			1	29														1									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Brunnea Gr.			1		1	2	3	2		7	4						2							1	1			3	3				4	1	1	4				3					5	1		3		2		1	1			1	
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Grandis Gr.																							5																1																1		
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Hyalinata Gr.																										1		2								1																					
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Iranda Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila malkini																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila narvae			2	1		2	1		3		11														27	22		3	8	2		5	1	5	6													2									1
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Oreta Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Rotunda Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Vagrita Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila valuma									1																	1										1																					
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila verrula																																																									
Arthropoda		Trichoptera	Sericostomatidae	Gumaga																																																									
Arthropoda		Trichoptera	Uenoidae	Uenoidae																																																									
Arthropoda		Trichoptera	Uenoidae	Uenoidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax occidentis																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax rickeri					11																																																				
Arthropoda		Trichoptera	Uenoidae	Neophylax splendens											1													1				1						3						2																	
Arthropoda		Trichoptera	Uenoidae	Neothremma																																																							3		
Arthropoda		Trichoptera	Uenoidae	Oligophlebodes																																				2																					
Annelida	Hirudinea			Hirudinea																																																									
Annelida	Hirudinea			Hirudinea (immature or damaged)																																																									
Annelida	Hirudinea		Erpobdellidae	Erpobdellidae																																																									
Annelida	Hirudinea		Erpobdellidae	Mooreobdella																																																									
Annelida	Hirudinea		Erpobdellidae	Erpobdella																																																									
Annelida	Hirudinea		Glossiphoniidae	Glossiphoniidae																																																									
Annelida	Hirudinea		Glossiphoniidae	Helobdella																																																									
Annelida	Hirudinea		Glossiphoniidae	Helobdella stagnalis																			1																																						
Annelida	Hirudinea		Glossiphoniidae	Glossiphonia complanata																																																									
Annelida	Hirudinea		Piscicolidae	Piscicola salmositica																																																									
Annelida	Hirudinea		Piscicolidae	Myzobdella														1																																											
Annelida	Oligochaeta			Oligochaeta		18	4	7	9	126	41	42	47	2	106	48	55	75	83	196	15	67	97	38	31	79	39	20	127	67	25	27	8	23	15	8	3	14	29	24	46	24	51	73	4	5	139	4	23	18	6	19	19	47	106	110	3	3	23	45	62
Arthropoda	Arachnida	Acariformes		Acari		28	7	3	4	17	4	4	25	11	4	70	24	10	27	3	19	6	1	65	4	2	5	2	4	7	20	9	1	5	7	10	16	4	11	1		13	1	27	20	21	1	5	2	4	1	1	5	23			11	3	5	8	14
Arthropoda	Branchiopoda	Cladocera		Cladocera																																																									
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	Crangonyx		62	6		70		79	3				10	39	17	31	76		17	39	23		22															1		42	1	6		87	58					8	32			43				
Arthropoda	Crustacea	Copepoda		Copepoda																																																									
Arthropoda	Crustacea	Decapoda		Pacifastacus							1	1		1		1		1																	1																										
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea					1		22																																				1						11	22			22				
Arthropoda	Crustacea	Ostracoda		Ostracoda												4												4											1			3	1							1						1					
Mollusca	Gastropoda		Ancylidae	Ferrissia		1										1	7					2																			1																				
Mollusca	Gastropoda		Lymnaeidae	Fossaria						1		1																																																	
Mollusca	Gastropoda		Lymnaeidae	Stagnicola																																																									
Mollusca	Gastropoda		Planorbidae	Planorbidae																																			1																						
Mollusca	Gastropoda		Planorbidae	Gyraulus		2											8		35		15	3		7				1													1	19										1									
Mollusca	Gastropoda		Planorbidae	Helisoma							9		1						2	6																													1												
Mollusca	Gastropoda		Pleuroceridae	Juga													2																	45	13																										
Mollusca	Gastropoda		Physidae	Physidae										1			1		1			31																			2	1	7												2		1				
Mollusca	Gastropoda		Physidae	Physa																																																									
Mollusca	Gastropoda		Pisidiidae	Pisidiidae			9	3	31	19	31		2	33	8		1			1	1	3			2	1	5	25								3		2	3			31		2	2	3	7	1				3		20			6	1	25		1
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Hydrobiidae																																																									
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Pristinicola																							1	69																																	
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Potamopyrgus antipodarum																																																									
Mollusca	Pelecypoda		Margaritiferidae	Margaritifera falcata						1				1																																															
Nematoda				Nematoda			6	7	11	35		7	8	24	3	36	35	25	4	1	3	1	4	1		6	3	6	1	1		7	39	4	6	2	12	17		2		116	14	2	5	7	10	1	2	3		7	8	6		2	2	4	41	7	8
Nemertea				Prostoma																																																									
Platyhelminthes				Turbellaria		2					11								2	3		1					40				3	2			1			5	2	10			3	4				9					2	1	1	1			6	4	1
Porifera		Hydra		Hydra																				1																																					
Porifera		Hydra	Hydridae	Hydrozoa																																																									
				SITE TOTAL ABUNDANCE		228	500	114	511	530	701	503	657	536	276	553	371	526	534	533	389	527	535	558	170	530	434	552	555	502	443	500	521	354	518	333	584	506	541	541	169	551	552	219	547	479	540	501	510	500	75	510	552	538	517	248	170	554	309	211	501

Phylum	Class	Order	Family	Final Identification	08ISS4724 8/7/2003	08ISS4730 8/5/2003	08ISS4735 8/11/2003	08ISS4735 DUPLICATE 9/22/2003	08ISS4884 8/4/2003	08ISS3877 8/13/2003	09JEN1318 8/5/2003	09JEN1357 8/5/2003	09JEN1358 9/13/2003	08LAK3121 8/26/2003	08LAK3540 9/2/2003	08LAK3616 8/12/2003	08LAK3627 9/2/2003	08LAK3699 8/18/2003	08LAK3879 8/12/2003	08LAK3880 8/18/2003	08LIT2585 8/5/2003	08LIT2602 8/6/2003	08LIT2603 8/6/2003	08LIT2682 8/5/2003	08LIT2685 8/5/2003	08LIT2692 8/1/2003	08LIT2781 8/1/2003	08LIT2876 8/5/2003	09LOW0325 8/6/2003	09LOW0751 8/6/2003	09LOW0753 8/4/2003	09LOW0753 DUPLICATE 9/20/2003	09LOW0788 8/6/2003	08EAS1502 7/30/2003	09MID1374 9/24/2003	09MID1495 9/4/2003	09MID1537 8/19/2003	09MID1704 8/14/2003	09MID1744 8/14/2003	09MID1817 8/14/2003	09MID1958 9/3/2003	09MID2426 8/13/2003	09MIL0291 8/4/2003	09MIL0340 8/14/2003	09MIL0390 8/4/2003	09NEW1657 8/15/2003	09NEW2076 8/19/2003	09NEW2102 8/15/2003	09NEW2128 8/15/2003	09NEW2151 9/25/2003	09NEW2151 REPLICATE 9/25/2003	08NOR0001 8/1/2003	08NOR1100 8/13/2003	08NOR1362 8/4/2003	08NOR1370 8/1/2003	08NOR1750 8/3/2003	08NOR2028 8/1/2003	08NOR2115 8/12/2003	08NOR2306 8/4/2003	08SAM0000 8/20/2003	08SAM2674 8/14/2003
Arthropoda		Coleoptera	Dytiscidae	Dytiscidae																																																								
Arthropoda		Coleoptera		Dytiscidae (early instar, pupa or damaged)												1		1													3									2																			3	1	1
Arthropoda		Coleoptera	Dytiscidae	Agabus																																																							
Arthropoda		Coleoptera	Dytiscidae	Hydroporus																																																							
Arthropoda		Coleoptera	Dytiscidae	Liodessus																																																							
Arthropoda		Coleoptera	Dytiscidae	Oreodytes	1											1																																5												8	
Arthropoda		Coleoptera	Dytiscidae	Rhantus																																																						
Arthropoda		Coleoptera	Elmidae	Elmidae																																																						
Arthropoda		Coleoptera		Elmidae (early instar, pupa or damaged)	34	40		2			3	6			2	17		23			12	42	29	5	5	27		12								17										3	15		5					2	17	25			11		
Arthropoda		Coleoptera	Elmidae	Ampumixis dispar																																																						
Arthropoda		Coleoptera	Elmidae	Cleptelmis								15			1							2											1																												
Arthropoda		Coleoptera	Elmidae	Heterlimnius	51	31	4	6	20	16					3	33		32		1	28	88	1	20	21	145	66	8														33				30	28	68	4	13	12			10	30	59			4		
Arthropoda		Coleoptera	Elmidae	Lara avara	1	1	1	2	1					2	2				6	8		1				3		2				12		2	3				1	7			2	3	2				2	1	2						4				
Arthropoda		Coleoptera	Elmidae	Narpus	3	8		1	6				1	7	15			2	8		2	2	1	2		18		14		39					12	1			10			6			27		9	6		2	1	1		2	5	1		1			
Arthropoda		Coleoptera	Elmidae	Optioservus		3				4	76	4	26			12		10	10		22	45	45	28	14	11	9									28					1	1				53	10					1	1	5	33	7	2	58	8		
Arthropoda		Coleoptera	Elmidae	Zaitzevia						3						1		2	8			2								3						1									3													1			
Arthropoda		Coleoptera	Hydraenidae	Hydraenidae																																																								
Arthropoda		Coleoptera	Hydraenidae	Hydraena															2																																										
Arthropoda		Coleoptera	Haliplidae	Haliplidae																																																							
Arthropoda		Coleoptera	Haliplidae	Haliplidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Haliplidae	Haliplus						2																												1																							
Arthropoda		Coleoptera	Haliplidae	Brychius												10									1																																				
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae																																																								
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Hydrophilidae	Anacaena																																																								
Arthropoda		Coleoptera	Hydrophilidae	Tropisternus																																																								
Arthropoda		Coleoptera	Hydrophilidae	Laccobius																																																								
Arthropoda		Coleoptera	Limnichidae	Limnichidae																																																								
Arthropoda		Coleoptera	Psephenidae	Psephenidae																																																								
Arthropoda		Coleoptera		Psephenidae (early instar, pupa or damaged)																																																								
Arthropoda		Coleoptera	Ptilodactylidae	Ptilodactylidae																																																								
Arthropoda		Diptera	Blephariceridae	Blephariceridae																																																								
Arthropoda		Diptera	Blephariceridae	Blephariceridae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Blephariceridae	Blepharicera																																																								
Arthropoda		Diptera	Ceratopogonidae	Ceratopogoninae	12	3	9	10	5		1							14	4	26			1			1		4		3	3	8			8		1			2		12	3	4	3			1	2	1	5	2									
Arthropoda		Diptera	Ceratopogonidae	Forcipomyiinae			16													1										1																															
Arthropoda		Diptera	Chironomidae	Chironomidae	95	209	37	33	127	133	6	97	4	154	20	179	114	22	135	30	73	28	125	136	129	39	83	87	8	106	261	136	39	56	95	65	312	170	22	70	80	137	163	189	113	98	114	178	150	87	121	222	27	107	118	138	62	62	52	43	55
Arthropoda		Diptera	Culicidae	Culicidae																																																							
Arthropoda		Diptera	Dixidae	Dixidae																																																							
Arthropoda		Diptera	Dixidae	Dixa		6	2		3					2	2	2			1	5			1					1			1		3	8						8	1		10	2	16																
Arthropoda		Diptera	Dixidae	Dixella																																																						1			
Arthropoda		Diptera	Dixidae	Meringodixa																27										5																															
Arthropoda		Diptera	Dolichopodidae	Dolichopodidae																																																								
Arthropoda		Diptera	Empididae	Empididae																																																								
Arthropoda		Diptera		Empididae (early instar, pupa or damaged)						5																																													1						
Arthropoda		Diptera	Empididae	Chelifera	1	1				4	1	2		2	8	13	196		9			23	5	2	8		2	11			3	4	6	1	12	3	2	3	9	6	3	3		1	34	1	6	2	3		1				6	1	2		4		1
Arthropoda		Diptera	Empididae	Clinocera												1																					3		1			2																			
Arthropoda		Diptera	Empididae	Hemerodromia												5		1									4										1																								
Arthropoda		Diptera	Empididae	Oreogeton																																																								
Arthropoda		Diptera	Ephydridae	Ephydridae																																																								
Arthropoda		Diptera		Ephydridae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Muscidae	Muscidae																																																								
Arthropoda		Diptera	Pelecorhynchidae	Pelecorhynchidae																																																								
Arthropoda		Diptera	Pelecorhynchidae	Glutops	1	3	2	2	2											3						6								2	2		2		1						4			2	2		1										
Arthropoda		Diptera	Psychodidae	Psychodidae																																																								
Arthropoda		Diptera	Psychodidae	Psychodidae (early instar, pupa or damaged)																																																								
Arthropoda		Diptera	Psychodidae	Maruina		1													3											1									1			2					1														
Arthropoda		Diptera	Psychodidae	Pericoma		4																						2		1	2				3		1			3		7	1			2	19	28	46	23	12						1				1
Arthropoda		Diptera	Ptychopteridae	Ptychopteridae																																																								
Arthropoda		Diptera	Ptychopteridae	Ptychoptera	3										1																																														
Arthropoda		Diptera	Simuliidae	Simuliidae																																																								
Arthropoda		Diptera	Simuliidae	Simulium	2	5				8	38	82	146	116	24	16	1	93	58	1	65	9	113	8	55	9	2	5	6	6	29	9	257	28	15	25	1		5	15		1	16	25	3	3	2	1	6	8	3	17	7	12	2	91	5	268		12	145
Arthropoda		Diptera	Stratiomyidae	Stratiomyidae																																																								
Arthropoda		Diptera	Stratiomyidae	Nemotelus																																																								
Arthropoda		Diptera	Tabanidae	Tabanidae																																																								
Arthropoda		Diptera	Thaumaleidae	Thaumaleidae																																																								
Arthropoda		Diptera	Thaumaleidae	Thaumalea			1													5																			1			1																			
Arthropoda		Diptera	Tipulidae	Tipulidae																																																								
Arthropoda		Diptera	Tipulidae	Antocha		4				12																																				20								5	15				1		
Arthropoda		Diptera	Tipulidae	Dicranota	2		5	1	2		1		1		4	24	6	7	1	7	1	2		3		3	1	6		9	19	7	12	3			2	3		6	1	2	10	4	16		1			9	8	24		2	3	3	3	1	9	6	5
Arthropoda		Diptera	Tipulidae	Hesperoconopa																																														1	1										
Arthropoda		Diptera	Tipulidae	Hexatoma	1		5	16	1	1																																			1					1	1										
Arthropoda		Diptera	Tipulidae	Limnophila			2	1							1															1		1	4	1																2	3					1					1
Arthropoda		Diptera	Tipulidae	Limonia					1							1				1																				4																					
Arthropoda		Diptera	Tipulidae	Ormosia																																																									
Arthropoda		Diptera	Tipulidae	Pedicia																					1				1																					2											
Arthropoda		Diptera	Tipulidae	Pilaria																																																								
Arthropoda		Diptera	Tipulidae	Rhabdomastix																																														1											
Arthropoda		Diptera	Tipulidae	Tipula										1		2	2		2	1	2	1							2	1			3	4				4																					1		
Arthropoda		Diptera	Tipulidae	Molophilus																																																								
Arthropoda		Ephemeroptera	Ameletidae	Ameletidae																																																								
Arthropoda		Ephemeroptera	Ameletidae	Ameletus			1																																																						
Arthropoda		Ephemeroptera	Baetidae	Baetidae																																																								
Arthropoda		Ephemeroptera	Baetidae	Acentrella						2														1																															1				4		
Arthropoda		Ephemeroptera	Baetidae	Baetis tricaudatus	44	31	5	1	8	1	6	10	23	66	47	2	62	122	94	19	169	23	81	78	142	46	14	6	3	51	18	4	7	15	115	75	98		93	10	166	20	6	16	39	126	29	30	10	51	32	67		61	36	9		15	15	60	121
Arthropoda		Ephemeroptera	Baetidae	Caenis																																																							
Arthropoda		Ephemeroptera	Baetidae	Centroptilum																																																							
Arthropoda		Ephemeroptera	Baetidae	Diphetor hageni	1	1		18	6	1	4	15	3		1	1	12	25	29		2	2		1		17	8	6		1	2	2				3			1	1					40	8	8		7			9		9	2	19					
Arthropoda		Ephemeroptera	Baetidae	Pseudocloeon																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerellidae																																																								
Arthropoda		Ephemeroptera		Ephemerellidae (early instar, pupa or damaged)																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella																																																								
Arthropoda		Ephemeroptera		Attenella (early instar, pupa or damaged)	31	1				1																																					2	75	2	4	2										
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella delantala	5	5																																										2													
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella margarita																																																							
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella																																																								
Arthropoda		Ephemeroptera		Caudatella (early instar, pupa or damaged)																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella hystrix																																	5																					
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella																																																								
Arthropoda		Ephemeroptera		Drunella (early instar, pupa or damaged)																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella coloradensis																															1				1																				
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella doddsi	4	27	7		9																												1					2					2	5		17	10										
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella grandis																																																								
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella spinifera			1		2																																									2											
Arthropoda		Ephemeroptera		Ephemerella																																																								
Arthropoda		Ephemeroptera		Ephemerella (early instar, pupa or damaged)						1							2							2				1																				2			1										
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerella inermis																																																							
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella teresa																																																							
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella tibialis	9	5			1	2		1						1			6	1		14	2	3	23	1		1							3			1	4	5				1	1	7	5	7	6				1						
Arthropoda		Ephemeroptera	Ephemerellidae	Timpanoga hecuba						1											4					6																														1					

Phylum	Class	Order	Family	Final Identification	9/7/2003	9/5/2003	9/11/2003	9/22/2003	9/4/2003	9/13/2003	9/5/2003	9/5/2003	9/13/2003	9/29/2003	9/2/2003	9/12/2003	9/2/2003	9/19/2003	9/12/2003	9/19/2003	9/5/2003	9/5/2003	9/5/2003	9/2/2003	9/5/2003	9/5/2003	9/2/2003	9/12/2003	9/12/2003	9/5/2003	9/5/2003	9/2/2003	9/5/2003	9/5/2003	9/4/2003	9/20/2003	9/6/2003	7/30/2003	9/24/2003	9/4/2003	9/19/2003	9/14/2003	9/14/2003	9/14/2003	9/3/2003	9/13/2003	9/4/2003	9/14/2003	9/4/2003	9/15/2003	9/19/2003	9/19/2003	9/15/2003	9/25/2003	9/25/2003	9/1/2003	9/13/2003	9/4/2003	9/1/2003	9/3/2003	9/1/2003	9/2/2003	9/4/2003	9/22/2003	9/14/2003
					09S54724	09S54730	09S54735	09S54735 DUPLICATE	09S54884	09S53877	09JRN1318	09JRN1357	09JRN1358	09LAK3121	09LAK3540	09LAK3616	09LAK3627	09LAK3699	09LAK3879	09LAK3880	09LUT2585	09LUT2602	09LUT2603	09LUT2662	09LUT2685	09LUT2692	09LUT2701	09LUT2876	09LOW0323	09LOW0751	09LOW0753	09LOW0753 DUPLICATE	09LOW0788	09EAS3502	09MIO1374	09MIO1495	09MIO1537	09MIO1704	09MIO1744	09MIO1817	09MIO1958	09MIO2426	09WIL0291	09WIL0340	09WIL0360	09NEW0657	09NEW0705	09NEW2102	09NEW2128	09NEW2151	09NEW2151 REPLICATE	09NOR0001	09NOR1300	09NOR1362	09NOR1370	09NOR1750	09NOR0203	09NOR2115	09NOR2306	09SAM0060	09SAM0074
Arthropoda		Ephemeroptera	Heptageniidae	Heptageniidae																																																															
Arthropoda		Ephemeroptera		Heptageniidae (early instar, pupa or damaged)																																																													
Arthropoda		Ephemeroptera	Heptageniidae	Cinygma		10		9				1								12	3		3					2	1		6	9	1	2						38				1						1														1	
Arthropoda		Ephemeroptera	Heptageniidae	Cinygmula	28	7	16	6	67								28					2								39			1		8	2			34	2		5			2	33	8	11	20	64													
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus																																																											
Arthropoda		Ephemeroptera		Epeorus (early instar, pupa or damaged)	2	1																																																									
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus albertae		1																																							1																		
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus deceptivus																																																										
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus grandis																																																										
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus longimanus	5	2																				1											5																											
Arthropoda		Ephemeroptera	Heptageniidae	Nixe																																																										
Arthropoda		Ephemeroptera	Heptageniidae	Ironodes			2	4	1											1								1					4		1																1	1											
Arthropoda		Ephemeroptera	Heptageniidae	Rhithrogena	13	10	42	7	10									5						16	1	3	30	5													43						31	3	11	6	28											
Arthropoda		Ephemeroptera	Leptophlebiidae	Leptophlebiidae																																																										
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia	2		12	23	18		1	9	4		26		17	5	2		2	7	1			2		74	1	7	3	2				16				6	5		9	7	10	2	4	5	10	13	17					1					3
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia bicornuta																																																										
Arthropoda		Hemiptera	Corixidae	Corixidae																																																										
Arthropoda		Hemiptera		Corixidae (early instar, pupa or damaged)						1																																																				
Arthropoda		Hemiptera	Corixidae	Trichorixa																																																										
Arthropoda		Megaloptera	Sialidae	Sialidae																																																										
Arthropoda		Megaloptera	Sialidae	Sialis												1															2	1																										1			6	
Arthropoda		Odonata	Gomphidae	Gomphidae																																																										
Arthropoda		Odonata		Gomphidae (early instar, pupa or damaged)																																																										
Arthropoda		Plecoptera	Capniidae	Capniidae																																																										
Arthropoda		Plecoptera		Capniidae (early instar, pupa or damaged)																																																										
Arthropoda		Plecoptera	Chloroperlidae	Chloroperlidae																																																										
Arthropoda		Plecoptera		Chloroperlidae (early instar, pupa or damaged)				15							2	1								1	1																										47	2											
Arthropoda		Plecoptera	Chloroperlidae	Suwallia	28	15				4																47	1																							11	1			2	1						
Arthropoda		Plecoptera	Chloroperlidae	Kathroperla				5	2																											2		7																								
Arthropoda		Plecoptera	Chloroperlidae	Paraperla					2																									2																													
Arthropoda		Plecoptera	Chloroperlidae	Sweltsa	19	8	18	21	28	3	9	2		3	3	1	3	3	11	81						76	25	31		9	1	1	1		35	2	10		18	53	21	5	37	54	81	2	89	24	52	47	109			1	1	22					
Arthropoda		Plecoptera	Leuctridae	Leuctridae																																																										
Arthropoda		Plecoptera		Leuctridae (early instar, pupa or damaged)																																																						1				
Arthropoda		Plecoptera	Leuctridae	Despaxia augusta			9	2	5																					7	2	3								2							1	5														
Arthropoda		Plecoptera	Leuctridae	Moselia infuscata			7		2											1																															1	1											
Arthropoda		Plecoptera	Nemouridae	Nemouridae																																																										
Arthropoda		Plecoptera		Nemouridae (early instar, pupa or damaged)																																																										
Arthropoda		Plecoptera	Nemouridae	Malenka	2		1		2		1	42			5		2	4		2		2				2	1	19		68	92	35	1			53				12			4	3	6		6	32	71									35			2	
Arthropoda		Plecoptera	Nemouridae	Soyedina			1								1					2								2				1				1																											
Arthropoda		Plecoptera	Nemouridae	Visoka cataractae			9	29																																																					
Arthropoda		Plecoptera	Nemouridae	Zapada																																																										
Arthropoda		Plecoptera		Zapada (early instar, pupa or damaged)																																																										
Arthropoda		Plecoptera	Nemouridae	Zapada cinctipes	4	14	18	16	11	1	2	50	9		64		23	5	6	1	5	41	24	35	12	8	62	27		88		119	165	3	4	17			1	47	2		64	58	68	4	6	4	10	12	8	7		77	31	12		3	4		48
Arthropoda		Plecoptera	Nemouridae	Zapada columbiana																																																										
Arthropoda		Plecoptera	Nemouridae	Zapada frigida				16																																																							
Arthropoda		Plecoptera	Nemouridae	Zapada Oregonensis Gr.			1		1			3							2			3											8							1	8	6			5	7					8	1										5
Arthropoda		Plecoptera	Peltoperlidae	Peltoperlidae																																																									
Arthropoda		Plecoptera	Peltoperlidae	Yoraperla			2		1											1										1	1										24	2																					
Arthropoda		Plecoptera	Perlidae	Perlidae																																																									
Arthropoda		Plecoptera		Perlidae (early instar, pupa or damaged)																																										3															
Arthropoda		Plecoptera	Perlidae	Calineuria californica			39	13	7	1																							2																													
Arthropoda		Plecoptera	Perlidae	Claassenia sabulosa																																																									
Arthropoda		Plecoptera	Perlidae	Doroneuria					27								7																				17		12		23	57								10	1											
Arthropoda		Plecoptera	Perlidae	Hesperoperla pacifica		1											1			14		1					1	4		1					1				14		4					3		1	1											
Arthropoda		Plecoptera	Perlodidae	Perlodidae																																																									
Arthropoda		Plecoptera		Perlodidae (early instar, pupa or damaged)	1				1										1			1				6	1	5							6	7				12			1	3	1		2			1		2									
Arthropoda		Plecoptera	Perlodidae	Isoperla																													1		1																											
Arthropoda		Plecoptera	Perlodidae	Kogotus																										1						12												1												
Arthropoda		Plecoptera	Perlodidae	Megarcys																																																	1							
Arthropoda		Plecoptera	Perlodidae	Skwala	6	5		24	18	2	2					1		22	5		37	2		27	13	13	27	7		3						1						3	1	2		11	6	11	2		13		4	10	9			3		
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcyidae																																																									
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella																																																									
Arthropoda		Plecoptera		Pteronarcella (early instar, pupa or damaged)																																																									
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella badia																																																									
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys																																																									
Arthropoda		Plecoptera		Pteronarcys (early instar, pupa or damaged)																																																									
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys californica																																																									
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys princeps				3	3			3																								1		2	1	4	9																					
Arthropoda		Trichoptera	Apataniidae	Apataniidae																																																									
Arthropoda		Trichoptera	Apataniidae	Apatania	2				1																											1																											
Arthropoda		Trichoptera	Apataniidae	Pedomoecus sierra																																																									
Arthropoda		Trichoptera	Brachycentridae	Brachycentridae																																																									
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus																																																									
Arthropoda		Trichoptera		Brachycentrus (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus americanus						7																																															2			1	
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus occidentalis						7																																																			
Arthropoda		Trichoptera	Brachycentridae	Micrasema						9					2		1			2															8					54	10	1	4			2															
Arthropoda		Trichoptera	Calamoceratidae	Calamoceratidae																																																									
Arthropoda		Trichoptera	Calamoceratidae	Heteroplectron californicum	1				1																														1																						
Arthropoda		Trichoptera	Glossosomatidae	Glossosomatidae																																																									
Arthropoda		Trichoptera		Glossosomatidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Glossosomatidae	Agapetus	2	5																																																							
Arthropoda		Trichoptera	Glossosomatidae	Anagapetus																																					2						4														
Arthropoda		Trichoptera	Glossosomatidae	Glossosoma	45	73	45	8	28	21	24				19		1	1	1	2	4	1	7	3	2	6	38	3							47	125	5		8	1		53	44	45	9	45	13	39	27	24	40	2		7	38	8			16	
Arthropoda		Trichoptera	Goeridae	Goeridae																																																									
Arthropoda		Trichoptera	Goeridae	Goeracea																																																									
Arthropoda		Trichoptera	Goeridae	Goera archaon																																																									
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae																																																									
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae																																																									
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae (early instar, pupa or damaged)			2																																																						
Arthropoda		Trichoptera	Hydropsychidae	Arctopsyche grandis																									1																																	
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche																																																									
Arthropoda		Trichoptera		Parapsyche (early instar, pupa or damaged)																								1																																		
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche almota			4													5			2		1						2		18	40					7			5	8			1									3				1
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche elsis																																				5																					
Arthropoda		Trichoptera	Hydropsychidae	Cheumatopsyche									23																																																
Arthropoda		Trichoptera		Hydroptilidae (early instar, pupa or damaged)																																																										
Arthropoda		Trichoptera	Hydroptilidae	Hydroptila						113		6	2			14		15			18			95	20																														3	8				308		1
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostomatidae																																																									
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma																																																										
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (panel case)	3		1																			2		1																														5				
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (turret case)																																1																											
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma cascadense				23	6											5															7									2						23	15											
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma Pluviale Gr.												3				1												1												1		2						2					1			1	77
Arthropoda		Trichoptera	Leptoceridae	Leptoceridae																																																									
Arthropoda		Trichoptera	Leptoceridae	Ceraclea																																																									
Arthropoda		Trichoptera	Limnephilidae	Limnephilidae																																																									
Arthropoda		Trichoptera		Limnephilidae (early instar, pupa or damaged)				1																																										3											
Arthropoda		Trichoptera	Limnephilidae	Cryptochia																																																									

					8/7/2003	8/5/2003	8/11/2003	9/22/2003	8/4/2003	8/13/2003	8/5/2003	8/5/2003	9/13/2003	8/26/2003	9/2/2003	8/12/2003	9/2/2003	8/18/2003	8/12/2003	8/18/2003	8/5/2003	8/6/2003	8/6/2003	8/5/2003	8/5/2003	8/1/2003	8/1/2003	8/5/2003	8/6/2003	8/6/2003	8/4/2003	9/20/2003	8/6/2003	7/30/2003	9/24/2003	9/4/2003	8/19/2003	8/14/2003	8/14/2003	8/14/2003	9/3/2003	8/13/2003	8/4/2003	8/14/2003	8/4/2003	8/15/2003	8/19/2003	8/15/2003	8/15/2003	9/25/2003	9/25/2003	8/1/2003	8/13/2003	8/4/2003	8/1/2003	8/3/2003	8/1/2003	8/12/2003	8/4/2003	8/20/2003	8/14/2003
Phylum	**Class**	**Order**	**Family**	**Final Identification**	08ISS4724	08ISS4730	08ISS4735	08ISS4735 DUPLICATE	08ISS4884	08ISS3877	09JEN1318	09JEN1357	09JEN1358	08LAK3121	08LAK3540	08LAK3616	08LAK3627	08LAK3699	08LAK3879	08LAK3880	08LIT2585	08LIT2602	08LIT2603	08LIT2682	08LIT2685	08LIT2692	08LIT2781	08LIT2876	09LOW0325	09LOW0751	09LOW0753	09LOW0753 DUPLICATE	09LOW0788	08EAS1502	09MID1374	09MID1495	09MID1537	09MID1704	09MID1744	09MID1817	09MID1958	09MID2426	09MIL0291	09MIL0340	09MIL0390	09NEW1657	09NEW2076	09NEW2102	09NEW2128	09NEW2151	09NEW2151 REPLICATE	08NOR0001	08NOR1100	08NOR1362	08NOR1370	08NOR1750	08NOR2028	08NOR2115	08NOR2306	08SAM0000	08SAM2674
Arthropoda		Trichoptera	Limnephilidae	Dicosmoecus gilvipes															1							1																										1									
Arthropoda		Trichoptera	Limnephilidae	Ecclisomyia	2		1	2																																										1											
Arthropoda		Trichoptera	Limnephilidae	Eocosmoecus																																																									
Arthropoda		Trichoptera	Limnephilidae	Hydatophylax																																																									
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus																													1																												
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus unicolor																																																									
Arthropoda		Trichoptera	Limnephilidae	Psychoglypha																									1		2	2				7							3										3				1				1
Arthropoda		Trichoptera	Limnephilidae	Ecclisocosmoecus																																																									
Arthropoda		Trichoptera	Philopotamidae	Philopotamidae																																																									
Arthropoda		Trichoptera		Philopotamidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Philopotamidae	Wormaldia	1		12	14	1			4								11			2	1				22		7	19	1							1	28	1						4							2		1		7		1	
Arthropoda		Trichoptera	Polycentropodidae	Polycentropodidae																																																								
Arthropoda		Trichoptera	Polycentropodidae	Polycentropus																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophilidae																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila																																																									
Arthropoda		Trichoptera		Rhyacophila (early instar, pupa or damaged)	3	1	1	5		4	6						8						4																	8	2			2		6	6			2				2	1			1			
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Angelita Gr.	2	1																																																							
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila arnaudi							1	1	1										2				1																																		
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Betteni Gr.			6	1	4	1		3			5		3	3	5		3	4	1	6	2	2		11		1					3		4			1	2		6	1	5		3			13	6			3		4			4		1
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila blarina								1										14	30				4																				3			1	1										
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Brunnea Gr.		2						2					1	1	2		4	2		3	3	1	2	3							1				3	2		3	1	4	7	11		3		5	2			2	3	10		3	1		
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Grandis Gr.																												2	3																												
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Hyalinata Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Iranda Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila malkini																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila narvae		2		1	3		10	1										3	2			1		1		1					8		1			2		5	1	1	7					2	1										
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Oreta Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Rotunda Gr.																																																									
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Vagrita Gr.																																					3																				
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila valuma					2											3						3																1		1				5													
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila verrula																																			1																						
Arthropoda		Trichoptera	Sericostomatidae	Gumaga																																							2	1																	
Arthropoda		Trichoptera	Uenoidae	Uenoidae																																																									
Arthropoda		Trichoptera	Uenoidae	Uenoidae (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax (early instar, pupa or damaged)																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax occidentis																																																									
Arthropoda		Trichoptera	Uenoidae	Neophylax rickeri	1	21																				1	1																				3														
Arthropoda		Trichoptera	Uenoidae	Neophylax splendens			6								2															2							3		1	2			5		1																
Arthropoda		Trichoptera	Uenoidae	Neothremma																																	1				7																				
Arthropoda		Trichoptera	Uenoidae	Oligophlebodes																																					31	10																			
Annelida	Hirudinea			Hirudinea																																																									
Annelida	Hirudinea			Hirudinea (immature or damaged)																																																									
Annelida	Hirudinea		Erpobdellidae	Erpobdellidae																																																									
Annelida	Hirudinea		Erpobdellidae	Mooreobdella																																																	1								
Annelida	Hirudinea		Erpobdellidae	Erpobdella																																																									
Annelida	Hirudinea		Glossiphoniidae	Glossiphoniidae																																																									
Annelida	Hirudinea		Glossiphoniidae	Helobdella																																																									
Annelida	Hirudinea		Glossiphoniidae	Helobdella stagnalis																																		5															18								
Annelida	Hirudinea		Glossiphoniidae	Glossiphonia complanata																																																									
Annelida	Hirudinea		Piscicolidae	Piscicola salmositica																																1															1										
Annelida	Hirudinea		Piscicolidae	Myzobdella																																																									
Annelida	Oligochaeta			Oligochaeta	22	36	10	5	11	14		112	76	49	14	36	7	13	22	15	14	52	7	33	23	38	66	84	51	20	2	10	37	35	65	7	18	394	31	9	9	48	60	42	27	26	19	3	52	1	4	35	200	3	11	80	193	19	8	238	28
Arthropoda	Arachnida	Acariformes		Acari	10	8	1	22	26	141	19	21	1		20	50	5	23	12	9	19	2	9	10	5	4	9	5		36	9	22	1	1	9	18	5		15	28	11	12	3		8	14	7	4	5	2	4	40		16	48	5	3	1	36	10	13
Arthropoda	Branchiopoda	Cladocera		Cladocera						1												3																																							
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	Crangonyx					1			1	61	17	17	29					79		4	58	13	1	4		2		14	20		1		3		4	1							33						39	303	9	7		71	33	9	70	
Arthropoda	Crustacea	Copepoda		Copepoda																																																									
Arthropoda	Crustacea	Decapoda		Pacifastacus																																								2																	
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea																										1	1																					1					1	51	1		
Arthropoda	Crustacea	Ostracoda		Ostracoda											7														1										1	1	1																				1
Mollusca	Gastropoda		Ancylidae	Ferrissia						2						2						2														1																					1	6		4	
Mollusca	Gastropoda		Lymnaeidae	Fossaria																																					2																				1
Mollusca	Gastropoda		Lymnaeidae	Stagnicola																																																	1						1		
Mollusca	Gastropoda		Planorbidae	Planorbidae																																																									
Mollusca	Gastropoda		Planorbidae	Gyraulus			1			1						1						2							5		5	67		1	1	10		6					39	1		6			1											30	
Mollusca	Gastropoda		Planorbidae	Helisoma																			1																																		53				
Mollusca	Gastropoda		Pleuroceridae	Juga							77	55	129																																																
Mollusca	Gastropoda		Physidae	Physidae												2		11							2						1	4											1												1		5				
Mollusca	Gastropoda		Physidae	Physa																																																								
Mollusca	Gastropoda		Pisidiidae	Pisidiidae	1			2			20	4	24		7	1	7		1	7	4	36	5	3	1	1		16		1		32		1	12	2	1	9	1	8			33	5		6			4	5	7	16				15	119			8	
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Hydrobiidae																																			2																						
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Pristinicola																												1		1			1																								
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Potamopyrgus antipodarum																																																									
Mollusca	Pelecypoda		Margaritiferidae	Margaritifera falcata																																																									
Nematoda				Nematoda	9		4	3	3	3	24	2	1	4	6	44		1	5	5	1	22	13	4	3	1	5	18		1	1	7		1	5	9	5	4	3	53	1	9	23			2	4	1	8		1	20		3	3	5	37	4	1	10	13
Nemertea				Prostoma																																																									
Platyhelminthes				Turbellaria			6	2	3			1							7		2			2		2							1				7		6		15	18	4	15	2				2	2	1			4					1		
Porifera		Hydra		Hydra																									1																				6												
Porifera		Hydra	Hydridae	Hydrozoa																																																									
				SITE TOTAL ABUNDANCE	515	612	375	379	511	535	338	577	536	423	370	507	509	529	540	316	588	519	520	603	500	560	516	538	84	555	504	523	577	206	502	503	527	603	301	528	490	521	571	534	547	507	506	560	535	508	544	520	562	500	619	551	572	606	525	511	523

Phylum	Class	Order	Family	Final Identification	9/13/2003	9/13/2003	9/21/2003	9/14/2003	9/14/2003	9/14/2003	9/13/2003	9/12/2003	9/15/2003	9/15/2003	9/12/2003	9/11/2003	9/11/2003	9/29/2003	9/11/2003	9/29/2003	9/5/2003	9/5/2003	9/5/2003	9/5/2003	9/12/2003	9/12/2003	9/8/2003	9/5/2003	9/5/2003	9/5/2003	9/8/2003	9/8/2003	TAXA TOTAL ABUNDANCE
					05SAR0862	05SAR0865 GOLD CREEK	05SAR0946	05SAR0951	05SAR0945	05SAR0945 REPLICATE	05SAR0947	05SOO943	05SOO1020	05SOO1020 REPLICATE	05SOO1022	05SOO1106	05SOO1120	05SOO1134	05SOO1144	05SOO1209	05SOO1283	05WES0622	05WES0629	05WES0903	05WES0905	05WES0936	05WES0937	05WES1178	05WES1340	05WES1450	05WES1579	
Arthropoda		Coleoptera	Dytiscidae	Dytiscidae																													
Arthropoda		Coleoptera		Dytiscidae (early instar, pupa or damaged)								3																					21
Arthropoda		Coleoptera	Dytiscidae	Agabus																											1		1
Arthropoda		Coleoptera	Dytiscidae	Hydroporus																													
Arthropoda		Coleoptera	Dytiscidae	Liodessus																													
Arthropoda		Coleoptera	Dytiscidae	Oreodytes								3																					38
Arthropoda		Coleoptera	Dytiscidae	Rhantus																													
Arthropoda		Coleoptera	Elmidae	Elmidae																													
Arthropoda		Coleoptera		Elmidae (early instar, pupa or damaged)	19		21				3			17		4	21	14	9										1			749
Arthropoda		Coleoptera	Elmidae	Ampumixis dispar																													
Arthropoda		Coleoptera	Elmidae	Cleptelmis							1							8		2					1		18						83
Arthropoda		Coleoptera	Elmidae	Heterlimnius	106	1					2	24	7	2	4		15	15							3					1			1701
Arthropoda		Coleoptera	Elmidae	Lara avara		1			7	5	5				1				2			5				3			1		10		193
Arthropoda		Coleoptera	Elmidae	Narpus	5							6	3	5	1		3	5							6	23			12				522
Arthropoda		Coleoptera	Elmidae	Optioservus		1	78	1			14	32	17	18	73	21	9	26	82	32	56						7						1641
Arthropoda		Coleoptera	Elmidae	Zaitzevia								1		3			5																131
Arthropoda		Coleoptera	Hydraenidae	Hydraenidae																													
Arthropoda		Coleoptera	Hydraenidae	Hydraena																													2
Arthropoda		Coleoptera	Haliplidae	Haliplidae																													
Arthropoda		Coleoptera	Haliplidae	Haliplidae (early instar, pupa or damaged)																													
Arthropoda		Coleoptera	Haliplidae	Haliplus																													3
Arthropoda		Coleoptera	Haliplidae	Brychius																													11
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae																													
Arthropoda		Coleoptera	Hydrophilidae	Hydrophilidae (early instar, pupa or damaged)																													
Arthropoda		Coleoptera	Hydrophilidae	Anacaena					1																								1
Arthropoda		Coleoptera	Hydrophilidae	Tropisternus																													
Arthropoda		Coleoptera	Hydrophilidae	Laccobius																													
Arthropoda		Coleoptera	Limnichidae	Limnichidae																													
Arthropoda		Coleoptera	Psephenidae	Psephenidae																													
Arthropoda		Coleoptera		Psephenidae (early instar, pupa or damaged)																													
Arthropoda		Coleoptera	Ptilodactylidae	Ptilodactylidae																													
Arthropoda		Diptera	Blephariceridae	Blephariceridae																													
Arthropoda		Diptera	Blephariceridae	Blephariceridae (early instar, pupa or damaged)		1																											1
Arthropoda		Diptera	Blephariceridae	Blepharicera																													
Arthropoda		Diptera	Ceratopogonidae	Ceratopogoninae			11			2	2		6	12	2	1			4			1				3					1		281
Arthropoda		Diptera	Ceratopogonidae	Forcipomyiinae							2																						24
Arthropoda		Diptera	Chironomidae	Chironomidae	15	8	217	5	49	14	10	97	61	117	42	81	96	6	92	44	34	49	38	58	81	53	21	69	19	12	4		11605
Arthropoda		Diptera	Culicidae	Culicidae																													
Arthropoda		Diptera	Dixidae	Dixidae																													
Arthropoda		Diptera	Dixidae	Dixa	4		1				3		2	6							2	2				3		1	1	4			210
Arthropoda		Diptera	Dixidae	Dixella						2																							3
Arthropoda		Diptera	Dixidae	Meringodixa							1																						37
Arthropoda		Diptera	Dolichopodidae	Dolichopodidae																													
Arthropoda		Diptera	Empididae	Empididae																													
Arthropoda		Diptera		Empididae (early instar, pupa or damaged)																													7
Arthropoda		Diptera	Empididae	Chelifera	4							17		8	1	1	5	1	6	3		1	4	2			1						687
Arthropoda		Diptera	Empididae	Clinocera														3															16
Arthropoda		Diptera	Empididae	Hemerodromia								1																					32
Arthropoda		Diptera	Empididae	Oreogeton																													2
Arthropoda		Diptera	Ephydridae	Ephydridae																													
Arthropoda		Diptera		Ephydridae (early instar, pupa or damaged)																													
Arthropoda		Diptera	Muscidae	Muscidae																													
Arthropoda		Diptera	Pelecorhynchidae	Pelecorhynchidae																													
Arthropoda		Diptera	Pelecorhynchidae	Glutops	2								2	1	1											4	1						78
Arthropoda		Diptera	Psychodidae	Psychodidae																													
Arthropoda		Diptera	Psychodidae	Psychodidae (early instar, pupa or damaged)							1																						1
Arthropoda		Diptera	Psychodidae	Maruina											1						2												16
Arthropoda		Diptera	Psychodidae	Pericoma									2	3	2		8	1	1														301
Arthropoda		Diptera	Ptychopteridae	Ptychopteridae																													
Arthropoda		Diptera	Ptychopteridae	Ptychoptera																	5												10
Arthropoda		Diptera	Simuliidae	Simuliidae																													
Arthropoda		Diptera	Simuliidae	Simulium	6	16	1	1	253	24	9	6	77	16	20	3	14	3		16	1	9	346		11	35	239	99	20	3	3	5063
Arthropoda		Diptera	Stratiomyidae	Stratiomyidae																													
Arthropoda		Diptera	Stratiomyidae	Nemotelus																													
Arthropoda		Diptera	Tabanidae	Tabanidae																1													1
Arthropoda		Diptera	Thaumaleidae	Thaumaleidae																													
Arthropoda		Diptera	Thaumaleidae	Thaumalea	2																								1				17
Arthropoda		Diptera	Tipulidae	Tipulidae																													
Arthropoda		Diptera	Tipulidae	Antocha													10	1						7									103
Arthropoda		Diptera	Tipulidae	Dicranota	1		4		1	2		2	2		2	2			7	1			1	17	2	8	7	1	1	1			488
Arthropoda		Diptera	Tipulidae	Hesperoconopa																													3
Arthropoda		Diptera	Tipulidae	Hexatoma																													35
Arthropoda		Diptera	Tipulidae	Limnophila															1							2							21
Arthropoda		Diptera	Tipulidae	Limonia													1											1					11
Arthropoda		Diptera	Tipulidae	Ormosia																							1						1
Arthropoda		Diptera	Tipulidae	Pedicia																													4
Arthropoda		Diptera	Tipulidae	Pilaria																													1
Arthropoda		Diptera	Tipulidae	Rhabdomastix																													2
Arthropoda		Diptera	Tipulidae	Tipula					2							1					1				1			1				1	70
Arthropoda		Diptera	Tipulidae	Molophilus																													1
Arthropoda		Ephemeroptera	Ameletidae	Ameletidae																													
Arthropoda		Ephemeroptera	Ameletidae	Ameletus																													7
Arthropoda		Ephemeroptera	Baetidae	Baetidae																													
Arthropoda		Ephemeroptera	Baetidae	Acentrella								3																					20
Arthropoda		Ephemeroptera	Baetidae	Baetis tricaudatus	73	37		2	90	16	8	55	73	32	103	21	48	50	5		4	9	23	76	14		28	22	82	2	22	6126
Arthropoda		Ephemeroptera	Baetidae	Caenis																													
Arthropoda		Ephemeroptera	Baetidae	Centroptilum																													
Arthropoda		Ephemeroptera	Baetidae	Diphetor hageni	1							15		2	5	3	8		10	3	1												495
Arthropoda		Ephemeroptera	Baetidae	Pseudocloeon																													
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerellidae																													
Arthropoda		Ephemeroptera		Ephemerellidae (early instar, pupa or damaged)																													
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella																													
Arthropoda		Ephemeroptera		Attenella (early instar, pupa or damaged)								6	1	5			3																202
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella delantala																													23
Arthropoda		Ephemeroptera	Ephemerellidae	Attenella margarita																													
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella																													
Arthropoda		Ephemeroptera		Caudatella (early instar, pupa or damaged)																													1
Arthropoda		Ephemeroptera	Ephemerellidae	Caudatella hystrix														17															22
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella																													
Arthropoda		Ephemeroptera		Drunella (early instar, pupa or damaged)																													
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella coloradensis													1																4
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella doddsi														3															235
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella grandis																													2
Arthropoda		Ephemeroptera	Ephemerellidae	Drunella spinifera																													17
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerella																													
Arthropoda		Ephemeroptera		Ephemerella (early instar, pupa or damaged)									1		1									1									49
Arthropoda		Ephemeroptera	Ephemerellidae	Ephemerella inermis																													1
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella teresa																													
Arthropoda		Ephemeroptera	Ephemerellidae	Serratella tibialis								3			1		3							5									161
Arthropoda		Ephemeroptera	Ephemerellidae	Timpanoga hecuba								4																					23

Phylum	Class	Order	Family	Final Identification	9/13/2003	9/13/2003	9/21/2003	9/14/2003	9/14/2003	9/14/2003	9/13/2003	9/12/2003	9/15/2003	9/15/2003	9/12/2003	9/11/2003	9/11/2003	9/29/2003	9/11/2003	9/25/2003	9/25/2003	9/9/2003	9/9/2003	9/9/2003	9/12/2003	9/12/2003	9/8/2003	9/9/2003	9/7/2003	9/9/2003	9/9/2003	9/9/2003	TAXA TOTAL ABUNDANCE
					03SAR0862	03SAR0865 GOLD CREEK	03SAR0946	03SAR0951	03SAR0945	03SAR0945 REPLICATE	03SAR0947	03SOO943	03SOO1820	03SOO1820 REPLICATE	03SOO1822	03SOO1306	03SOO1130	03SOO1134	03SOO1144	03SOO1209	03SOO1283	03WES5622	03WES5629	03WES5903	03WES5905	03WES5936	03WES5937	03WES5178	03WES5140	03WES5450	03WES5579	
Arthropoda		Ephemeroptera	Heptageniidae	Heptageniidae																													
Arthropoda		Ephemeroptera		Heptageniidae (early instar, pupa or damaged)																													14
Arthropoda		Ephemeroptera	Heptageniidae	Cinygma					3	2	1										28					3	15	2					223
Arthropoda		Ephemeroptera	Heptageniidae	Cinygmula	43						1	1																					658
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus																													
Arthropoda		Ephemeroptera		Epeorus (early instar, pupa or damaged)																	17												31
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus albertae																	38												40
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus deceptivus																													4
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus grandis													2																5
Arthropoda		Ephemeroptera	Heptageniidae	Epeorus longimanus	2				1																								22
Arthropoda		Ephemeroptera	Heptageniidae	Nixe								1					1																2
Arthropoda		Ephemeroptera	Heptageniidae	Ironodes	1						1		4																				55
Arthropoda		Ephemeroptera	Heptageniidae	Rhithrogena								13	7	13	4		9	51			1									1			746
Arthropoda		Ephemeroptera	Leptophlebiidae	Leptophlebiidae																													
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia								1	2	1		5		6	22	134						3	15		2				1008
Arthropoda		Ephemeroptera	Leptophlebiidae	Paraleptophlebia bicornuta								2					1																4
Arthropoda		Hemiptera	Corixidae	Corixidae																													
Arthropoda		Hemiptera		Corixidae (early instar, pupa or damaged)																													1
Arthropoda		Hemiptera	Corixidae	Trichorixa																													
Arthropoda		Megaloptera	Sialidae	Sialidae																													
Arthropoda		Megaloptera	Sialidae	Sialis			5																										37
Arthropoda		Odonata	Gomphidae	Gomphidae																													
Arthropoda		Odonata		Gomphidae (early instar, pupa or damaged)																													
Arthropoda		Plecoptera	Capniidae	Capniidae																													
Arthropoda		Plecoptera		Capniidae (early instar, pupa or damaged)																													
Arthropoda		Plecoptera	Chloroperlidae	Chloroperlidae																													
Arthropoda		Plecoptera		Chloroperlidae (early instar, pupa or damaged)								4			13															1		104
Arthropoda		Plecoptera	Chloroperlidae	Suwallia													7																132
Arthropoda		Plecoptera	Chloroperlidae	Kathroperla																													17
Arthropoda		Plecoptera	Chloroperlidae	Paraperla										12																			29
Arthropoda		Plecoptera	Chloroperlidae	Sweltsa	26				20	25		3	27	28	38	2	4	14	56		45			3	6	3	11						2270
Arthropoda		Plecoptera	Leuctridae	Leuctridae																													
Arthropoda		Plecoptera		Leuctridae (early instar, pupa or damaged)																													12
Arthropoda		Plecoptera	Leuctridae	Despaxia augusta	1																									1			51
Arthropoda		Plecoptera	Leuctridae	Moselia infuscata																													18
Arthropoda		Plecoptera	Nemouridae	Nemouridae																													
Arthropoda		Plecoptera		Nemouridae (early instar, pupa or damaged)																													
Arthropoda		Plecoptera	Nemouridae	Malenka		2	1		1			2					1		5			2				2	19						929
Arthropoda		Plecoptera	Nemouridae	Soyedina																													14
Arthropoda		Plecoptera	Nemouridae	Visoka cataractae																													38
Arthropoda		Plecoptera	Nemouridae	Zapada																													
Arthropoda		Plecoptera		Zapada (early instar, pupa or damaged)																													10
Arthropoda		Plecoptera	Nemouridae	Zapada cinctipes	1			1	3			18	45	51	26	82	6	13	23	193	13	2		71	4		32	1	68	29		2884
Arthropoda		Plecoptera	Nemouridae	Zapada columbiana																													
Arthropoda		Plecoptera	Nemouridae	Zapada frigida																													16
Arthropoda		Plecoptera	Nemouridae	Zapada Oregonensis Gr.						2			1	4	2									4									122
Arthropoda		Plecoptera	Peltoperlidae	Peltoperlidae																													
Arthropoda		Plecoptera	Peltoperlidae	Yoraperla																													279
Arthropoda		Plecoptera	Perlidae	Perlidae																													
Arthropoda		Plecoptera		Perlidae (early instar, pupa or damaged)																													3
Arthropoda		Plecoptera	Perlidae	Calineuria californica								2	2	10	10		1	2															210
Arthropoda		Plecoptera	Perlidae	Claassenia sabulosa																													
Arthropoda		Plecoptera	Perlidae	Doroneuria																													171
Arthropoda		Plecoptera	Perlidae	Hesperoperla pacifica	10								1	2	1			1			4												162
Arthropoda		Plecoptera	Perlodidae	Perlodidae																													
Arthropoda		Plecoptera		Perlodidae (early instar, pupa or damaged)	1				2						1			2		1					1								82
Arthropoda		Plecoptera	Perlodidae	Isoperla								4	2	6					2														51
Arthropoda		Plecoptera	Perlodidae	Kogotus																													50
Arthropoda		Plecoptera	Perlodidae	Megarcys																													2
Arthropoda		Plecoptera	Perlodidae	Skwala								7	1	4	10		6		10	1	10			6	43								602
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcyidae																													
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella																													
Arthropoda		Plecoptera		Pteronarcella (early instar, pupa or damaged)																													1
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcella badia																													10
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys																													
Arthropoda		Plecoptera		Pteronarcys (early instar, pupa or damaged)																													
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys californica																													
Arthropoda		Plecoptera	Pteronarcyidae	Pteronarcys princeps																													32
Arthropoda		Trichoptera	Apataniidae	Apataniidae																													
Arthropoda		Trichoptera	Apataniidae	Apatania																													5
Arthropoda		Trichoptera	Apataniidae	Pedomoecus sierra																													
Arthropoda		Trichoptera	Brachycentridae	Brachycentridae																													
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus																													
Arthropoda		Trichoptera		Brachycentrus (early instar, pupa or damaged)																													
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus americanus													36	3															221
Arthropoda		Trichoptera	Brachycentridae	Brachycentrus occidentalis																													7
Arthropoda		Trichoptera	Brachycentridae	Micrasema	1										1		1	14						1									190
Arthropoda		Trichoptera	Calamoceratidae	Calamoceratidae																													
Arthropoda		Trichoptera	Calamoceratidae	Heteroplectron californicum																													5
Arthropoda		Trichoptera	Glossosomatidae	Glossosomatidae																													
Arthropoda		Trichoptera		Glossosomatidae (early instar, pupa or damaged)																													
Arthropoda		Trichoptera	Glossosomatidae	Agapetus																													19
Arthropoda		Trichoptera	Glossosomatidae	Anagapetus																													23
Arthropoda		Trichoptera	Glossosomatidae	Glossosoma		2			26	2		42	15	21	10		98	61		3	2			48	3				1			1907
Arthropoda		Trichoptera	Goeridae	Goeridae																													
Arthropoda		Trichoptera	Goeridae	Goeracea																													6
Arthropoda		Trichoptera	Goeridae	Goera archaion																													
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae																													
Arthropoda		Trichoptera	Hydropsychidae	Hydropsychidae (early instar, pupa or damaged)																													2
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae																													
Arthropoda		Trichoptera	Hydropsychidae	Arctopsychinae (early instar, pupa or damaged)		1																		1			5						10
Arthropoda		Trichoptera	Hydropsychidae	Arctopsyche grandis													7																14
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche																													
Arthropoda		Trichoptera		Parapsyche (early instar, pupa or damaged)																						1							31
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche almota	12	3			48	7																9		1					267
Arthropoda		Trichoptera	Hydropsychidae	Parapsyche elsis																													11
Arthropoda		Trichoptera	Hydropsychidae	Cheumatopsyche												11				2													36
Arthropoda		Trichoptera		Hydroptilidae (early instar, pupa or damaged)																													3
Arthropoda		Trichoptera	Hydroptilidae	Hydroptila													3		1					3									710
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostomatidae																													
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma																													
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (panel case)																													21
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma (turret case)			1									9																	16
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma cascadense					2																								190
Arthropoda		Trichoptera	Lepidostomatidae	Lepidostoma Ptuviale Gr.				2													1					1							125
Arthropoda		Trichoptera	Leptoceridae	Leptoceridae																													
Arthropoda		Trichoptera	Leptoceridae	Ceraclea																													
Arthropoda		Trichoptera	Limnephilidae	Limnephilidae																													
Arthropoda		Trichoptera		Limnephilidae (early instar, pupa or damaged)																													5
Arthropoda		Trichoptera	Limnephilidae	Cryptochia																													

Phylum	Class	Order	Family	Final Identification	8/12/2003	8/12/2003	8/21/2003	8/14/2003	8/14/2003	8/14/2003	8/12/2003	8/12/2003	8/15/2003	8/15/2003	8/12/2003	8/11/2003	8/11/2003	8/11/2003	8/11/2003	2/25/2003	8/9/2003	9/2/2003	9/3/2003	9/3/2003	9/12/2003	9/12/2003	9/9/2003	9/9/2003	9/12/2003	9/8/2003	9/8/2003	9/9/2003	TAXA TOTAL ABUNDANCE
					385AM2862	385AM3865 GOLD CREEK	385AM2846	385AM2951	385AM3045	385AM3045 REPLICATE	385AM2847	395OO0943	395OO0920	395OO0920 REPLICATE	395OO1022	395OO1106	395OO1130	395OO1134	395OO1144	395OO1209	395OO1283	39WS0622	39WS0629	39WS0903	39WS0905	39WS1036	39WS1037	39WS1178	39WS1340	39WS1400	39WS1379	
Arthropoda		Trichoptera	Limnephilidae	Dicosmoecus gilvipes											2																	13
Arthropoda		Trichoptera	Limnephilidae	Ecclisomyia																												11
Arthropoda		Trichoptera	Limnephilidae	Eocosmoecus																												1
Arthropoda		Trichoptera	Limnephilidae	Hydatophylax																												
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus																												5
Arthropoda		Trichoptera	Limnephilidae	Onocosmoecus unicolor																												
Arthropoda		Trichoptera	Limnephilidae	Psychoglypha															1											3		25
Arthropoda		Trichoptera	Limnephilidae	Ecclisocosmoecus																												
Arthropoda		Trichoptera	Philopotamidae	Philopotamidae																												
Arthropoda		Trichoptera		Philopotamidae (early instar, pupa or damaged)																												
Arthropoda		Trichoptera	Philopotamidae	Wormaldia	5						1										1						2					245
Arthropoda		Trichoptera	Polycentropodidae	Polycentropodidae																												
Arthropoda		Trichoptera	Polycentropodidae	Polycentropus																												
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophilidae																												
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila																												
Arthropoda		Trichoptera		Rhyacophila (early instar, pupa or damaged)							1		2		5																	87
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Angelita Gr.																												7
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila arnaudi												1			3													22
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Betteni Gr.					3				2	8	17		1	1	1		4					3	6					232
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila blarina										1	2		2		7	2	2											143
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Brunnea Gr.			1		2		1	1	2	3	8		2	1		1					1		1	2	1			171
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Grandis Gr.																												13
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Hyalinata Gr.																												4
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Iranda Gr.																												
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila malkin								1					1															2
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila narvae	1	1								1	1			13			1											173
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Oreta Gr.	1																											1
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Rotunda Gr.	1																											1
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila Vagrita Gr.																												3
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila valuma	20				1		1																					40
Arthropoda		Trichoptera	Rhyacophilidae	Rhyacophila verrula																												1
Arthropoda		Trichoptera	Sericostomatidae	Gumaga																												3
Arthropoda		Trichoptera	Uenoidae	Uenoidae																												
Arthropoda		Trichoptera	Uenoidae	Uenoidae (early instar, pupa or damaged)																												
Arthropoda		Trichoptera	Uenoidae	Neophylax																												
Arthropoda		Trichoptera	Uenoidae	Neophylax (early instar, pupa or damaged)																												
Arthropoda		Trichoptera	Uenoidae	Neophylax occidentis																												
Arthropoda		Trichoptera	Uenoidae	Neophylax rickeri													3															41
Arthropoda		Trichoptera	Uenoidae	Neophylax splendens	3																											33
Arthropoda		Trichoptera	Uenoidae	Neothremma																												11
Arthropoda		Trichoptera	Uenoidae	Oligophlebodes																												43
Annelida	Hirudinea			Hirudinea																												
Annelida	Hirudinea			Hirudinea (immature or damaged)																												
Annelida	Hirudinea		Erpobdellidae	Erpobdellidae																											2	2
Annelida	Hirudinea		Erpobdellidae	Mooreobdella																												1
Annelida	Hirudinea		Erpobdellidae	Erpobdella												1																1
Annelida	Hirudinea		Glossiphoniidae	Glossiphoniidae																												
Annelida	Hirudinea		Glossiphoniidae	Helobdella																												
Annelida	Hirudinea		Glossiphoniidae	Helobdella stagnalis	2	7					2								1													36
Annelida	Hirudinea		Glossiphoniidae	Glossiphonia complanata		2																										2
Annelida	Hirudinea		Piscicolidae	Piscicola salmositica																												2
Annelida	Hirudinea		Piscicolidae	Myzobdella																												1
Annelida	Oligochaeta			Oligochaeta	42	40	99	65	5		82	127	84	19	12		10	8	35	13	29	16	9	141		28	136	178	38	119	84	6408
Arthropoda	Arachnida	Acariformes		Acari	6		2	2	4		3	8	4	5	8		14	8	8	20	21		1	9	5	4	4					1558
Arthropoda	Branchiopoda	Cladocera		Cladocera																												4
Arthropoda	Crustacea	Amphipoda	Crangonyctidae	Crangonyx		3	13				15						3	1	32	54	4	3	76	17	37		4	111	17	33	6	2105
Arthropoda	Crustacea	Copepoda		Copepoda																												
Arthropoda	Crustacea	Decapoda		Pacifastacus												1					3											12
Arthropoda	Crustacea	Isopoda	Asellidae	Caecidotea		1	35					6																		1		178
Arthropoda	Crustacea	Ostracoda		Ostracoda					5		1										1											34
Mollusca	Gastropoda		Ancylidae	Ferrissia							1					14																45
Mollusca	Gastropoda		Lymnaeidae	Fossaria																												5
Mollusca	Gastropoda		Lymnaeidae	Stagnicola																												2
Mollusca	Gastropoda		Planorbidae	Planorbidae																												1
Mollusca	Gastropoda		Planorbidae	Gyraulus				1								38			1							8	3			1		321
Mollusca	Gastropoda		Planorbidae	Helisoma							46																					119
Mollusca	Gastropoda		Pleuroceridae	Juga														89			50											460
Mollusca	Gastropoda		Physidae	Physidae							1	1				63			4			1								1		145
Mollusca	Gastropoda		Physidae	Physa																												
Mollusca	Gastropoda		Pisidiidae	Pisidiidae	1		1	4	3	1	26	5			1	49			62	6	1	52	2	3		32	5	1			2	967
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Hydrobiidae																												2
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Pristinicola																												73
Mollusca	Gastropoda	Mesogastropoda	Hydrobiidae	Potamopyrgus antipodarum																												
Mollusca	Pelecypoda		Margaritiferidae	Margaritifera falcata															4													6
Nematoda				Nematoda		5	10	10	8	1	2		9	7	6		2	5	20	5	6	10	6	16	3	9		7	1	2	8	1135
Nemertea				Prostoma																												
Platyhelminthes				Turbellaria	1			1	2	1	2			5	1		1			2					9	3		68		4	63	380
Porifera		Hydra		Hydra																												8
Porifera		Hydra	Hydridae	Hydrozoa																												
				SITE TOTAL ABUNDANCE	438	133	500	95	542	106	251	527	553	509	563	414	567	504	517	539	409	158	506	522	247	221	583	577	300	230	195	64766