Analysis of biological samples:
Technical summary of methods and quality assurance procedures
Prepared for Shannon & Wilson, Inc.
Dave Cline, Project Manager
February 6, 2018

by
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METHODS

Sample processing

Seven macroinvertebrate and 7 periphyton samples collected for the Willow Creek Daylight Project (SW project 21-1-12588) were delivered to Rhithron's laboratory facility in Missoula, Montana on October 9, 2017. All samples arrived in good condition. A chain of custody document containing sample identification information was provided by the Shannon & Wilson (SW) Project Manager. Upon arrival, samples were unpacked and examined, and checked against the SW chain of custody. An inventory spreadsheet was created and uploaded into the Rhithron database prior to sample processing.

Macroinvertebrates

Standard sorting protocols (Plotnikoff and Wiseman 2001) were applied in an attempt to achieve representative subsamples of a minimum of 500 organisms. Caton sub-sampling devices (Caton 1991), divided into 30 grids, each approximately 6 cm by 6 cm were used. Each individual sample was thoroughly mixed in its jar(s), poured out and evenly spread into the Caton tray, and individual grids were randomly selected. The contents of each grid were examined under stereoscopic microscopes using 10x-30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in 80% ethanol for subsequent identification. Grid selection, examination, and sorting continued until at least 500 organisms were sorted or until the entire sample was processed. The final grid was completely sorted of all organisms, and the number of grids sorted was recorded.

After the target number of organisms was obtained in the subsample, an intensive search for New Zealand mudsnails was performed. No specimens of New Zealand mudsnails were found in any sample. All unsorted sample fractions were re-preserved and archived at the Rhithron laboratory.

Organisms were individually examined by certified taxonomists, using 10x – 80x stereoscopic dissecting scopes (Leica S8E) and identified to target taxonomic levels consistent with B-IBI for Puget Sound Lowlands streams protocols (Karr and Chu 1999), using appropriate published taxonomic references and keys.

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

Identification, counts, life stages, and information about the condition of specimens were recorded on electronic bench sheets. Organisms that could not be identified to the taxonomic targets because of immaturity, poor condition, or lack of complete current regionally-applicable published keys were left at appropriate taxonomic levels that were coarser than those specified. To obtain accuracy in richness measures, these organisms were designated as "not unique" if other specimens from the same group could be taken to target levels. Organisms designated as "unique" were those that could be definitively distinguished from other organisms in the sample.

Identified organisms were preserved in 80% ethanol in labeled vials, and archived at the Rhithron laboratory.

Periphyton

The periphyton samples were preserved with Lugol's solution, and initial sample volumes were measured and recorded. The samples were thoroughly mixed by shaking, and split into 2 aliquots for diatom and soft-bodied algae analyses.

Permanent diatom slides were prepared: subsamples were taken and treated with 70% Nitric acid (HNO_3) and digested using a closed-vessel microwave digestion system (Milestone Ethos EZ), following the method developed by the Academy of Natural Sciences, Philadelphia (ANSP 2002). The samples were neutralized by rinses with distilled water, and subsample volumes were adjusted to obtain adequate densities for slide mounts. Dilution and concentration factors, as appropriate, were recorded for each sample. Subsamples were dried onto 22-mm square coverslips. Coverslips were mounted on slides using Naphrax diatom mount. To ensure a high quality mount for identification and to make replicates available for archives, 2 slide mounts were made from each sample. One of the replicates was selected from each sample batch for identification. A diamond scribe mark was made to define a transect line on the cover slip, and a minimum of 600 diatom valves were identified along the transect mark. A Leica DM 2500 compound microscope, Nomarski contrast, and 1000x magnification were used for identifications. Diatoms were identified to the lowest possible taxonomic level, generally species, following standard taxonomic references.

For soft-bodied algae samples, the raw periphyton sample was manually homogenized and emptied into a porcelain evaporating dish. A small, random sub-sample of algal material was pipetted into a standard Palmer-Maloney counting chamber using a disposable Pasteur pipette. Visible (macroscopic) algae were also sub-sampled, in proportion to their estimated abundance relative to the total volume of algal material in the sample, and added to the liquid fraction on the slide. The Palmer-Maloney cell was then covered with a 22 x 30 mm coverslip.

Soft-bodied algae were identified to genus using a Leica DM 2500 compound microscope under 200X and 400X magnification, following standard taxonomic references. Three hundred cells or natural units of algae were identified, when possible. Living diatom cells were included in these counts. (Including these cells will allow for the calculation of diatom species abundance.)

Quality control procedures

Quality control procedures for initial sample processing and subsampling involved checking sorting efficiency. These checks were conducted on a random selection of 10% of the samples by independent observers who microscopically re-examined 100% of sorted substrate from each sample. Quality control procedures for each sample proceeded as follows:

The quality control technician poured the sorted substrate from a processed sample out into a Caton tray, redistributing the substrate so that it could be accurately lifted out by removing entire grids in a random fashion. Grids were selected, and re-examined until all of the substrate was re-sorted. All organisms that were missed were counted and this number was added to the total number obtained in the original sort. Sorting efficiency was evaluated by applying the following calculation:

$$SE = \frac{n_1}{n_1 + n_2} \times 100$$

where: SE is the sorting efficiency, expressed as a percentage, n_1 is the total number of specimens in the first sort, and n_2 is the total number of specimens in the second sort.

Quality control procedures for taxonomic determinations of invertebrates involved checking accuracy, precision and enumeration. One sample was randomly selected and all organisms re-identified and counted by an independent taxonomist. Taxa lists and enumerations were compared by calculating a Bray-Curtis similarity statistic (Bray and Curtis 1957), Percent Taxonomic Disagreement (PTD) and Percent Difference in Enumeration (PDE). Routinely,

discrepancies between the original identifications and the QC identifications are discussed among the taxonomists, and necessary rectifications to the data are made. Discrepancies that cannot be rectified by discussions are routinely sent out to taxonomic specialists for identification.

Data analysis

Taxa and counts for each sample were entered into Rhithron's customized laboratory information management system (LIMS). Standard metric calculations for aquatic invertebrate and periphyton assemblages were made using Rhithron's customized LIMS. Metric calculations and scoring for the B-IBI for Puget Sound Lowlands streams (Karr and Chu 1999) were also performed for the invertebrate samples. A sites-by-taxa and sites-by-metrics data matrix was compiled in Microsoft Excel. Diatom and non-diatom algae identifications were also compiled in Microsoft Excel.

RESULTS

Quality Control Procedures

Results of quality control procedures for subsampling and taxonomy are given in Table 1. Sorting efficiency was 97.40% for the randomly selected sort QC sample. Taxonomic precision for identification and enumeration measured by the Bray-Curtis index was 99.44%, PTD was 1.10% and PDE was 0.56% for the randomly selected taxonomy QC sample, and data entry efficiency averaged 100% for the project. These similarity statistics fall within acceptable industry criteria (Stribling et al. 2003).

Data analysis

Taxa lists and counts, and values and scores for various standard bioassessment metrics and indices calculated by Rhithron are given in the Appendix.

Electronic spreadsheets were provided to the SW Project Manager via e-mail.

REFERENCES

ANSP. 2002. Protocols for the analysis of algal samples collected as part of the U.S. Geological Survey National Water-Quality Assessment Program. The Academy of Natural Sciences Patrick Center for Environmental Research: Report No. 02-06. May 2002.

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

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

Karr, J. R. and E. W. Chu. 1999. *Restoring Life in Running Waters*. Island Press.

Plotnikoff, R. and C. Wiseman. 2001. Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams: 2001 Revision. Washington Department of Ecology. Olympia.

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

Table 1. *Results of quality control procedures for invertebrate subsampling and taxonomy.* Willow Creek Daylight Project 2017.

RAI Sample ID	Station Name	Station ID	Sorting efficiency	Bray-Curtis similarity for taxonomy and enumeration	Percent Taxonomic Disagreement (PTD)	Percent Difference in Enumeration (PDE)
SW17CHM001	Puget Sound	WC-01	97.40%			
SW17CHM002	Lower Willow Creek	WC-02				
SW17CHM003	Willow Creek Marsh	WC-03		99.44%	1.10%	0.56%
SW17CHM004	Willow Creek Marsh	WC-04				
SW17CHM005	Willow Creek Marsh	WC-05				
SW17CHM006	Upper Willow Creek	WC-06				
SW17CHM007	Upper Shellebarger Creek	WC-07				

APPENDIX

Invertebrate taxa lists and metric summaries
Periphyton taxa lists and metric summaries

Willow Creek Daylight Project

2017

Taxa Listing

Project ID:	**SW17CHM**
RAI No.:	**SW17CHM001**

RAI No.:	SW17CHM001		Sta. Name:	Puget Sound
Client ID:	WC-01			
Date Coll.:	9/20/2017	No. Jars: 2	STORET ID:	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Nemata							
Nemata	17	7.56%	Yes	Unknown		5	UN
Oligochaeta							
Oligochaeta	1	0.44%	Yes	Unknown		10	CG
Polychaeta							
Polychaeta	2	0.89%	Yes	Unknown	Damaged	11	UN
Bivalvia							
Bivalvia	64	28.44%	Yes	Immature		11	CF
Cardiidae							
Cardiidae	2	0.89%	Yes	Unknown		11	UN
Veneridae							
Veneridae	33	14.67%	Yes	Unknown		11	UN
Gastropoda							
Gastropoda	3	1.33%	Yes	Immature		7	SC
Amphipoda							
Amphipoda	12	5.33%	Yes	Unknown	Damaged	4	CG
Anisogammaridae							
Anisogammarus sp.	4	1.78%	Yes	Unknown		11	UN
Corophiidae							
Monocorophium sp.	6	2.67%	Yes	Unknown		11	UN
Caprellidae							
Caprella sp.	6	2.67%	Yes	Unknown		11	UN
Pleustidae							
Pleustidae	14	6.22%	Yes	Unknown	Damaged	11	UN
Phoxocephalidae							
Phoxocephalidae	28	12.44%	Yes	Unknown	Damaged	11	UN
Decapoda							
Decapoda	3	1.33%	Yes	Unknown	Damaged	6	SH
Isopoda							
Isopoda	5	2.22%	Yes	Unknown	Damaged	8	CG
Sphaeromatidae							
Gnorimosphaeroma sp.	4	1.78%	Yes	Unknown		11	UN
Cumacea							
Cumacea	12	5.33%	Yes	Unknown		11	UN
Leptocheliidae							
Leptochelia sp.	2	0.89%	Yes	Unknown		11	UN
Copepoda							
Copepoda	5	2.22%	Yes	Unknown		8	CG
Ostracoda							
Ostracoda	2	0.89%	Yes	Unknown		8	CG
Sample Count	**225**						

Taxa Listing

RAI No.:	SW17CHM002		Sta. Name:	Lower Willow Creek
Client ID:	WC-02			
Date Coll.:	9/20/2017	No. Jars: 2	STORET ID:	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Oligochaeta							
Oligochaeta							
Oligochaeta	18	2.92%	Yes	Unknown		10	CG
Anisogammaridae							
Eogammarus sp.	82	13.31%	Yes	Unknown		11	UN
Decapoda							
Decapoda	3	0.49%	Yes	Unknown	Damaged	6	SH
Sphaeromatidae							
Gnorimosphaeroma sp.	2	0.32%	Yes	Unknown		11	UN
Copepoda							
Copepoda	4	0.65%	Yes	Unknown		8	CG
Ostracoda							
Ostracoda	501	81.33%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Dasyhelea sp.	3	0.49%	Yes	Larva		11	CG
Chironomidae							
Chironominae							
Chironomus sp.	3	0.49%	Yes	Larva		10	CG
Sample Count	**616**						

RAI No.:	SW17CHM003	**Sta. Name:**	Willow Creek Marsh
Client ID:	WC-03		
Date Coll.:	9/20/2017	**No. Jars:** 2	**STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Oligochaeta							
Oligochaeta							
Oligochaeta	8	4.28%	Yes	Unknown		10	CG
Physidae							
Physidae	19	10.16%	Yes	Unknown		8	SC
Planorbidae							
Planorbidae	1	0.53%	Yes	Unknown	Damaged	6	SC
Diplostraca							
Cladocera	3	1.60%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	47	25.13%	Yes	Unknown		6	CG
Copepoda							
Copepoda	21	11.23%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	3	1.60%	Yes	Larva		6	PR
Culicidae							
Culicidae	71	37.97%	Yes	Larva	Damaged	10	CG
Dixidae							
Dixella sp.	3	1.60%	Yes	Larva		4	CG
Chironomidae							
Chironominae							
Chironomus sp.	9	4.81%	Yes	Larva		10	CG
Polypedilum sp.	1	0.53%	Yes	Larva		6	SH
Tanypodinae							
Procladius sp.	1	0.53%	Yes	Larva		9	PR

Sample Count 187

Taxa Listing

RAI No.:	SW17CHM004		**Sta. Name:**	Willow Creek Marsh
Client ID:	WC-04			
Date Coll.:	9/20/2017	**No. Jars:** 2	**STORET ID:**	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Asellidae							
Caecidotea sp.	1	50.00%	Yes	Unknown		8	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	1	50.00%	Yes	Larva		6	PR
Sample Count	**2**						

Taxa Listing

RAI No.:	SW17CHM005		Sta. Name:	Willow Creek Marsh
Client ID:	WC-05			
Date Coll.:	9/20/2017	No. Jars: 2	STORET ID:	

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Erpobdellidae							
Erpobdellidae	10	32.26%	Yes	Unknown		8	PR
Oligochaeta							
Oligochaeta	1	3.23%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	8	25.81%	Yes	Unknown		8	CF
Plecoptera							
Nemouridae							
Malenka sp.	1	3.23%	Yes	Larva		1	SH
Chironomidae							
Chironominae							
Polypedilum sp.	6	19.35%	Yes	Larva		6	SH
Chironominae							
Rheotanytarsus sp.	1	3.23%	Yes	Larva		6	CF
Orthocladiinae							
Parametriocnemus sp.	1	3.23%	Yes	Larva		5	CG
Prodiamesinae							
Prodiamesa sp.	3	9.68%	Yes	Larva		3	CG
Sample Count	**31**						

Taxa Listing

RAI No.:	SW17CHM006	Sta. Name:	Upper Willow Creek
Client ID:	WC-06		
Date Coll.:	9/20/2017	No. Jars: 2	STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Trepaxonemata							
Trepaxonemata	7	1.30%	Yes	Unknown		4	PR
Nemata							
Nemata	5	0.93%	Yes	Unknown		5	UN
Oligochaeta							
Oligochaeta	70	13.01%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	5	0.93%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	203	37.73%	Yes	Unknown		6	CG
Acari							
Acari	1	0.19%	Yes	Unknown		5	PR
Ephemeroptera							
Baetidae							
Baetis tricaudatus complex	69	12.83%	Yes	Larva		5	CG
Heptageniidae							
Cinygma sp.	6	1.12%	Yes	Larva		0	SC
Plecoptera							
Chloroperlidae							
Sweltsa sp.	4	0.74%	Yes	Larva		0	PR
Nemouridae							
Malenka sp.	51	9.48%	Yes	Larva		1	SH
Zapada cinctipes	2	0.37%	Yes	Larva		3	SH
Trichoptera							
Hydropsychidae							
Parapsyche sp.	4	0.74%	Yes	Larva		0	PR
Diptera							
Dixidae							
Dixa sp.	4	0.74%	Yes	Larva		1	CG
Psychodidae							
Psychodidae	2	0.37%	Yes	Larva	Early Instar	4	CG
Simuliidae							
Simulium sp.	86	15.99%	Yes	Larva		6	CF
Simulium sp.	2	0.37%	No	Pupa		6	CF
Tipulidae							
Dicranota sp.	1	0.19%	Yes	Larva		3	PR
Chironomidae							
Chironominae							
Micropsectra sp.	2	0.37%	Yes	Larva		4	CG
Orthocladiinae							
Brillia sp.	10	1.86%	Yes	Larva		4	SH
Parametriocnemus sp.	3	0.56%	Yes	Larva		5	CG
Tvetenia Bavarica Gr.	1	0.19%	Yes	Larva		5	CG

Sample Count   538

Taxa Listing

RAI No.: SW17CHM007	**Sta. Name:**	Upper Shellebarger Creek
Client ID: WC-07		
Date Coll.: 9/20/2017	**No. Jars:** 2	**STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Trepaxonemata							
Trepaxonemata	21	5.24%	Yes	Unknown		4	PR
Nemata							
Nemata	1	0.25%	Yes	Unknown		5	UN
Erpobdellidae							
Erpobdellidae	1	0.25%	Yes	Unknown		8	PR
Oligochaeta							
Oligochaeta	11	2.74%	Yes	Unknown		10	CG
Sphaeriidae							
Sphaeriidae	3	0.75%	Yes	Unknown		8	CF
Crangonyctidae							
Crangonyx sp.	44	10.97%	Yes	Unknown		6	CG
Acari							
Acari	2	0.50%	Yes	Unknown		5	PR
Ephemeroptera							
Baetidae							
Baetis tricaudatus complex	44	10.97%	Yes	Larva		5	CG
Leptohyphidae							
Tricorythodes sp.	1	0.25%	Yes	Larva		4	CG
Plecoptera							
Nemouridae							
Malenka sp.	29	7.23%	Yes	Larva		1	SH
Trichoptera							
Hydropsychidae							
Parapsyche sp.	1	0.25%	Yes	Larva		0	PR
Diptera							
Psychodidae							
Psychodidae	1	0.25%	Yes	Larva	Damaged	4	CG
Simuliidae							
Simulium sp.	19	4.74%	No	Pupa		6	CF
Simulium sp.	221	55.11%	Yes	Larva		6	CF
Chironomidae							
Orthocladiinae							
Eukiefferiella Claripennis Gr.	1	0.25%	Yes	Larva		8	CG
Tvetenia Bavarica Gr.	1	0.25%	Yes	Larva		5	CG
Sample Count	**401**						

Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM001
Sta. Name: Puget Sound
Client ID: WC-01
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 225
Sample Abundance: 225.00   100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 10cm 0% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	19	224	99.56%
Oligochaeta	1	1	0.44%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera			
Chironomidae			

Legend:
- Terrestrial
- Other Non-Insect
- Oligochaeta
- Odonata
- Ephemeroptera
- Plecoptera
- Heteroptera
- Megaloptera
- Neuroptera
- Trichoptera
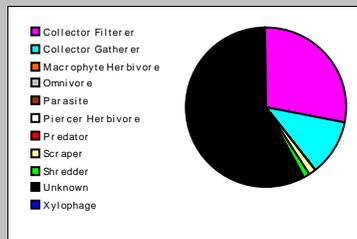- Lepidoptera
- Coleoptera
- Diptera
- Chironomidae
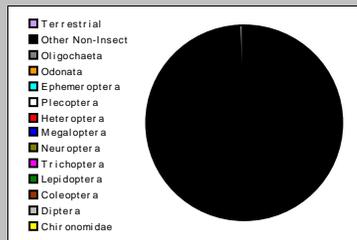
Dominant Taxa

Category	A	PRA
Bivalvia	64	28.44%
Veneridae	33	14.67%
Phoxocephalidae	28	12.44%
Nemata	17	7.56%
Pleustidae	14	6.22%
Cumacea	12	5.33%
Amphipoda	12	5.33%
Monocorophium	6	2.67%
Caprella	6	2.67%
Isopoda	5	2.22%
Copepoda	5	2.22%
Gnorimosphaeroma	4	1.78%
Anisogammarus	4	1.78%
Gastropoda	3	1.33%
Decapoda	3	1.33%

Functional Composition

Category	R	A	PRA
Predator			
Parasite			
Collector Gatherer	5	25	11.11%
Collector Filterer	1	64	28.44%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	3	1.33%
Shredder	1	3	1.33%
Omnivore			
Unknown	12	130	57.78%

Legend:
- Collector Filterer
- Collector Gatherer
- Macrophyte Herbivore
- Omnivore
- Parasite
- Piercer Herbivore
- Predator
- Scraper
- Shredder
- Unknown
- Xylophage

Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	20
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	225
All Non-Insect Richness	20
All Non-Insect Percent	100.00%
Oligochaeta+Hirudinea Percent	0.44%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	28.44%
Dominant Taxa (2) Percent	43.11%
Dominant Taxa (3) Percent	55.56%
Dominant Taxa (10) Percent	87.56%
Diversity	
Shannon H (loge)	2.392
Shannon H (log2)	3.451
Margalef D	3.508
Simpson D	0.133
Evenness	0.077
Function	
Predator Richness	0
Predator Percent	0.00%
Filterer Richness	1
Filterer Percent	28.44%
Collector Percent	39.56%
Scraper+Shredder Percent	2.67%
Scraper/Filterer	0.047
Scraper/Scraper+Filterer	0.045
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	4
Semivoltine Richness	1
Multivoltine Percent	3.11%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	0.44%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.700
Pollution Sensitive Richness	0
Pollution Tolerant Percent	2.22%
Hilsenhoff Biotic Index	5.792
Intolerant Percent	0.00%
Supertolerant Percent	5.78%
CTQa	108.000

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	16	53.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	6	28.57%	Moderate
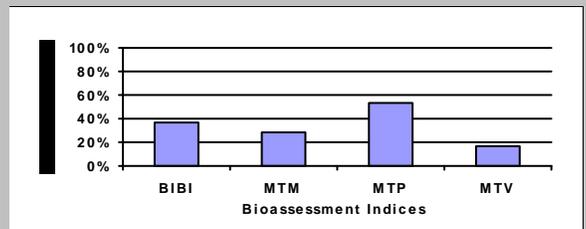
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM002
Sta. Name: Lower Willow Creek
Client ID: WC-02
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 616
Sample Abundance: 616.00   100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 15cm 0% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	592	96.10%
Oligochaeta	1	18	2.92%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	1	3	0.49%
Chironomidae	1	3	0.49%

Legend:
- Terrestrial
- Other Non-Insect
- Oligochaeta
- Odonata
- Ephemeroptera
- Plecoptera
- Heteroptera
- Megaloptera
- Neuroptera
- Trichoptera
- Lepidoptera
- Coleoptera
- Diptera
- Chironomidae
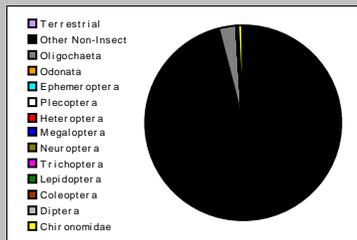
Dominant Taxa

Category	A	PRA
Ostracoda	501	81.33%
Eogammarus	82	13.31%
Oligochaeta	18	2.92%
Copepoda	4	0.65%
Decapoda	3	0.49%
Dasyhelea	3	0.49%
Chironomus	3	0.49%
Gnorimosphaeroma	2	0.32%

Functional Composition

Category	R	A	PRA
Predator			
Parasite			
Collector Gatherer	5	529	85.88%
Collector Filterer			
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	1	3	0.49%
Omnivore			
Unknown	2	84	13.64%

Legend:
- Collector Filterer
- Collector Gatherer
- Macrophyte Herbivore
- Omnivore
- Parasite
- Piercer Herbivore
- Predator
- Scraper
- Shredder
- Unknown
- Xylophage

Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	8
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	610
All Non-Insect Richness	6
All Non-Insect Percent	99.03%
Oligochaeta+Hirudinea Percent	2.92%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	81.33%
Dominant Taxa (2) Percent	94.64%
Dominant Taxa (3) Percent	97.57%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	0.669
Shannon H (log2)	0.965
Margalef D	1.090
Simpson D	0.680
Evenness	0.085
Function	
Predator Richness	0
Predator Percent	0.00%
Filterer Richness	0
Filterer Percent	0.00%
Collector Percent	85.88%
Scraper+Shredder Percent	0.49%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	1
Burrower Percent	0.49%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	0.49%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	2
Semivoltine Richness	1
Multivoltine Percent	82.47%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	2.92%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.500
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.49%
Hilsenhoff Biotic Index	8.068
Intolerant Percent	0.00%
Supertolerant Percent	85.39%
CTQa	108.000

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	1	3.33%	Severe
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	6	33.33%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe

Tuesday, February 06, 2018
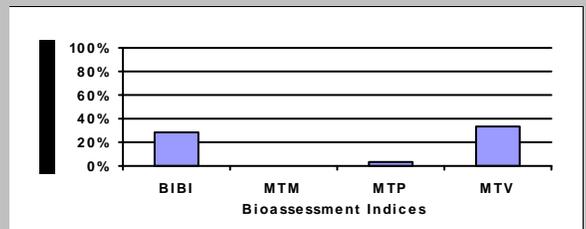
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM003
Sta. Name: Willow Creek Marsh
Client ID: WC-03
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 187
Sample Abundance: 187.00   100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 8cm 100% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	91	48.66%
Oligochaeta	1	8	4.28%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	3	77	41.18%
Chironomidae	3	11	5.88%

Pie chart legend: Terrestrial, Other Non-Insect, Oligochaeta, Odonata, Ephemeroptera, Plecoptera, Heteroptera, Megaloptera, Neuroptera, Trichoptera, Lepidoptera, Coleoptera, Diptera, Chironomidae
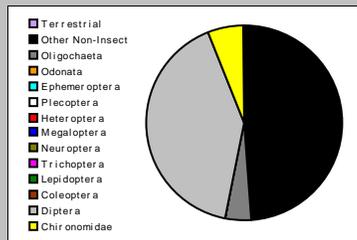
Dominant Taxa

Category	A	PRA
Culicidae	71	37.97%
Crangonyx	47	25.13%
Copepoda	21	11.23%
Physidae	19	10.16%
Chironomus	9	4.81%
Oligochaeta	8	4.28%
Dixella	3	1.60%
Cladocera	3	1.60%
Ceratopogoninae	3	1.60%
Procladius	1	0.53%
Polypedilum	1	0.53%
Planorbidae	1	0.53%

Functional Composition

Category	R	A	PRA
Predator	2	4	2.14%
Parasite			
Collector Gatherer	6	159	85.03%
Collector Filterer	1	3	1.60%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	20	10.70%
Shredder	1	1	0.53%
Omnivore			
Unknown			

Pie chart legend: Collector Filterer, Collector Gatherer, Macrophyte Herbivore, Omnivore, Parasite, Piercer Herbivore, Predator, Scraper, Shredder, Unknown, Xylophage

Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	12
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	99
All Non-Insect Richness	6
All Non-Insect Percent	52.94%
Oligochaeta+Hirudinea Percent	4.28%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	37.97%
Dominant Taxa (2) Percent	63.10%
Dominant Taxa (3) Percent	74.33%
Dominant Taxa (10) Percent	98.93%
Diversity	
Shannon H (loge)	1.756
Shannon H (log2)	2.534
Margalef D	2.103
Simpson D	0.231
Evenness	0.118
Function	
Predator Richness	2
Predator Percent	2.14%
Filterer Richness	1
Filterer Percent	1.60%
Collector Percent	86.63%
Scraper+Shredder Percent	11.23%
Scraper/Filterer	6.667
Scraper/Scraper+Filterer	0.870
Habit	
Burrower Richness	1
Burrower Percent	4.81%
Swimmer Richness	2
Swimmer Percent	39.57%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	4
Hemoglobin Bearer Percent	6.42%
Air Breather Richness	1
Air Breather Percent	37.97%
Voltinism	
Univoltine Richness	7
Semivoltine Richness	0
Multivoltine Percent	18.72%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	4.81%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.441
Pollution Sensitive Richness	0
Pollution Tolerant Percent	54.01%
Hilsenhoff Biotic Index	8.326
Intolerant Percent	0.00%
Supertolerant Percent	70.59%
CTQa	108.000

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	12	24.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	10	33.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	1	4.76%	Severe

Bar chart: Bioassessment Indices — BIBI, MTM, MTP, MTV

Tuesday, February 06, 2018
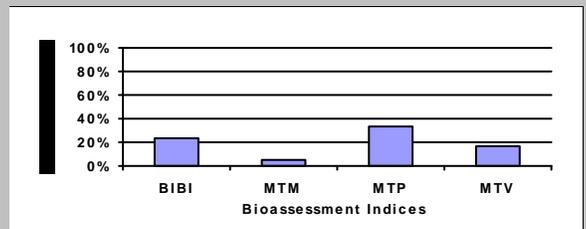
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM004
Sta. Name: Willow Creek Marsh
Client ID: WC-04
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 2
Sample Abundance: 2.00   100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 30cm 20% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	1	1	50.00%
Oligochaeta			
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera	1	1	50.00%
Chironomidae			
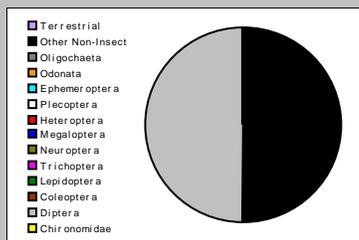
Dominant Taxa

Category	A	PRA
Ceratopogoninae	1	50.00%
Caecidotea	1	50.00%

Functional Composition

Category	R	A	PRA
Predator	1	1	50.00%
Parasite			
Collector Gatherer	1	1	50.00%
Collector Filterer			
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder			
Omnivore			
Unknown			
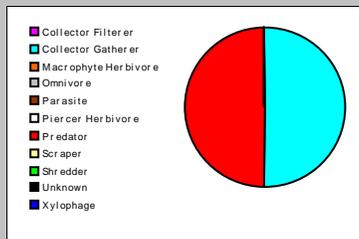
Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	2
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	1
All Non-Insect Richness	1
All Non-Insect Percent	50.00%
Oligochaeta+Hirudinea Percent	0.00%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	50.00%
Dominant Taxa (2) Percent	100.00%
Dominant Taxa (3) Percent	100.00%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	0.693
Shannon H (log2)	1.000
Margalef D	1.443
Simpson D	0.000
Evenness	0.500
Function	
Predator Richness	1
Predator Percent	50.00%
Filterer Richness	0
Filterer Percent	0.00%
Collector Percent	50.00%
Scraper+Shredder Percent	0.00%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	0
Clinger Percent	0.00%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	1
Semivoltine Richness	0
Multivoltine Percent	0.00%
Tolerance	
Sediment Tolerant Richness	0
Sediment Tolerant Percent	0.00%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.500
Pollution Sensitive Richness	0
Pollution Tolerant Percent	50.00%
Hilsenhoff Biotic Index	7.000
Intolerant Percent	0.00%
Supertolerant Percent	50.00%
CTQa	108.000

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	16	32.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	8	26.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	3	16.67%	Severe
MTM	Montana DEQ Mountains (Bukantis 1998)	3	14.29%	Severe

Tuesday, February 06, 2018
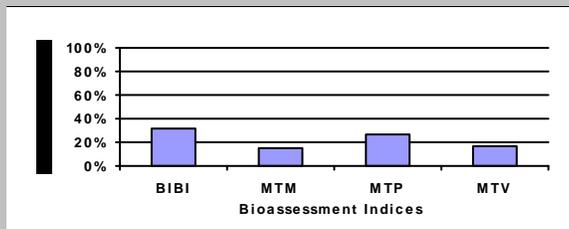
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM005
Sta. Name: Willow Creek Marsh
Client ID: WC-05
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count:	31	
Sample Abundance:	31.00	100.00% of sample used
Coll. Procedure:		
Sample Notes:	depth of 14cm 65% riparian cover	

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	2	18	58.06%
Oligochaeta	1	1	3.23%
Odonata			
Ephemeroptera			
Plecoptera	1	1	3.23%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera			
Diptera			
Chironomidae	4	11	35.48%
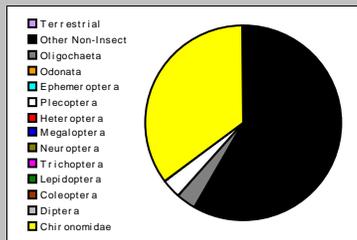
Dominant Taxa

Category	A	PRA
Erpobdellidae	10	32.26%
Sphaeriidae	8	25.81%
Polypedilum	6	19.35%
Prodiamesa	3	9.68%
Rheotanytarsus	1	3.23%
Parametriocnemus	1	3.23%
Oligochaeta	1	3.23%
Malenka	1	3.23%

Functional Composition

Category	R	A	PRA
Predator	1	10	32.26%
Parasite			
Collector Gatherer	3	5	16.13%
Collector Filterer	2	9	29.03%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	2	7	22.58%
Omnivore			
Unknown			
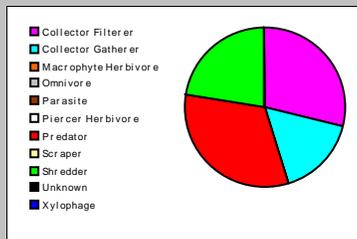
Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	8
E Richness	0
P Richness	1
T Richness	0
EPT Richness	1
EPT Percent	3.23%
All Non-Insect Abundance	19
All Non-Insect Richness	3
All Non-Insect Percent	61.29%
Oligochaeta+Hirudinea Percent	35.48%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	32.26%
Dominant Taxa (2) Percent	58.06%
Dominant Taxa (3) Percent	77.42%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	1.701
Shannon H (log2)	2.455
Margalef D	2.038
Simpson D	0.196
Evenness	0.147
Function	
Predator Richness	1
Predator Percent	32.26%
Filterer Richness	2
Filterer Percent	29.03%
Collector Percent	45.16%
Scraper+Shredder Percent	22.58%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	2
Clinger Percent	6.45%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	19.35%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	3
Semivoltine Richness	0
Multivoltine Percent	35.48%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	3.23%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.433
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.00%
Hilsenhoff Biotic Index	6.806
Intolerant Percent	3.23%
Supertolerant Percent	61.29%
CTQa	97.714

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	13	43.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	4	22.22%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	5	23.81%	Moderate

Tuesday, February 06, 2018
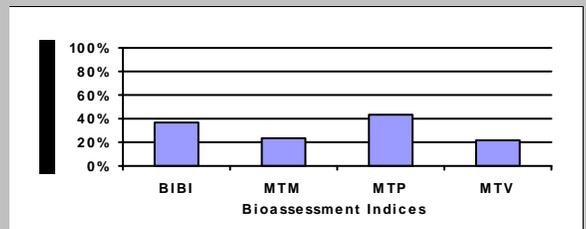
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM006
Sta. Name: Upper Willow Creek
Client ID: WC-06
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 538
Sample Abundance: 896.67   60.00% of sample used
Coll. Procedure:
Sample Notes: depth of 14cm 90% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	221	41.08%
Oligochaeta	1	70	13.01%
Odonata			
Ephemeroptera	2	75	13.94%
Plecoptera	3	57	10.59%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	1	4	0.74%
Lepidoptera			
Coleoptera			
Diptera	4	95	17.66%
Chironomidae	4	16	2.97%

Legend: Terrestrial, Other Non-Insect, Oligochaeta, Odonata, Ephemeroptera, Plecoptera, Heteroptera, Megaloptera, Neuroptera, Trichoptera, Lepidoptera, Coleoptera, Diptera, Chironomidae
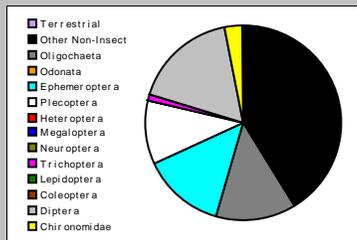
Dominant Taxa

Category	A	PRA
Crangonyx	203	37.73%
Simulium	88	16.36%
Oligochaeta	70	13.01%
Baetis tricaudatus complex	69	12.83%
Malenka	51	9.48%
Brillia	10	1.86%
Trepaxonemata	7	1.30%
Cinygma	6	1.12%
Sphaeriidae	5	0.93%
Nemata	5	0.93%
Sweltsa	4	0.74%
Parapsyche	4	0.74%
Dixa	4	0.74%
Parametriocnemus	3	0.56%
Zapada cinctipes	2	0.37%

Functional Composition

Category	R	A	PRA
Predator	5	17	3.16%
Parasite			
Collector Gatherer	8	354	65.80%
Collector Filterer	2	93	17.29%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	6	1.12%
Shredder	3	63	11.71%
Omnivore			
Unknown	1	5	0.93%

Legend: Collector Filterer, Collector Gatherer, Macrophyte Herbivore, Omnivore, Parasite, Piercer Herbivore, Predator, Scraper, Shredder, Unknown, Xylophage
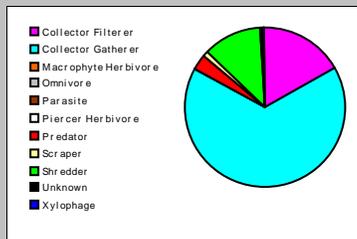
Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	20
E Richness	2
P Richness	3
T Richness	1
EPT Richness	6
EPT Percent	25.28%
All Non-Insect Abundance	291
All Non-Insect Richness	6
All Non-Insect Percent	54.09%
Oligochaeta+Hirudinea Percent	13.01%
Baetidae/Ephemeroptera	0.920
Hydropsychidae/Trichoptera	1.000
Dominance	
Dominant Taxon Percent	37.73%
Dominant Taxa (2) Percent	54.09%
Dominant Taxa (3) Percent	67.10%
Dominant Taxa (10) Percent	95.54%
Diversity	
Shannon H (loge)	1.920
Shannon H (log2)	2.770
Margalef D	3.023
Simpson D	0.211
Evenness	0.094
Function	
Predator Richness	5
Predator Percent	3.16%
Filterer Richness	2
Filterer Percent	17.29%
Collector Percent	83.09%
Scraper+Shredder Percent	12.83%
Scraper/Filterer	0.065
Scraper/Scraper+Filterer	0.061
Habit	
Burrower Richness	2
Burrower Percent	2.23%
Swimmer Richness	2
Swimmer Percent	13.57%
Clinger Richness	6
Clinger Percent	28.81%
Characteristics	
Cold Stenotherm Richness	1
Cold Stenotherm Percent	1.12%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	2
Air Breather Percent	0.56%
Voltinism	
Univoltine Richness	11
Semivoltine Richness	1
Multivoltine Percent	17.29%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	13.20%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.931
Pollution Sensitive Richness	1
Pollution Tolerant Percent	0.00%
Hilsenhoff Biotic Index	5.630
Intolerant Percent	12.83%
Supertolerant Percent	13.94%
CTQa	85.000

Bioassessment Indices

| BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	18	36.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	18	60.00%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	8	44.44%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	2	9.52%	Severe
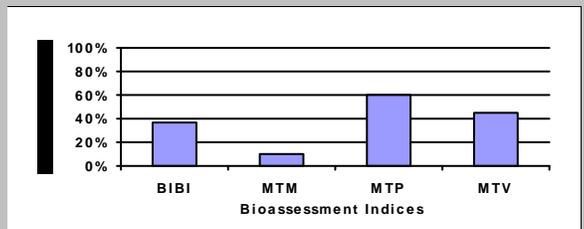
Metrics Report

Project ID: SW17CHM
RAI No.: SW17CHM007
Sta. Name: Upper Shellebarger Creek
Client ID: WC-07
STORET ID
Coll. Date: 9/20/2017
Latitude: **Longitude:**

Abundance Measures

Sample Count: 401
Sample Abundance: 401.00   100.00% of sample used
Coll. Procedure:
Sample Notes: depth of 8cm 100% riparian cover

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	6	72	17.96%
Oligochaeta	1	11	2.74%
Odonata			
Ephemeroptera	2	45	11.22%
Plecoptera	1	29	7.23%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	1	1	0.25%
Lepidoptera			
Coleoptera			
Diptera	2	241	60.10%
Chironomidae	2	2	0.50%

Pie chart legend: Terrestrial, Other Non-Insect, Oligochaeta, Odonata, Ephemeroptera, Plecoptera, Heteroptera, Megaloptera, Neuroptera, Trichoptera, Lepidoptera, Coleoptera, Diptera, Chironomidae
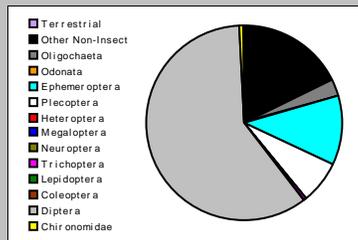
Dominant Taxa

Category	A	PRA
Simulium	240	59.85%
Crangonyx	44	10.97%
Baetis tricaudatus complex	44	10.97%
Malenka	29	7.23%
Trepaxonemata	21	5.24%
Oligochaeta	11	2.74%
Sphaeriidae	3	0.75%
Acari	2	0.50%
Tvetenia Bavarica Gr.	1	0.25%
Tricorythodes	1	0.25%
Psychodidae	1	0.25%
Parapsyche	1	0.25%
Nemata	1	0.25%
Eukiefferiella Claripennis Gr.	1	0.25%
Erpobdellidae	1	0.25%

Functional Composition

Category	R	A	PRA
Predator	4	25	6.23%
Parasite			
Collector Gatherer	7	103	25.69%
Collector Filterer	2	243	60.60%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper			
Shredder	1	29	7.23%
Omnivore			
Unknown	1	1	0.25%

Pie chart legend: Collector Filterer, Collector Gatherer, Macrophyte Herbivore, Omnivore, Parasite, Piercer Herbivore, Predator, Scraper, Shredder, Unknown, Xylophage
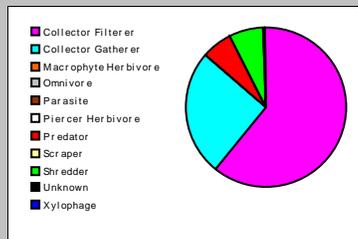
Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	15
E Richness	2
P Richness	1
T Richness	1
EPT Richness	4
EPT Percent	18.70%
All Non-Insect Abundance	83
All Non-Insect Richness	7
All Non-Insect Percent	20.70%
Oligochaeta+Hirudinea Percent	2.99%
Baetidae/Ephemeroptera	0.978
Hydropsychidae/Trichoptera	1.000
Dominance	
Dominant Taxon Percent	59.85%
Dominant Taxa (2) Percent	70.82%
Dominant Taxa (3) Percent	81.80%
Dominant Taxa (10) Percent	98.75%
Diversity	
Shannon H (loge)	1.446
Shannon H (log2)	2.087
Margalef D	2.355
Simpson D	0.369
Evenness	0.099
Function	
Predator Richness	4
Predator Percent	6.23%
Filterer Richness	2
Filterer Percent	60.60%
Collector Percent	86.28%
Scraper+Shredder Percent	7.23%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	1
Burrower Percent	0.25%
Swimmer Richness	1
Swimmer Percent	10.97%
Clinger Richness	3
Clinger Percent	67.33%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	0
Hemoglobin Bearer Percent	0.00%
Air Breather Richness	1
Air Breather Percent	0.25%
Voltinism	
Univoltine Richness	7
Semivoltine Richness	1
Multivoltine Percent	17.21%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	2.99%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.566
Pollution Sensitive Richness	0
Pollution Tolerant Percent	0.25%
Hilsenhoff Biotic Index	5.524
Intolerant Percent	7.48%
Supertolerant Percent	3.99%
CTQa	97.200

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	14	46.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	5	27.78%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe

Bar chart: Bioassessment Indices (BIBI, MTM, MTP, MTV)

Tuesday, February 06, 2018
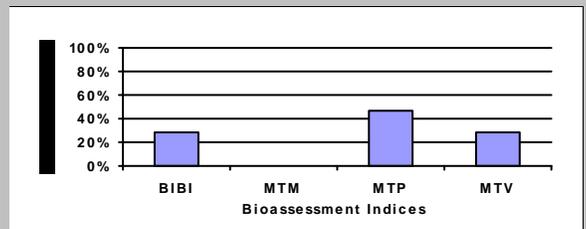
Taxa Listing

RAI No.:	SW17CHP001		Sta. Name:	Puget Sound
Client ID:	WC-01			
Date Coll.:	9/20/2017	No Jars: 1	STORET ID:	WC-01

Sample Notes: Periphyton Area 4.5cm x 5cm, 5cm x 6.5cm (cobbles)

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	345	87.56%	345	
Chlorophyta				
Ulva sp.	2	0.51%	2	
Diatoms				
Bacillariophyta				
Achnanthes parvula	1	0.17%		
Achnanthes pseudogroenlandica	1	0.17%		
Achnanthidium rivulare	14	2.33%		
Amphora pediculus	29	4.83%		
Cocconeis costata v. costata	1	0.17%		
Cocconeis scutellum v. parva	53	8.83%		
Diploneis sp.	1	0.17%		Very lightly silicified cell
Gomphonema pumilum v. rigidum	47	7.83%		6 girdle views
Grammatophora oceanica	1	0.17%		
Halamphora coffeaeformis	5	0.83%		
Licmophora communis	7	1.17%		
Melosira lineata	4	0.67%		
Navicula abunda	108	18.00%		
Navicula halinae	6	1.00%		
Navicula perminuta	50	8.33%		
Navicula salinicola	46	7.67%		
Nitzschia sp.	1	0.17%		obscure view
Nitzschia inconspicua	63	10.50%		
Opephora mutabilis	3	0.50%		
Parlibellus berkeleyi	6	1.00%		
Planothidium delicatulum	25	4.17%		
Planothidium dubium	1	0.17%		
Rhoicosphenia abbreviata	2	0.33%		
Tabularia fasciculata	124	20.67%		
Trachyneis aspera	1	0.17%		

Sample Count   947

Taxa Listing

RAI No.:	SW17CHP002			Sta. Name:	Lower Willow Creek
Client ID:	WC-02				
Date Coll.:	9/20/2017	No Jars:	1	STORET ID:	WC-02
Sample Notes:	Periphyton Area 9.5cm x 6cm (cobble)				

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	300	69.93%	300	
Diatoms				
Bacillariophyta				
Achnanthes placentuloides	1	0.17%		A. placentuloides
Berkeleya rutilans	3	0.50%		
Gomphonema sp.	1	0.17%		Girdle view
Halamphora coffeaeformis	20	3.33%		A. coeffeaeformis
Navicula abunda	118	19.67%		N. abundans
Navicula gregaria	14	2.33%		
Navicula paul-schulzii	6	1.00%		paul schulzii
Navicula perminuta	34	5.67%		
Navicula perminuta	2	0.33%		cf big perminuta, because bigger in size.
Nitzschia amplectens	10	1.67%		without striae
Nitzschia dissipata	1	0.17%		
Nitzschia frustulum	21	3.50%		
Nitzschia inconspicua	330	55.00%		
Nitzschia levidensis	2	0.33%		
Nitzschia palea	2	0.33%		
Opephora mutabilis	17	2.83%		2 girdle views
Planothidium delicatulum	11	1.83%		
Planothidium engelbrechtii	3	0.50%		
Staurosira punctiformis	3	0.50%		
Tabularia fasciculata	1	0.17%		
Sample Count	**900**			

Taxa Listing

RAI No.:	SW17CHP003		Sta. Name:	Willow Creek Marsh
Client ID:	WC-03			
Date Coll.:	9/20/2017	No Jars: 1	STORET ID:	WC-03
Sample Notes:	Periphyton Area 1cm x 45cm (water parsley stem)			

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	52	89.66%	52	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	21	6.69%		
Amphora pediculus	12	3.82%		
Brachysira microcephala	1	0.32%		
Cocconeis placentula sensu lato	53	16.88%		
Diploneis krammeri	1	0.32%		
Epithemia sp.	1	0.32%		broken valve
Eunotia trinacria	1	0.32%		
Frustulia vulgaris	4	1.27%		2 broken valve
Gomphonema sp.	2	0.64%		broken valve
Gomphonema angustatum	1	0.32%		
Gomphonema kobayasii	2	0.64%		
Gomphonema parvulum	2	0.64%		
Melosira lineata	1	0.32%		
Meridion circulare	3	0.96%		broken valve
Navicula cincta	3	0.96%		
Navicula cryptocephala	20	6.37%		
Navicula cryptotenella	10	3.18%		
Navicula tripunctata	10	3.18%		
Nitzschia sp.	5	1.59%		half broken valve
Nitzschia dissipata	6	1.91%		
Nitzschia frustulum	5	1.59%		
Nitzschia inconspicua	14	4.46%		
Nitzschia linearis	1	0.32%		
Nitzschia palea	2	0.64%		
Pinnularia brebissonii	1	0.32%		
Pinnularia rupestris	7	2.23%		
Pinnularia saprophila	19	6.05%		
Pinnularia subundulata	2	0.64%		
Placoneis clementis	8	2.55%		
Placoneis porifera	1	0.32%		
Planothidium frequentissimum	16	5.10%		
Planothidium haynaldii	2	0.64%		
Planothidium lanceolatum	38	12.10%		
Psammothidium bioretii	2	0.64%		
Pseudostaurosira parasitica	1	0.32%		
Reimeria sinuata	1	0.32%		
Rhoicosphenia abbreviata	5	1.59%		
Rossithidium pusillum	1	0.32%		

Taxa Listing

RAI No.:	SW17CHP003	**Sta. Name:** Willow Creek Marsh
Client ID:	WC-03	
Date Coll.:	9/20/2017 **No Jars:** 1	**STORET ID:** WC-03

Sample Notes: Periphyton Area 1cm x 45cm (water parsley stem)

Taxonomic Name	Count	PRA	Cell Count	Comment
Sellaphora atomoides	15	4.78%		
Sellaphora nigri	2	0.64%		
Sellaphora pupula	1	0.32%		
Sellaphora saugerresii	3	0.96%		
Sellaphora seminulum	2	0.64%		
Stauroneis gracilis	2	0.64%		
Stauroneis kriegeri	2	0.64%		
Staurosirella pinnata	2	0.64%		

Sample Count 366

Taxa Listing

RAI No.:	SW17CHP004	Sta. Name: Willow Creek Marsh
Client ID:	WC-04	
Date Coll.:	9/20/2017 No Jars: 1	STORET ID: WC-04
Sample Notes:	Periphyton Area 2cm x 30cm (wooden stake)	

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	296	84.57%	296	
Cyanophyta				
Leptolyngbya sp.	4	1.14%	56	
Diatoms				
Bacillariophyta				
Achnanthidium sp.	1	0.17%		big Raphless valve only
Achnanthidium deflexum	2	0.33%		
Achnanthidium minutissimum	55	9.17%		
Achnanthidium rivulare	2	0.33%		
Amphora copulata	2	0.33%		
Amphora pediculus	204	34.00%		
Cocconeis placentula sensu lato	25	4.17%		
Diploneis smithii v. pumila	1	0.17%		
Epithemia sorex	1	0.17%		
Eunotia rushforthii	1	0.17%		
Fragilaria vaucheriae	5	0.83%		
Gomphonema sp.	1	0.17%		girdle view
Gomphonema angustatum	2	0.33%		
Gomphonema parvulum	3	0.50%		
Hippodonta sp.	1	0.17%		girdle view only
Hippodonta capitata	1	0.17%		
Lemnicola hungarica	2	0.33%		
Luticola mutica	1	0.17%		
Mayamaea atomus	2	0.33%		
Melosira lineata	3	0.50%		
Navicula abunda	1	0.17%		
Navicula cincta	1	0.17%		
Navicula cryptocephala	12	2.00%		
Navicula cryptotenella	5	0.83%		
Navicula gregaria	3	0.50%		
Navicula lanceolata	3	0.50%		
Navicula reichardtiana	1	0.17%		
Nitzschia sp.	4	0.67%		Girdle view and broken valve
Nitzschia dissipata	9	1.50%		
Nitzschia frustulum	12	2.00%		
Nitzschia hantzschiana	3	0.50%		
Nitzschia inconspicua	8	1.33%		
Nitzschia linearis	6	1.00%		
Nitzschia palea	4	0.67%		
Planothidium frequentissimum	28	4.67%		
Planothidium haynaldii	2	0.33%		
Planothidium lanceolatum	105	17.50%		2 girdle views

Taxa Listing

RAI No.: SW17CHP004	**Sta. Name:** Willow Creek Marsh
Client ID: WC-04	
Date Coll.: 9/20/2017 **No Jars:** 1	**STORET ID:** WC-04
Sample Notes: Periphyton Area 2cm x 30cm (wooden stake)	

Taxonomic Name	Count	PRA	Cell Count	Comment
Platessa hustedtii	1	0.17%		
Rhoicosphenia abbreviata	20	3.33%		
Sellaphora sp.	5	0.83%		Girdle views
Sellaphora atomoides	19	3.17%		
Sellaphora hustedtii	1	0.17%		
Sellaphora nigri	8	1.33%		
Sellaphora pupula	1	0.17%		
Sellaphora saugerresii	9	1.50%		
Sellaphora seminulum	3	0.50%		
Staurosira construens v. venter	5	0.83%		
Staurosirella leptostauron	4	0.67%		
Ulnaria ulna	2	0.33%		broken valves

Sample Count   900

Taxa Listing

RAI No.:	SW17CHP005		Sta. Name:	Willow Creek Marsh
Client ID:	WC-05			
Date Coll.:	9/20/2017	No Jars: 1	STORET ID: WC-05	
Sample Notes:	Periphyton Area 3cm x 25cm (skunk cabbage stem)			

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	238	63.47%	238	
Cryptophyta				
Cryptomonas sp.	1	0.27%	1	
Cyanophyta				
Leptolyngbya sp.	61	16.27%	1708	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	35	5.83%		
Achnanthidium rivulare	3	0.50%		
Amphora copulata	2	0.33%		
Amphora pediculus	42	7.00%		
Aulacoseira italica	2	0.33%		
Caloneis bacillum	2	0.33%		1 girdle view
Cocconeis placentula sensu lato	223	37.17%		
Diatoma vulgaris	1	0.17%		
Diploneis smithii	1	0.17%		
Eunotia rushforthii	3	0.50%		1 girdle
Fragilaria vaucheriae	2	0.33%		
Gomphonema angustatum	4	0.67%		
Gomphonema parvulum	5	0.83%		1 girdle view
Halamphora coffeaeformis	4	0.67%		
Mayamaea atomus	2	0.33%		
Melosira lineata	8	1.33%		
Meridion circulare	1	0.17%		
Navicula sp.	2	0.33%		girdle view
Navicula cryptocephala	3	0.50%		
Navicula gregaria	4	0.67%		
Navicula lanceolata	1	0.17%		broken valve
Navicula reichardtiana	1	0.17%		
Nitzschia acidoclinata	1	0.17%		
Nitzschia desertorum	2	0.33%		
Nitzschia dissipata	8	1.33%		
Nitzschia fonticola	1	0.17%		
Nitzschia frustulum	1	0.17%		
Nitzschia inconspicua	9	1.50%		
Nitzschia linearis	6	1.00%		
Nitzschia palea	3	0.50%		
Pinnularia rupestris	4	0.67%		3 girdle views
Planothidium dubium	1	0.17%		
Planothidium frequentissimum	34	5.67%		
Planothidium haynaldii	3	0.50%		
Planothidium lanceolatum	121	20.17%		

RAI No.:	SW17CHP005		**Sta. Name:**	Willow Creek Marsh	
Client ID:	WC-05				
Date Coll.:	9/20/2017	**No Jars:** 1	**STORET ID:**	WC-05	
Sample Notes:	Periphyton Area 3cm x 25cm (skunk cabbage stem)				

Taxonomic Name	Count	PRA	Cell Count	Comment
Platessa hustedtii	4	0.67%		
Rhoicosphenia abbreviata	15	2.50%		
Rhopalodia gibberula	2	0.33%		
Rhopalodia musculus	1	0.17%		
Sellaphora atomoides	8	1.33%		
Sellaphora nigri	3	0.50%		
Sellaphora pupula	1	0.17%		
Sellaphora saugerresii	5	0.83%		
Sellaphora seminulum	6	1.00%		
Stauroneis kriegeri	1	0.17%		
Staurosira construens v. venter	2	0.33%		1 girdle view
Staurosirella leptostauron	2	0.33%		girdle view
Surirella angusta	1	0.17%		
Ulnaria ulna	4	0.67%		

Sample Count 900

Taxa Listing

RAI No.:	SW17CHP006	Sta. Name: Upper Willow Creek
Client ID:	WC-06	
Date Coll.:	9/20/2017 No Jars: 1	STORET ID: WC-06
Sample Notes:	Periphyton Area 8cm x 4.5cm (cobble)	

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	54	62.79%	54	
Cyanophyta				
Leptolyngbya sp.	7	8.14%	56	
Diatoms				
Bacillariophyta				
Achnanthidium exiguum	1	0.17%		
Achnanthidium gracillimum	5	0.83%		
Achnanthidium minutissimum	34	5.67%		
Amphora pediculus	28	4.67%		
Aulacoseira italica	2	0.33%		1 broken valve
Cocconeis placentula sensu lato	315	52.50%		Mostly broken valve
Fragilaria capucina v. gracilis	2	0.33%		
Gomphonema angustatum	2	0.33%		
Gomphonema parvulum	2	0.33%		
Gomphonema productum	1	0.17%		
Mayamaea atomus	2	0.33%		
Melosira lineata	1	0.17%		
Navicula cryptocephala	4	0.67%		1 broken valve
Navicula cryptotenella	10	1.67%		
Navicula reichardtiana	1	0.17%		
Nitzschia dissipata	2	0.33%		
Nitzschia frustulum	1	0.17%		
Nitzschia inconspicua	7	1.17%		
Nitzschia linearis	5	0.83%		
Nitzschia palea	2	0.33%		broken valve
Pinnularia decrescens	1	0.17%		P. decrescens
Planothidium frequentissimum	16	2.67%		
Planothidium haynaldii	3	0.50%		
Planothidium lanceolatum	82	13.67%		
Reimeria sinuata	3	0.50%		
Rhoicosphenia abbreviata	26	4.33%		
Rossithidium pusillum	4	0.67%		
Sellaphora atomoides	14	2.33%		
Sellaphora nigri	10	1.67%		
Sellaphora pulchra	1	0.17%		
Sellaphora saugerresii	5	0.83%		
Sellaphora seminulum	2	0.33%		
Stauroneis kriegeri	1	0.17%		
Staurosira construens v. venter	2	0.33%		
Staurosirella pinnata	2	0.33%		
Ulnaria ulna	1	0.17%		broken valve

RAI No.:	SW17CHP006	**Sta. Name:** Upper Willow Creek
Client ID:	WC-06	
Date Coll.:	9/20/2017 **No Jars:** 1	**STORET ID:** WC-06
Sample Notes:	Periphyton Area 8cm x 4.5cm (cobble)	

Taxonomic Name	Count	PRA	Cell Count	Comment

Sample Count 661

Taxa Listing

RAI No.:	SW17CHP007	Sta. Name: Upper Shellebarger Creek
Client ID:	WC-07	
Date Coll.:	9/20/2017 No Jars: 1	STORET ID: WC-07
Sample Notes:	Periphyton Area 8cm x 5.5cm (cobble)	

Taxonomic Name	Count	PRA	Cell Count	Comment
Algae				
Bacillariophyta				
Diatoms	92	90.20%	92	
Diatoms				
Bacillariophyta				
Achnanthidium minutissimum	2	0.33%		
Achnanthidium rivulare	1	0.17%		
Amphora pediculus	8	1.33%		
Cocconeis placentula sensu lato	505	84.17%		Mostly broken valves
Navicula cryptocephala	1	0.17%		
Navicula cryptotenella	2	0.33%		
Nitzschia sp.	1	0.17%		broken valve
Nitzschia inconspicua	3	0.50%		
Placoneis clementis	1	0.17%		
Planothidium frequentissimum	7	1.17%		
Planothidium lanceolatum	57	9.50%		
Reimeria sinuata	3	0.50%		
Rhoicosphenia abbreviata	4	0.67%		
Sellaphora seminulum	1	0.17%		
Staurosira construens v. venter	3	0.50%		
Ulnaria ulna	1	0.17%		
Sample Count	**692**			

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP001
Station Name: Puget Sound
Client ID: WC-01
STORET ID: WC-01
Date Collected: 9/20/2017
Count Of Taxon: 25
Sum Of Count: 600

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.468	Excellent	Good
Species Richness	25	Good	Fair
Native Taxa Percent	2.33%		
Cosmopolitan Taxa Percent	45.50%		
Mountains Rare Taxa Percent	2.33%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	20.67%	Excellent	Excellent
Sediment			
Siltation Taxa Percent	46.67%	Fair	Excellent
Motile Taxa Percent	32.50%		
Mountains Brackish Taxa Percent	5.17%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.112	Good	Good
Nitrogen Heterotroph Taxa Percent	10.50%		
Polysaprobous Taxa Percent	32.00%		
Low DO Taxa Percent	0.00%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	27.33%		
Eutraphentic Taxa Percent	38.00%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.00%		
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	0.17%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Fair
MTP	Montana DEQ Plains (Bahls 1992)	Fair

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.67%	31.92%
Mountains Metals Increasers Taxa Percent	0.33%	3.14%
Mountains Nutrient Increasers Taxa Percent	0.33%	4.46%
Mountains Sediment Increasers Taxa Percent	15.67%	36.32%
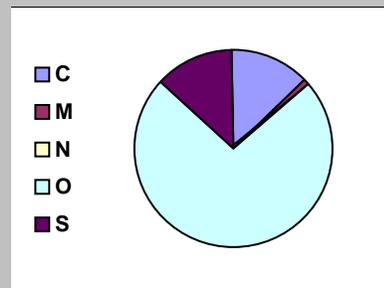
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	20.67%	46.81%
Plains General Increasers Taxa Percent	0.33%	0.89%
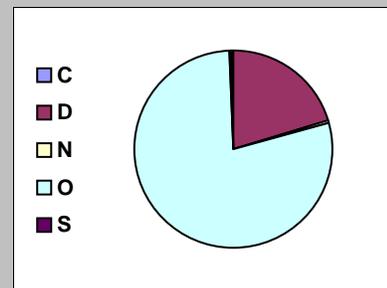
Dominant Taxa

Category	A	PRA
Tabularia fasciculata	124	20.67%
Navicula abunda	108	18.00%
Nitzschia inconspicua	63	10.50%
Cocconeis scutellum v. parva	53	8.83%
Navicula perminuta	50	8.33%
Gomphonema pumilum v. rigidum	47	7.83%
Navicula salinicola	46	7.67%
Amphora pediculus	29	4.83%
Planothidium delicatulum	25	4.17%
Achnanthidium rivulare	14	2.33%

Metrics Report

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	2.286	Good	Fair
Species Richness	19	Fair	Poor
Native Taxa Percent	0.00%		
Cosmopolitan Taxa Percent	71.17%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	55.00%	Fair	Fair
Sediment			
Siltation Taxa Percent	90.00%	Poor	Poor
Motile Taxa Percent	72.67%		
Mountains Brackish Taxa Percent	0.17%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	1.956	Fair	Good
Nitrogen Heterotroph Taxa Percent	58.83%		
Polysaprobous Taxa Percent	61.50%		
Low DO Taxa Percent	2.67%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	6.33%		
Eutraphentic Taxa Percent	65.00%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.00%		
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	0.33%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Poor
MTP	Montana DEQ Plains (Bahls 1992)	Poor

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	57.67%	95.35%
Mountains Sediment Increasers Taxa Percent	57.67%	99.38%
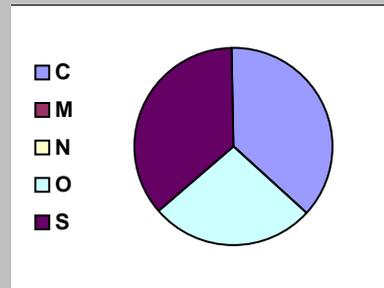
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	6.00%	80.51%
Plains General Increasers Taxa Percent	0.17%	0.87%
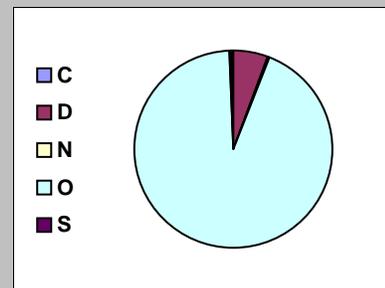
Dominant Taxa

Category	A	PRA
Nitzschia inconspicua	330	55.00%
Navicula abunda	118	19.67%
Navicula perminuta	36	6.00%
Nitzschia frustulum	21	3.50%
Amphora coffeaeformis	20	3.33%
Opephora mutabilis	17	2.83%
Navicula gregaria	14	2.33%
Planothidium delicatulum	11	1.83%
Nitzschia amplectens	10	1.67%
Navicula paul-schulzii	6	1.00%

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP003
Station Name: Willow Creek Marsh
Client ID: WC-03
**STORET ID:** WC-03
Date Collected: 9/20/2017
Count Of Taxon: 46
Sum Of Count: 314

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	4.511	Excellent	Excellent
Species Richness	46	Excellent	Excellent
Native Taxa Percent	1.27%		
Cosmopolitan Taxa Percent	75.48%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.64%		
Dominant Taxon Percent	16.88%	Excellent	Excellent
Sediment			
Siltation Taxa Percent	34.39%	Good	Excellent
Motile Taxa Percent	39.17%		
Mountains Brackish Taxa Percent	73.25%		
Plains Brackish Taxa Percent	2.23%		
Organic Nutrients			
Pollution Index	2.534	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	9.55%		
Polysaprobous Taxa Percent	33.12%		
Low DO Taxa Percent	3.50%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	67.83%		
Eutraphentic Taxa Percent	49.04%		
Rhopalodiales Percent	0.32%		
Metals			
Disturbance Taxa Percent	6.69%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	14.01%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Excellent

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.92%	32.64%
Mountains Metals Increasers Taxa Percent	2.23%	4.18%
Mountains Nutrient Increasers Taxa Percent	3.18%	6.55%
Mountains Sediment Increasers Taxa Percent	13.69%	31.21%
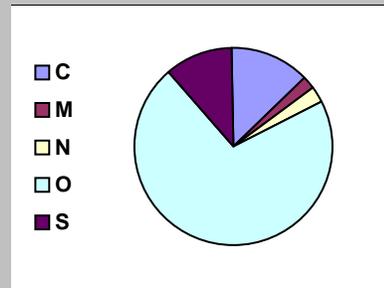
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	1.91%	86.86%
Plains General Increasers Taxa Percent	16.56%	11.31%
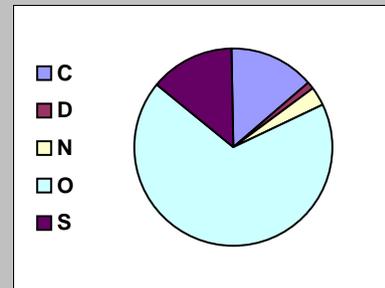
Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	53	16.88%
Planothidium lanceolatum	38	12.10%
Achnanthidium minutissimum	21	6.69%
Navicula cryptocephala	20	6.37%
Pinnularia saprophila	19	6.05%
Planothidium frequentissimum	16	5.10%
Sellaphora atomoides	15	4.78%
Nitzschia inconspicua	14	4.46%
Amphora pediculus	12	3.82%
Navicula tripunctata	10	3.18%

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP004
Station Name: Willow Creek Marsh
Client ID: WC-04
STORET ID: WC-04
Date Collected: 9/20/2017
Count Of Taxon: 49
Sum Of Count: 600

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.683	Excellent	Good
Species Richness	49	Excellent	Excellent
Native Taxa Percent	0.33%		
Cosmopolitan Taxa Percent	91.83%		
Mountains Rare Taxa Percent	0.33%		
Plains Rare Taxa Percent	0.33%		
Dominant Taxon Percent	34.00%	Good	Good
Sediment			
Siltation Taxa Percent	20.50%	Good	Excellent
Motile Taxa Percent	51.83%		
Mountains Brackish Taxa Percent	87.67%		
Plains Brackish Taxa Percent	0.67%		
Organic Nutrients			
Pollution Index	2.547	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	8.17%		
Polysaprobous Taxa Percent	33.67%		
Low DO Taxa Percent	5.33%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	83.83%		
Eutraphentic Taxa Percent	71.00%		
Rhopalodiales Percent	0.17%		
Metals			
Disturbance Taxa Percent	9.17%	Excellent	Excellent
Acidophilous Taxa Percent	0.17%		
Metals Tolerant Taxa Percent	20.33%		
Abnormal Cells Percent	0.00%	Excellent	

| BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Good

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	42.33%	81.59%
Mountains Metals Increasers Taxa Percent	4.00%	5.37%
Mountains Nutrient Increasers Taxa Percent	5.33%	8.38%
Mountains Sediment Increasers Taxa Percent	41.50%	92.22%
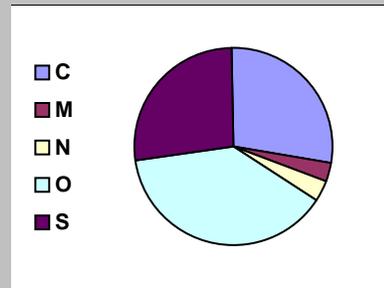
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	4.00%	83.65%
Plains General Increasers Taxa Percent	15.50%	10.03%
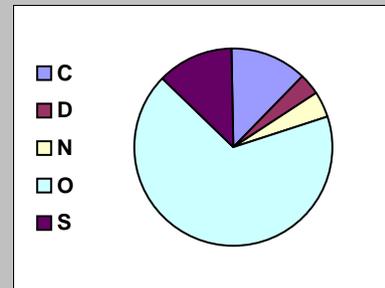
Dominant Taxa

Category	A	PRA
Amphora pediculus	204	34.00%
Planothidium lanceolatum	105	17.50%
Achnanthidium minutissimum	55	9.17%
Planothidium frequentissimum	28	4.67%
Cocconeis placentula sensu lato	25	4.17%
Rhoicosphenia abbreviata	20	3.33%
Sellaphora atomoides	19	3.17%
Navicula cryptocephala	12	2.00%
Nitzschia frustulum	12	2.00%
Nitzschia dissipata	9	1.50%

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP005
Station Name: Willow Creek Marsh
Client ID: WC-05
STORET ID: WC-05
Date Collected: 9/20/2017
Count Of Taxon: 49
Sum Of Count: 600

Metrics (Bahls 1993)

| Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	3.453	Excellent	Good
Species Richness	49	Excellent	Excellent
Native Taxa Percent	0.67%		
Cosmopolitan Taxa Percent	91.17%		
Mountains Rare Taxa Percent	0.50%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	37.17%	Good	Good
Sediment			
Siltation Taxa Percent	11.33%	Excellent	Excellent
Motile Taxa Percent	19.83%		
Mountains Brackish Taxa Percent	90.00%		
Plains Brackish Taxa Percent	0.83%		
Organic Nutrients			
Pollution Index	2.549	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	5.67%		
Polysaprobous Taxa Percent	34.67%		
Low DO Taxa Percent	4.33%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	88.50%		
Eutraphentic Taxa Percent	76.83%		
Rhopalodiales Percent	0.50%		
Metals			
Disturbance Taxa Percent	5.83%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	23.50%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Good
MTP	Montana DEQ Plains (Bahls 1992)	Good

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	15.33%	31.56%
Mountains Metals Increasers Taxa Percent	3.17%	4.75%
Mountains Nutrient Increasers Taxa Percent	4.17%	7.35%
Mountains Sediment Increasers Taxa Percent	13.33%	30.50%
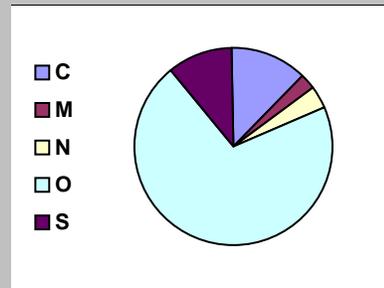
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	2.17%	86.43%
Plains General Increasers Taxa Percent	10.50%	5.05%
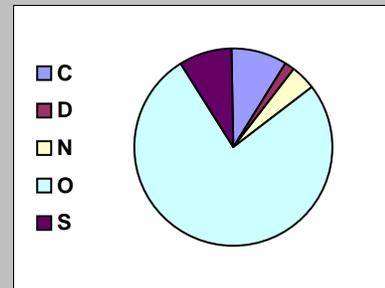
Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	223	37.17%
Planothidium lanceolatum	121	20.17%
Amphora pediculus	42	7.00%
Achnanthidium minutissimum	35	5.83%
Planothidium frequentissimum	34	5.67%
Rhoicosphenia abbreviata	15	2.50%
Nitzschia inconspicua	9	1.50%
Nitzschia dissipata	8	1.33%
Sellaphora atomoides	8	1.33%
Melosira lineata	8	1.33%

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP006
Station Name: Upper Willow Creek
Client ID: WC-06
STORET ID: WC-06
Date Collected: 9/20/2017
Count Of Taxon: 36
Sum Of Count: 600

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	2.814	Good	Fair
Species Richness	36	Excellent	Good
Native Taxa Percent	0.17%		
Cosmopolitan Taxa Percent	93.83%		
Mountains Rare Taxa Percent	0.00%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	52.50%	Fair	Fair
Sediment			
Siltation Taxa Percent	11.00%	Excellent	Excellent
Motile Taxa Percent	13.83%		
Mountains Brackish Taxa Percent	94.00%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.697	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	5.17%		
Polysaprobous Taxa Percent	22.33%		
Low DO Taxa Percent	3.50%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	88.83%		
Eutraphentic Taxa Percent	80.83%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	5.67%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	15.33%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Fair
MTP	Montana DEQ Plains (Bahls 1992)	Fair

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	11.83%	25.46%
Mountains Metals Increasers Taxa Percent	4.67%	5.82%
Mountains Nutrient Increasers Taxa Percent	5.00%	8.08%
Mountains Sediment Increasers Taxa Percent	10.83%	24.83%
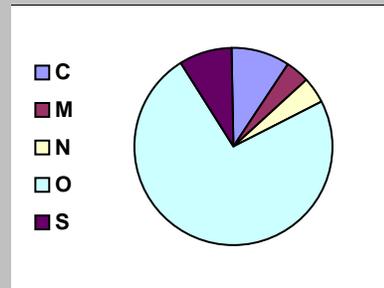
Metric	Value	Prob.
Plains General Decreasers Taxa Percent	1.00%	88.10%
Plains General Increasers Taxa Percent	12.33%	6.55%
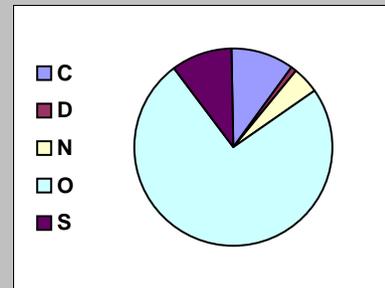
Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	315	52.50%
Planothidium lanceolatum	82	13.67%
Achnanthidium minutissimum	34	5.67%
Amphora pediculus	28	4.67%
Rhoicosphenia abbreviata	26	4.33%
Planothidium frequentissimum	16	2.67%
Sellaphora atomoides	14	2.33%
Navicula cryptotenella	10	1.67%
Sellaphora nigri	10	1.67%
Nitzschia inconspicua	7	1.17%

Metrics Report

Project ID: SW17CHP
Sample ID: SW17CHP007
Station Name: Upper Shellebarger Creek
Client ID: WC-07
STORET ID: WC-07
**Date Collected:** 9/20/2017
Count Of Taxon: 16
Sum Of Count: 600

Metrics (Bahls 1993)

Metric	Value	MTM	MTP
Community Structure			
Shannon H (log2)	1.000	Poor	Poor
Species Richness	16	Fair	Poor
Native Taxa Percent	0.17%		
Cosmopolitan Taxa Percent	99.50%		
Mountains Rare Taxa Percent	0.17%		
Plains Rare Taxa Percent	0.00%		
Dominant Taxon Percent	84.17%	Poor	Poor
Sediment			
Siltation Taxa Percent	1.50%	Excellent	Excellent
Motile Taxa Percent	3.33%		
Mountains Brackish Taxa Percent	99.00%		
Plains Brackish Taxa Percent	0.00%		
Organic Nutrients			
Pollution Index	2.878	Excellent	Excellent
Nitrogen Heterotroph Taxa Percent	0.67%		
Polysaprobous Taxa Percent	11.67%		
Low DO Taxa Percent	0.17%		
Inorganic Nutrients			
Nitrogen Autotroph Taxa Percent	98.67%		
Eutraphentic Taxa Percent	96.33%		
Rhopalodiales Percent	0.00%		
Metals			
Disturbance Taxa Percent	0.33%	Excellent	Excellent
Acidophilous Taxa Percent	0.00%		
Metals Tolerant Taxa Percent	9.67%		
Abnormal Cells Percent	0.00%	Excellent	

BioIndex	Description	Rating
MTM	Montana DEQ Mountains (Bahls 1992)	Poor
MTP	Montana DEQ Plains (Bahls 1992)	Poor

Increaser/Decreaser Taxa (Teply and Bahls 2005)

Metric	Value	Prob.
Mountains General Increasers Taxa Percent	2.67%	12.92%
Mountains Metals Increasers Taxa Percent	0.67%	3.29%
Mountains Nutrient Increasers Taxa Percent	0.67%	4.65%
Mountains Sediment Increasers Taxa Percent	2.67%	10.75%
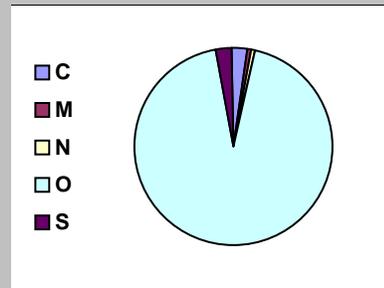
Metric	Value	Prob.
Plains General Increasers Taxa Percent	1.50%	1.10%
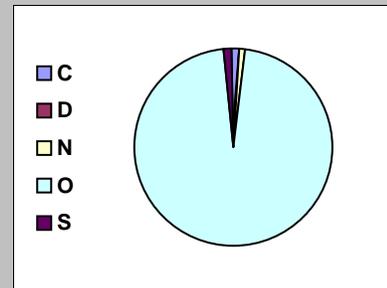
Dominant Taxa

Category	A	PRA
Cocconeis placentula sensu lato	505	84.17%
Planothidium lanceolatum	57	9.50%
Amphora pediculus	8	1.33%
Planothidium frequentissimum	7	1.17%
Rhoicosphenia abbreviata	4	0.67%
Nitzschia inconspicua	3	0.50%
Staurosira construens v. venter	3	0.50%
Reimeria sinuata	3	0.50%
Achnanthidium minutissimum	2	0.33%
Navicula cryptotenella	2	0.33%