

Benthic Macroinvertebrates Monitoring

Chapter Includes:

Streams Sampled

Procedures

Results

Benthic Macroinvertebrates Monitoring

Collecting data on macroinvertebrates helps to determine the biological health of streams and to identify areas where degradation is occurring due to human impacts. This is clearly discussed and illustrated in the following *Field Guide to Freshwater Invertebrates* by Leska Fore.

This report included sample results for 2006 and 2007. In 2006 and 2007, twenty-three samples were collected. The sample sites are listed below and the results are included at the end of the chapter.

Samples were collected by Thurston County Environmental Health staff and by volunteers of the local Stream Teams for Thurston County and the cities. The sampling procedures and analysis procedure used were developed by Dr. James R. Karr, University of Washington. The samples were analyzed by Aquatic Biology Associates, Inc., Corvallis, Oregon using a species level B-IBI scoring criteria developed by Leska Fore. (Fore, L.S., K. Paulsen and K. O’Laughlin, 2000, “Assessing the Performance of Volunteers in Monitoring Streams.” *Freshwater Biology*. In press.) A benthic index of biological integrity, or B-IBI, was generated for each sample. A B-IBI is a multimetric index approach which results in each stream receiving a “score” of low, medium or high biological integrity.

The aquatic insects are sorted from the organic debris in the sample by the analytical lab rather than by field sample collection staff and volunteers. In 2003 the sample area was tripled, from 3 square feet to 9 square feet, to ensure an adequate number of insects to accurately represent the stream.

Included in this chapter is a listing of the sites sampled for macroinvertebrates, excerpts from a field guide on macroinvertebrates and their use as an indicator of stream health, Stream Team and Thurston County sampling and lab procedure, and the results sheets with benthic index of biological integrity scores for the creeks sampled.

Streams Sampled

The stream sites sampled by the Stream Team volunteers in 2006 and 2007 are as follows:

- Black Lake Ditch @ R. W. Johnson Road**
- Deschutes River @ Pioneer Park**
- Ellis Creek @ Priest Point Park - east side of East Bay Drive**
- Fox Creek @ Pleasant Glade NE**
- Green Cove Creek @ 36th Ave NW**
- Indian Creek @ Wheeler Ave SE**
- Little McAllister Creek @ Meadows**
- McLane Creek @ DNR Nature Trail**
- Mission Creek @ Bethel Street NE**
- Moxlie Creek @ Watershed Park**
- Palm Creek @ Pleasant Glade NE**
- Percival Creek @ SPSCC Artist’s Bridge**
- Schneider Creek @ West Bay Drive**

Woodland Creek @ Draham Rd.

Woodland Creek @ Pleasant Glade Rd.

Eight streams were sampled by Thurston County Environmental Health staff in 2006 and 2007. The samples were collected at the ambient monitoring locations. They are as follows:

Chambers Creek off end of 58th Avenue off Henderson Blvd

Green Cove Creek off Cooper Point Rd at 4300 block

Kennedy Creek near Hwy 101

McLane Creek @ Delphi Rd./McKenzie Rd. bridge

Percival Creek at foot bridge below Evergreen Park Ct.

Perry Creek @ Perry Creek Rd. SW

Schneider Creek @ Pneumonia Gulch Ln NW

Woodard Creek off Libby Rd. at 4100 block

Field Guide to Freshwater Invertebrates

Leska S. Fore

Annabel Wildrick (Illustrations)

The animals living in a stream provide the best indicators of that stream's overall health and ecological condition. Human activities that alter a watershed and interfere with the natural processes of a stream have immediate as well as long-lasting effects on the animals that live in the stream. We monitor invertebrates because they represent an enormous diversity of body shapes, survival strategies, and adaptations. Many invertebrates require clear, cool water, adequate oxygen, stable flows, and a steady source of food in order to complete their life cycles. These animals, in turn, provide food for trout, salmon, herons, and kingfishers. Below are descriptions of the invertebrates you might expect to find at an excellent stream site (i.e., a site unchanged by humans), a moderate site, and a poor (i.e., degraded) site.

Excellent stream site

Here we find a variety of organisms with very different body shapes and ways of making a living. High biodiversity (or taxa richness) indicates a site with low human influence: most of the animals on this guide sheet should be present in a riffle sample. Several different types (or taxa) of stoneflies, mayflies, and caddisflies indicate a healthy site. More than one type of riffle beetle may also be identifiable, some are longer and skinnier than others. Some caddisflies are tolerant of degradation, so a large number of caddisflies does not necessarily indicate a good site, especially if they are the same species.

Moderate stream site

The total number of different types of organisms (taxa richness) declines as degradation increases. About half to two-thirds the number of taxa found at an excellent site are found in a moderate site. The primary change from an excellent site is that there will be many fewer taxa of stoneflies. Mayflies will be present, but probably fewer taxa as well. Several types of caddisflies may be present depending on the type of degradation. The relative proportions of soft-bodied worms, baetid mayflies, simuliid flies, or amphipods may increase. Beetles are probably still present; molluscs are not.

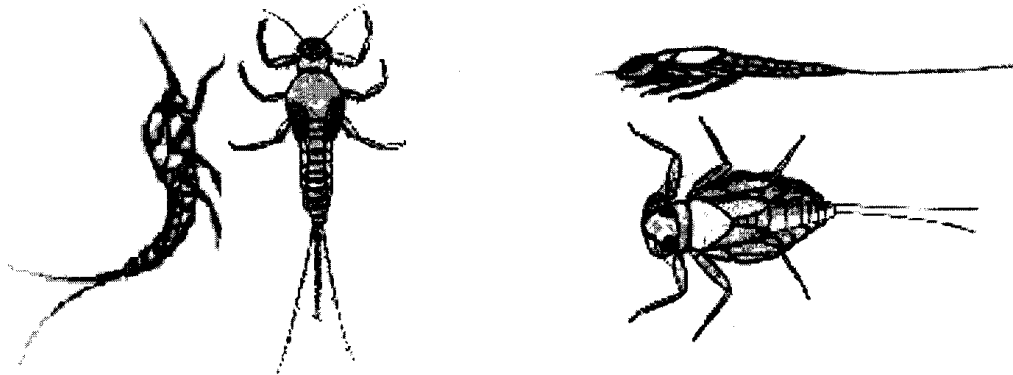
Benthic Macroinvertebrates Monitoring

Poor stream site

The total number of taxa will be low. Most of the taxa found are soft-bodied animals, e.g., fly larvae, oligochaetes, nematodes, and in very poor sites, leeches and planaria. Worms are often difficult to distinguish from each other because their shapes are similarly adapted to living in soft sediments. Stoneflies are absent entirely. The only mayflies present are probably baetids (a family of mayflies). Caddisflies may be present, but only a few tolerant types. Amphipods are often present. There may be a large proportion of a single type of animal. In general, animals present may be smaller than those found at an excellent site.

Mayfly nymphs (*Order Ephemeroptera*)

Mayflies are insects that spend most of their lives in streams, emerging briefly as adults (“ephemerally”) to mate and lay eggs. Gills are often visible along the abdomen. If an animal has three tails it’s a mayfly;



but some mayflies have two tails. Mayfly nymphs are strong swimmers and move like dolphins. As immature nymphs many mayflies feed on algae; as adults they do not eat. Mayfly diversity declines as streams are degraded; mayflies are particularly sensitive to mine waste.

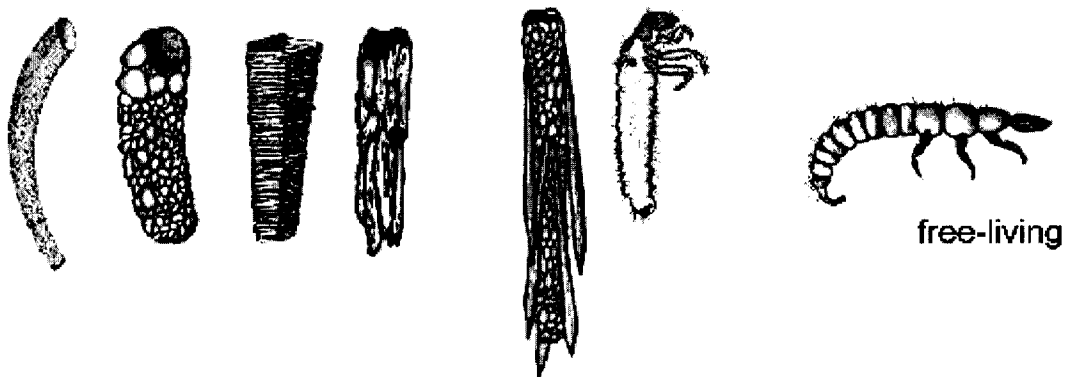
Stonefly nymphs (*Order Plecoptera*)

Stonefly nymphs are typically found on or near stones in the stream. They are rather primitive and may have been among the first insects to develop flight. Adult males and females emerge from the water to mate and locate each other by drumming with their abdomens. Stoneflies move like turtles and many are predators that hide and stalk their prey between stones and cobble. Stoneflies look similar to mayflies but are stockier. Diversity of these animals declines rapidly at the first signs of human disturbance.



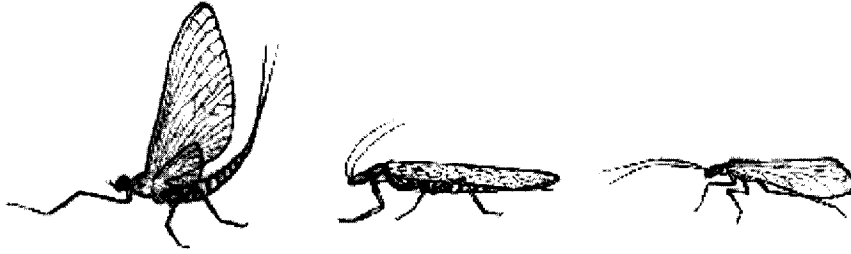
Caddisfly larvae (*Order Trichoptera*)

Caddisflies use silk (like butterflies) to build cases from gravel, twigs, needles, or sand. Different species build distinct cases, but they often lose them when removed from a stream. Caddisflies are insects that emerge to mate as winged adults. Caddisfly larvae make a living in a variety of ways: some capture food in nets, others scrape algae or shred leaf litter. Free-living caddisfly larvae do not build cases; many are predators and need to move quickly to capture other animals for food. Some caddisflies are very sensitive to human disturbance; others are tolerant.



Adult mayfly, stonefly, caddisfly

All three of these groups leave the water to mate as winged adults. Large swarms of mating mayflies and caddisflies often occur when all the individuals of a single species emerge at the same time. Stoneflies crawl out of the water and mate on the ground. The females of all three groups fly upstream and drop their eggs onto the water or dive into the stream to attach them to rocks or leaves.



Riffle beetles (*Order Coleoptera*)

Riffle beetle larvae are specially adapted to cling to smooth rocks in fast-flowing water (riffles). After emergence, adults fly for a short time but return to the water to feed in the same habitat as the larvae. Both the larvae and adults are rather small, dark-colored, and tend to drift to the bottom of a sample so they may be hard to see. Riffle beetles collect and gather a variety of different foods.



Fly larvae (*Order Diptera*)

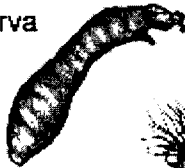
There are many species of true flies, but you are likely to recognize three main groups or families. Midge larvae (or chironomids) are very small, often C-shaped, and have a spastic squirming movement. They are often attached to debris by their tiny legs. Black fly larvae (or simuliids) are dumb-bell shaped and soft. They attach themselves to the substrate and prefer soft sediment. Crane fly larvae (or tipulids) are large and fleshy with very short “tentacles” at one end.



chironomids



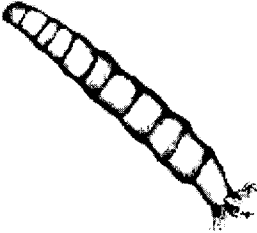
larva



simuliids



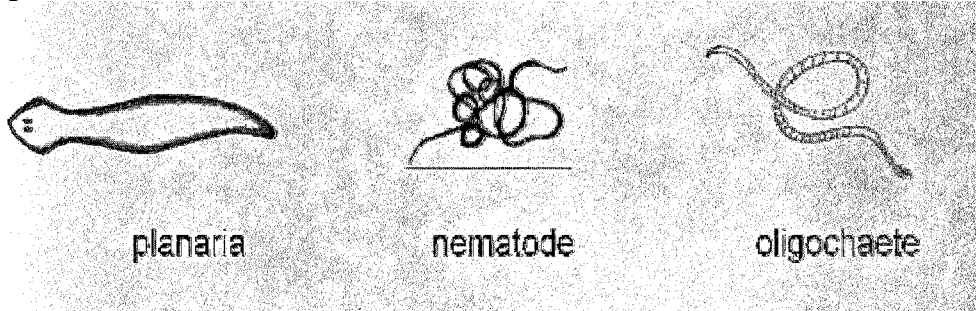
pupa



tipulid

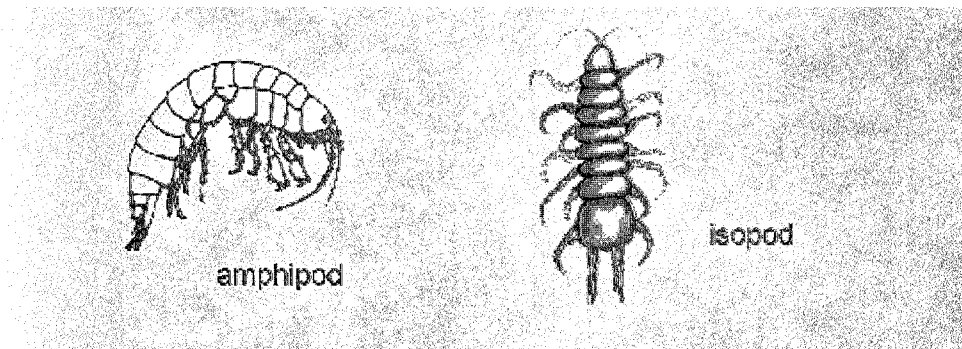
Aquatic worms

Flatworms (planaria), roundworms (nematodes), and freshwater earthworms (oligochaetes) are properly called worms; but don't confuse them with the soft-bodied larvae of flies, for examples, which are not. Nematodes and oligochaetes are long and thin and writhe like snakes. Note that these animals do not have legs.

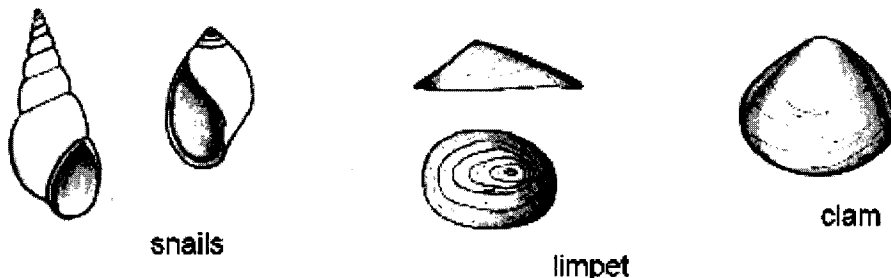


Crustaceans

Amphipods (or “scuds”) are very fast swimmers that look like shrimp. They have many appendages and look fuzzy. High proportions of these animals are present in very degraded sites. Isopods (or sowbugs) are usually found creeping through leaf litter.

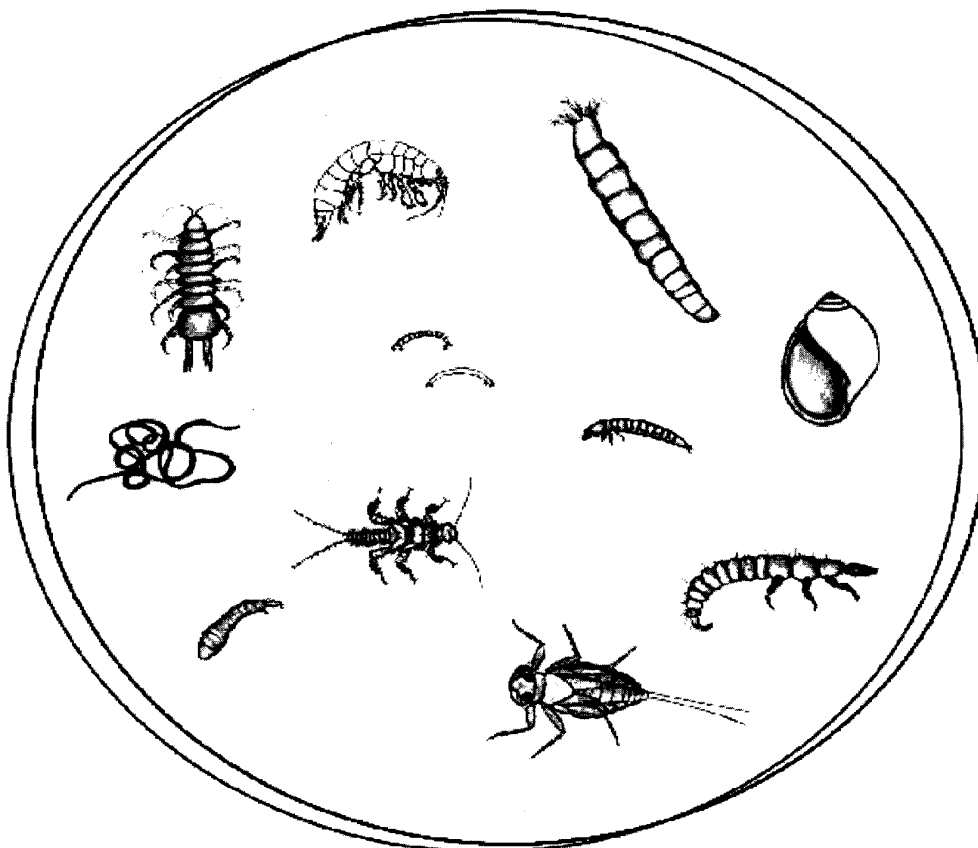


Molluscs (Classes Gastropoda & Pelecypoda)



Most snails and limpets eat algae they scrape from rocks. Check to see if the animal is still in the shell. As larvae, freshwater mussels (or clams) may hitch a ride by attaching themselves to migrating fish. Mussels are very sensitive to sediment because they feed by filtering stream water through their shells. Mature mussels indicate an undisturbed site and may be up to 40 years old.

Petri dish of invertebrates illustrates their approximate, relative size.



About this guide. Funding was provided through a King County Regional Water Quality Block Grant and the Bellevue Utilities Department (Seattle, WA). The guide was developed in 1998 for volunteers in the Pacific Northwest; therefore, the invertebrates illustrated are common to this area and the site descriptions may be specific to this region. This guide is published on the internet at www.seanet.com/~leska. You may download, copy, or distribute this guide for educational purposes but not for resale. For more information contact leska@seanet.com.

PROCEDURES (adapted from Stream Team Benthic Macroinvertebrate Monitoring Packet 2002)

When to sample: Species composition and population sizes of macroinvertebrates vary substantially through a stream's seasonal cycles. Because the goal is to assess the influence of human actions, not natural variation through time, samples are collected during a "window". For Pacific Northwest streams, that window is between July 1 and October 15. This gives representative sampling of stream invertebrates, avoids endangering from seasonal high water, and avoids the salmon spawning season.

Checklist of Equipment:

clipboard & reporting sheet	trash bags	big plastic scoop
pencil and permanent marker	flashlight	2 magnifying glasses
map of site	meter tape	stopwatch
500 micron mesh Surber sampler	waders (opt.)	first aid kit
flagging (use rocks or weights)	squirt bottle	small spray bottle
weed fork for stirring sample	2 buckets	bottle of alcohol
metric ruler	forceps	tarp
screened rinsing jug	3 plastic containers with lids	
insect repellent (opt.)	rubber gloves	

Selecting a Riffle:

Sampling should be done in a riffle environment (fast moving water over rock or cobble substrate; surface water should be broken) near the middle of the stream. The water should be 10-40 cm in depth. Three riffles will be needed to complete the protocol. Each riffle (A, B, and C) will be sampled in three places to produce a "composite sample" for that riffle. Ideally, a riffle should be long enough to accommodate three samples. The first sample should be taken a few feet from the end of the riffle; the second sample in the middle of the riffle; and the third sample a few feet from the top of the riffle. Ideally, the samples would be at least 5 feet apart, and riffles A, B, and C would be separated by areas of quiet water such as "pools" or "glides." (The three riffles may be only a few feet apart, or may be much farther apart, depending on the site.) Avoid bridges and other large human-made structural features if possible. (If you encounter such a feature, sampling would ideally be done at least 50 meters upstream and 200 meters downstream of it.)

Sampling Procedure:

Approach the riffle from downstream. If three people are available to work in the water, one can hold the net and read the instructions; one can perform the sampling; and one can hold the bucket and tools (weed fork, flagging, and big plastic scoop) and be the "timer". If there is a fourth person, he/she can stay on the shore and be the instruction-reader.

1. Place the Surber sampler on the streambed with the opening of the net facing upstream, parallel to the current. Hold the brass frame firmly on the substrate to prevent invertebrates from slipping under the net.

2. While one person holds the net, another person should lift any large rocks (2+ inches) within the frame and wash into the net any organisms crawling on or attached to the rocks. Put the washed rock into the bucket for further “picking” onshore. If a large rock is half inside the sample grid and half outside, only wash the part of the rock that is inside the grid. In such a case, make sure you remove all organisms from the inside half of the rock and then place it in the stream, away from the net, instead of in the bucket.
3. Using both hands, **vigorously** stir the remaining substrate with the weed fork. Stir to a depth of 10 cm (4 inches) for **60 seconds** to loosen organisms. If you encounter more large rocks that interfere with stirring, stop the clock, wash any organisms off the large rocks and into the net, and put the rocks in the bucket. Then start the clock and continue stirring. (The three samples should be stirred in the same way, so observe each other’s stirring technique.) When finished stirring, check to see if some small rocks have entered the net during the stirring. If so, scoop them up, “wash” them in the stream at the mouth of the net, and put the rocks back in the stream.
4. Slowly lift the brass frame off the substrate, tilting the net up and out of the water. Place a flagged weight exactly where the Surber sampling grid was placed. Move upstream to the middle of the riffle and repeat steps 1-3. Again lift the brass frame off the substrate, tilting the net up and out of the water, and place a second flagged weight. Move upstream to the top of the riffle, and repeat steps 1-3 for a third time.
5. After sampling at the third location in the riffle, slowly lift the brass frame off the substrate, tilting the net up and out of the water once more. Keeping the opening of the net above water, use the large plastic scoop to pour water through the net, **from the outside in**, to wash trapped or clinging organisms into the Surber sampler’s “cod”. Place a flagged weight exactly where the Surber grid was placed during the third sample.
6. Carry the net and the bucket to shore. (Avoid standing in the creek whenever possible.) Set the net down on the tarp and twist it to prevent bugs from escaping. Using the magnifying glass and forceps, examine all the rocks in the bucket. Pick off any organisms and place them in the first plastic sample container. **Make sure that any water you use to rinse rocks, equipment, or your hands comes from the screened rinsing jug.** After having a second person check the rocks, return the rocks to the stream. Check the bucket for any “escaped” bugs too.
7. Now remove the cod end of the net and dump it into the plastic sample container. If the cod is “overflowing” with leaf debris, make sure all material is captured from the inside of the net. Use water from the screened rinsing jug, the spray bottle, the flashlight, and long forceps to make sure all bugs are removed from the cod and placed in the plastic sample container. Turn the net inside out and use small forceps to pick off any bugs still clinging to the net and add them to the sample. (If a bug is clinging so tightly to the cod screen or net that you cannot dislodge it, use a tiny drop of alcohol to make it release its “grip”.)
8. Snap the lid on securely, making sure that lid “A” goes onto the composite sample from the first riffle (Riffle A). If the net seems “gritty” or “filmy”, it can be rinsed in the stream (without the cod attached) as long as you check to make sure no new organisms are caught on it.
9. Move upstream to the next riffle suitable for sampling. Repeat entire procedure for Riffle B and again for Riffle C, storing each composite sample in a separate plastic container.

10. Fill in the Macroinvertebrate Sampling Report. Record the riffle locations by measuring, in a straight line, from a reference point to the downstream ends of Riffle A, Riffle B, and Riffle C. Gather the 9 flagged weights and take all equipment immediately to the Stream Team lab. We need to put the organisms in alcohol as soon as possible to prevent deterioration.

Lab Protocol

Equipment:

shallow pans	forceps
magnifying glasses	alcohol
mailing bottles	labels and pens
squirt bottles	500 micron sieve
rubber spatula	plastic spoon

Procedure:

1. Choose a station for preparing your samples for mailing. Keep all bugs at that station only.
2. **ONLY WORK ON ONE PLASTIC CONTAINER AT A TIME.** Open container A and prepare that sample for mailing before opening up container B.
3. Remove any debris or rocks which are larger than the mailing bottle and put them in a shallow pan. Use a magnifying glass and forceps to pick any bugs off the debris or rocks. Place bugs in mailing bottle.
4. “Decant” the remaining sample by swirling the contents of the plastic container and pouring it off through the sieve. (This can be done at a sink or outside.) Add water to the container, swirl, and pour at least five times, until all the organic matter is in the sieve. Check through the remaining sand and rocks to make sure there are no caddis fly cases, snails, or other bugs remaining. Discard the sand and rocks and rinse the plastic container.
5. Use water to wash organic matter to the side of the sieve. Use the rubber spatula or a spoon to transfer contents of the sieve into the mailing bottle. Check the sieve for any clinging organisms, and use alcohol to dislodge any remaining bugs.
6. Fill the mailing bottle to the top with alcohol and put the lid on tightly.
7. Label the mailing bottle with:
Creek Name & Site Location
Date
Stream Team, 360-357-2491
Riffle A B C (*Circle one*)

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Black Lake Ditch

Water Body	Black Lake Ditch	Black Lake Ditch	Black Lake Ditch	Black Lake Ditch
Station	RW Johnson Roa	RW Johnson Road	RW Johnson Road	RW Johnson Road
Client	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/22/04	8/10/05	6/21/06	6/21/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	34	3	34	3	37	3	35	3
D Number Ephemeroptera taxa	3	1	4	1	3	1	3	1
D Number Plecoptera taxa	4	3	2	1	3	1	5	3
D Number Trichoptera taxa	6	3	5	3	6	3	6	3
D Number of long-lived taxa	2	1	2	1	1	1	2	1
D Number of intolerant taxa	0	1	0	1	0	1	1	1
I % Tolerant taxa	29.04	3	21.32	3	14.54	5	9.62	5
D % Predator	1.49	1	26.96	5	1.28	1	2.83	1
D Number of clinger taxa	20	3	21	5	20	3	21	5
I % Dominance (3 taxa)	54.73	3	57.46	3	87.2	1	83.63	1

9 square feet total area sampled starting 2002

TOTAL SCORE		22		26		20		24
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	3160	1252	12726	8667
D EPT taxa richness	13	11	12	14
D Predator richness	9	9	10	9
D Scraper richness	8	8	7	7
D Shredder richness	3	3	3	5
D %Intolerant taxa	0	0	0	0.03
I Hilsenhoff Biotic Index	4.95	5.2	5.35	5.29
I %Collector	75.98	83.47	91.54	86.45
I %Parasite	1.04	0.29	0	0.25
I %Oligochaeta	4.31	7.93	0.45	0.86
I Number tolerant taxa	8	10	8	6
I %Simuliidae	40.98	43.69	63.12	59.18
I %Chironomidae	1.55	1.53	3.69	3.29

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integ

D= Metric value generally decreases with declining biological integrity.

L= Low biological integrity.

M= Moderate biological integrity.

H= High biological integrity.



BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team
 Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.
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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Chambers Creek

Water Body	Chambers Creek		Chambers Creek		Chambers Creek		Chambers Creek	
Station	Public Health		Public Health		Public Health		Public Health	
Client	9/23/04		9/15/05		9/7/06		9/20/07	
Date	9/23/04		9/15/05		9/7/06		9/20/07	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	57	5	59	5	39	3	54	5
D Number Ephemeroptera taxa	7	3	9	5	6	3	8	3
D Number Plecoptera taxa	10	5	7	3	7	3	10	5
D Number Trichoptera taxa	11	5	11	5	11	5	10	5
D Number of long-lived taxa	9	5	6	5	4	3	5	5
D Number of intolerant taxa	1	1	2	1	0	1	0	1
I % Tolerant taxa	12.83	5	17.53	5	16.57	5	20.48	3
D % Predator	35.6	5	14.4	3	17.15	3	23.02	5
D Number of clinger taxa	>20	5	>20	5	>20	5	>20	5
I % Dominance (3 taxa)	42.78	5	39.05	5	43.15	5	30.76	5
TOTAL SCORE	44		42		36		42	

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
 Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1855		2561		419		1580	
D EPT taxa richness	28		27		24		28	
D Predator richness	15		15		12		17	
D Scraper richness	15		15		10		12	
D Shredder richness	10		9		6		8	
D %Intolerant taxa	3.16		4.14		0		0	
I Hilsenhoff Biotic Index	3.07		4.27		4		3.57	
I %Collector	38.24		65.16		67.43		43.2	
I %Parasite	1.1		1.41		1.15		2.65	
I %Oligochaeta	4.97		20.89		9.14		2.58	
I Number tolerant taxa	8		7		3		6	
I %Simuliidae	9.81		6.01		20.29		4.62	
I %Chironomidae	4.26		9.76		8		3.56	

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity.

D= Metric value generally decreases with declining biological integrity.

L= Low biological integrity.
 M= Moderate biological integrity.
 H= High biological integrity.



BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

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Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Deschutes River @ Pioneer Park

Water Body	Deschutes River	Deschutes River
Station	Pioneer Park	Pioneer Park
Client	Stream Team	Stream Team
Date	8/19/06	8/18/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	69	5	56	5						
D Number Ephemeroptera taxa	11	5	11	5						
D Number Plecoptera taxa	9	5	5	3						
D Number Trichoptera taxa	11	5	8	3						
D Number of long-lived taxa	5	5	2	1						
D Number of intolerant taxa	1	1	1	1						
I % Tolerant taxa	11.62	5	24.16	3						
D % Predator	5.52	1	1.51	1						
D Number of clinger taxa	>20	5	>20	5						
I % Dominance (3 taxa)	27.43	5	45.09	5						
TOTAL SCORE		42		32		0		0		0

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	5037		14446							
D EPT taxa richness	31		24							
D Predator richness	18		8							
D Scraper richness	18		13							
D Shredder richness	5		4							
D %Intolerant taxa	0.1		0.07							
I Hilsenhoff Biotic Index	4.59		4.63							
I %Collector	55.69		71.78							
I %Parasite	3.75		2.62							
I %Oligochaeta	0.33		0.17							
I Number tolerant taxa	13		10							
I %Simuliidae	13.17		5.43							
I %Chironomidae	37.95		40.79							

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity

D= Metric value generally decreases with declining biological integrity.

L= Low biological integrity.

M= Moderate biological integrity.

H= High biological integrity.



BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team
 Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.
 Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.
 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Ellis Creek @ Priest Point Park

Water Body	Ellis Creek	Ellis Creek	Ellis Creek
Station	Priest Point Park	Priest Point Park	Priest Point Park
Client	Stream Team	Stream Team	Stream Team
Date	8/10/05	8/2/06	7/14/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	52	5	57	5	52	5		
D Number Ephemeroptera taxa	5	3	6	3	4	1		
D Number Plecoptera taxa	9	5	9	5	12	5		
D Number Trichoptera taxa	10	5	10	5	10	5		
D Number of long-lived taxa	4	3	7	5	6	5		
D Number of intolerant taxa	3	3	4	5	4	5		
I % Tolerant taxa	3.77	5	5.67	5	10.88	5		
D % Predator	32.76	5	30.16	5	37.65	5		
D Number of clinger taxa	>20	5	>20	5	33	5		
I % Dominance (3 taxa)	40.44	5	36.09	5	46.53	5		
TOTAL SCORE		44		48		46		0

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
 Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	983	1476	1431		
D EPT taxa richness	24	25	26		
D Predator richness	18	20	18		
D Scraper richness	9	12	7		
D Shredder richness	5	7	8		
D %Intolerant taxa	0.48	0.48	1.09		
I Hilsenhoff Biotic Index	3.69	3.74	3.05		
I %Collector	49.7	47.27	29.53		
I %Parasite	1.71	0.49	0.75		
I %Oligochaeta	0.49	0.65	0.25		
I Number tolerant taxa	4	4	2		
I %Simuliidae	2.56	9.57	5.36		
I %Chironomidae	17.54	18.49	16.57		

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity.
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BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Fox Creek @ Pleasant Glade NE

Water Body	Fox Creek	Fox Creek	Fox Creek	Fox Creek
Station	Pleasant Glade NE	Pleasant Glade NE	Pleasant Glade NE	Pleasant Glade NE
Client	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/10/04	8/16/05	8/2/06	8/15/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	39	3	31	3	38	3	33	3		
D Number Ephemeroptera taxa	3	1	2	1	3	1	2	1		
D Number Plecoptera taxa	2	1	2	1	2	1	1	1		
D Number Trichoptera taxa	2	1	0	1	3	1	1	1		
D Number of long-lived taxa	1	1	1	1	1	1	0	1		
D Number of intolerant taxa	0	1	1	1	3	3	0	1		
I % Tolerant taxa	11.87	5	8.09	5	8.53	5	18.08	5		
D % Predator	3.22	1	2.93	1	5.5	1	8.82	1		
D Number of clinger taxa	16	3	13	3	15	3	12	3		
I % Dominance (3 taxa)	71.32	3	75.75	1	58.49	3	62.38	3		

TOTAL SCORE	 20	 18	 22	 20	 0
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	7221	12419	8299	3634		
D EPT taxa richness	7	4	8	4		
D Predator richness	7	5	9	12		
D Scraper richness	7	5	4	2		
D Shredder richness	5	4	6	1		
D %Intolerant taxa	0	0.03	0.6	0		
I Hilsenhoff Biotic Index	6.69	6.58	6.18	6.61		
I %Collector	81.47	82.72	73.55	76.19		
I %Parasite	0.54	0.9	0.82	0.22		
I %Oligochaeta	0.51	2.65	10.92	0.38		
I Number tolerant taxa	13	13	9	10		
I %Simuliidae	24.28	31.02	17.8	43.56		
I %Chironomidae	63.87	54.38	52.84	41.61		

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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L= Low biological integrity.

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BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team
 Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.
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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Green Cove Creek

Water Body	Green Cove Creek	Green Cove Creek	Green Cove Creek	Green Cove Creek						
Station	36th Avenue NW	Mouth Site	@ 36th Avenue NE	Mouth Site						
Client	Stream Team	Public Health	Stream Team	Public Health						
Date	7/22/06	8/23/06	8/11/07	9/12/07						
METRIC	Value	Score	Value	Score	Value	Score	Value	Score		
D Total number of taxa	50	5	32	3	53	5	58	5		
D Number Ephemeroptera taxa	3	1	3	1	5	3	5	3		
D Number Plecoptera taxa	7	3	5	3	9	5	8	5		
D Number Trichoptera taxa	9	3	6	3	10	5	9	3		
D Number of long-lived taxa	2	1	5	5	2	1	7	5		
D Number of intolerant taxa	2	1	1	1	3	3	3	3		
I % Tolerant taxa	1.74	5	10.06	5	7.77	5	29.67	3		
D % Predator	18.47	3	17.88	3	19.36	3	17.13	3		
D Number of clinger taxa	>20	5	18	3	30	5	>20	5		
I % Dominance (3 taxa)	57.85	3	56.24	3	48.51	5	47.21	5		
TOTAL SCORE		30		30		40		40		

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
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OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	7003	643	9640	1651		
D EPT taxa richness	19	14	24	22		
D Predator richness	15	12	17	16		
D Scraper richness	6	5	10	11		
D Shredder richness	7	4	7	7		
D %Intolerant taxa	0.08	0.37	1.66	1.38		
I Hilsenhoff Biotic Index	4.03	4.06	3.66	3.71		
I %Collector	46.7	51.21	42.77	29.76		
I %Parasite	1.13	0	2.61	1.38		
I %Oligochaeta	0.56	3.91	0.1	0.15		
I Number tolerant taxa	6	4	5	5		
I %Simuliidae	0.58	4.84	0.05	0.73		
I %Chironomidae	40.57	25.88	29.15	9.06		

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

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Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Indian Creek @ Wheeler Avenue SE

Water Body	Indian Creek	Indian Creek	Indian Creek	Indian Creek	Indian Creek
Station	Wheeler Ave SE	Wheeler Ave SE	Wheeler Ave SE	Wheeler Ave SE	Wheeler Ave SE
Client	Stream Team	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/14/03	8/10/04	8/17/05	8/5/06	7/6/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	41	5	36	3	40	3	40	3	40	3
D Number Ephemeroptera taxa	4	1	3	1	3	1	4	1	3	1
D Number Plecoptera taxa	6	3	5	3	6	3	5	3	5	3
D Number Trichoptera taxa	8	3	6	3	5	3	5	3	6	3
D Number of long-lived taxa	4	3	2	1	4	3	5	5	4	3
D Number of intolerant taxa	2	1	1	1	3	3	1	1	2	1
I % Tolerant taxa	10.22	5	7.66	5	3.08	5	3.67	5	6.83	5
D % Predator	23.53	5	24.52	5	24.38	5	21.51	5	24.42	5
D Number of clinger taxa	>20	5	20	3	21	5	22	5	24	5
I % Dominance (3 taxa)	36.07	5	42.88	5	55.33	3	52.29	3	37.94	5

TOTAL SCORE 36 30 34 34 34

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1921	547	1045	1435	789
D EPT taxa richness	18	14	14	14	14
D Predator richness	12	10	9	11	9
D Scraper richness	6	7	7	8	10
D Shredder richness	6	5	7	5	8
D %Intolerant taxa	8.48	0.22	4.57	0.33	0.45
I Hilsenhoff Biotic Index	3.86	3.58	3.67	3.49	3.75
I %Collector	49.96	55.36	59.41	60.07	55.98
I %Parasite	1.06	0.22	0.68	0.42	0.45
I %Oligochaeta	5.98	11.16	21.08	3.34	5.31
I Number tolerant taxa	2	3	3	4	5
I %Simuliidae	14.45	5.47	4.35	2	8.5
I %Chironomidae	9.41	3.06	6.99	10.93	13.35

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Kennedy Creek

Water Body	Kennedy Creek		Kennedy Creek		Kennedy Creek		Kennedy Creek		Kennedy Creek	
Station	Kennedy Creek		Kennedy Creek		Kennedy Creek		Kennedy Creek		Kennedy Creek	
Client	Public Health		Public Health		Public Health		Public Health		Public Health	
Date	9/3/03		8/31/04		9/2/05		8/29/06		8/30/07	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	48	5	42	5	64	5	32	3	49	5
D Number Ephemeroptera taxa	9	5	8	3	9	5	5	3	8	3
D Number Plecoptera taxa	10	5	9	5	10	5	6	3	8	5
D Number Trichoptera taxa	6	3	5	3	9	3	4	1	6	3
D Number of long-lived taxa	6	5	6	5	5	5	5	5	5	5
D Number of intolerant taxa	3	3	3	3	1	1	0	1	3	3
I % Tolerant taxa	18.13	5	11.42	5	16.85	5	21.84	3	10.34	5
D % Predator	14.27	3	12.78	3	8.04	1	22.88	5	14.29	3
D Number of clinger taxa	>20	5	>20	5	>20	5	21	5	>20	5
I % Dominance (3 taxa)	52.64	3	51.84	3	40.04	5	45.12	5	49.52	5
9 square feet total area sampled starting 2002										
TOTAL SCORE		42		40		40		34		42

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
 Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1818	3550	3345	920	4234
D EPT taxa richness	25	22	28	15	22
D Predator richness	14	13	16	8	11
D Scraper richness	17	13	17	8	15
D Shredder richness	4	4	6	3	5
D %Intolerant taxa	1.37	0.24	0.43	0	0.29
I Hilsenhoff Biotic Index	2.78	3	3.85	3.37	3.17
I %Collector	25.5	40.28	53.03	39.91	35.74
I %Parasite	0.07	0.34	0.14	0.26	2.04
I %Oligochaeta	1.56	0.61	2.9	2.73	1.36
I Number tolerant taxa	5	5	9	4	4
I %Simuliidae	1.97	7.52	12.31	7.15	3.45
I %Chironomidae	7.42	21.17	16.71	2.21	16.68

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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 BIBI scores between 25-39.
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Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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Little McAllister Creek @ Meadows

Water Body	Little McAllister	Little McAllister	Little McAllister
Station	Meadows	Meadows	Meadows
Client	Stream Team	Stream Team	Stream Team
Date	8/11/05	2006 ?Aug	8/4/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	44	5	48	5	44	5				
D Number Ephemeroptera taxa	1	1	2	1	2	1				
D Number Plecoptera taxa	6	3	3	1	4	3				
D Number Trichoptera taxa	3	1	5	3	8	3				
D Number of long-lived taxa	3	3	3	3	2	1				
D Number of intolerant taxa	1	1	0	1	1	1				
I % Tolerant taxa	35.28	3	6.82	5	9.1	5				
D % Predator	11.34	3	10.76	3	44.91	5				
D Number of clinger taxa	21	5	21	5	26	5				
I % Dominance (3 taxa)	44.51	5	63.95	3	37.59	5				

TOTAL SCORE	30	30	34	0	0
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	960	1893	882				
D EPT taxa richness	10	10	14				
D Predator richness	12	14	14				
D Scraper richness	4	5	7				
D Shredder richness	5	5	5				
D %Intolerant taxa	0.62	0	0.14				
I Hilsenhoff Biotic Index	5.03	5.89	4.09				
I %Collector	44.49	74.66	36.66				
I %Parasite	9.1	1.03	2.44				
I %Oligochaeta	8.35	0.8	2.58				
I Number tolerant taxa	9	9	9				
I %Simuliidae	0.75	53.75	10.72				
I %Chironomidae	15.59	25.09	21.57				

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

McLane Creek

Water Body	McLane Creek		McLane Creek		McLane Creek		McLane Creek			
Station	DNR Trail		Mouth at Delphi Rd		DNR Trail		Mouth at Delphi Rd			
Client	Stream Team		Public Health		Stream Team		Public Health			
Date	2006	August	9/6/06		7/28/07		9/14/07			
METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	55	5	47	5	62	5	58	5		
D Number Ephemeroptera taxa	8	3	6	3	10	5	9	5		
D Number Plecoptera taxa	10	5	9	5	11	5	7	3		
D Number Trichoptera taxa	12	5	3	1	12	5	6	3		
D Number of long-lived taxa	4	3	4	3	4	3	4	3		
D Number of intolerant taxa	6	5	0	1	7	5	2	1		
I % Tolerant taxa	14.58	5	9.91	5	24.66	3	10.53	5		
D % Predator	31.66	5	24.88	5	16.95	3	18.48	3		
D Number of clinger taxa	>20	5	>20	5	>20	5	>20	5		
I % Dominance (3 taxa)	60.63	3	35.61	5	49.6	5	50.94	3		

TOTAL SCORE	44	38	44	36	0
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
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OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	3006	736	2558	3493		
D EPT taxa richness	30	18	33	22		
D Predator richness	14	11	17	15		
D Scraper richness	12	10	16	15		
D Shredder richness	10	6	6	5		
D %Intolerant taxa	0.81	0	1.26	0.14		
I Hilsenhoff Biotic Index	3.11	3.42	4.05	2.84		
I %Collector	25.29	38.69	53.57	31.24		
I %Parasite	0.89	0.65	0.84	1.2		
I %Oligochaeta	0.34	7.48	0.23	1.68		
I Number tolerant taxa	5	8	5	11		
I %Simuliidae	1.7	0.81	15.86	0.99		
I %Chironomidae	11.88	14.63	22.79	6		

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

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Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Mission Creek

Water Body	Mission Creek	Mission Creek	Mission Creek	Mission Creek	Mission Creek
Station	Bethel Street NE	Bethel Street NE	Bethel Street NE	Bethel Street NE	Bethel Street NE
Client	Stream Team	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/4/03	8/5/04	8/20/05	7/15/06	8/18/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	64	5	62	5	44	5	62	5	58	5
D Number Ephemeroptera taxa	6	3	4	1	4	1	3	1	6	3
D Number Plecoptera taxa	10	5	14	5	6	3	10	5	9	5
D Number Trichoptera taxa	11	5	11	5	9	3	10	5	9	3
D Number of long-lived taxa	4	3	7	5	3	3	6	5	7	5
D Number of intolerant taxa	6	5	8	5	2	1	4	5	3	3
I % Tolerant taxa	5.41	5	3.6	5	2.87	5	4.24	5	4.34	5
D % Predator	12.55	3	32.06	5	15.9	3	24.79	5	16.42	3
D Number of clinger taxa	>20	5	>20	5	23	5	>20	5	>20	5
I % Dominance (3 taxa)	56.75	3	61.65	3	55.89	3	44.19	5	63.35	3

TOTAL SCORE	 42	 44	 32	 46	 40
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	5332	2794	1167	1527	5572
D EPT taxa richness	27	29	19	23	24
D Predator richness	22	24	13	23	19
D Scraper richness	10	7	5	7	9
D Shredder richness	9	11	6	10	9
D %Intolerant taxa	1.41	0.78	0.51	0.63	0.69
I Hilsenhoff Biotic Index	5.19	4.23	4.95	4.09	4.7
I %Collector	66.75	54.94	65.32	42.96	61.99
I %Parasite	0.92	0.26	0.62	1.1	0.43
I %Oligochaeta	5.22	1.84	11.79	1.65	0.86
I Number tolerant taxa	5	2	2	3	2
I %Simuliidae	0.6	1.2	1.33	3.45	1.33
I %Chironomidae	57.27	41.95	53.95	40.13	47.12

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity

D= Metric value generally decreases with declining biological integrity.

L= Low biological integrity.

M= Moderate biological integrity.

H= High biological integrity.



BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Moxlie Creek @ Watershed Park

Water Body	Moxlie Creek	Moxlie Creek	Moxlie Creek	Moxlie Creek	Moxlie Creek
Station	Watershed Park	Watershed Park	Watershed Park	Watershed Park	Watershed Park
Client	Stream Team	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/4/03	8/5/04	8/17/05	8/2/06	8/25/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	23	3	28	3	33	3	26	3	37	3
D Number Ephemeroptera taxa	1	1	0	1	2	1	2	1	2	1
D Number Plecoptera taxa	5	3	2	1	4	3	2	1	2	1
D Number Trichoptera taxa	0	1	1	1	2	1	5	3	3	1
D Number of long-lived taxa	1	1	2	1	3	3	5	5	3	3
D Number of intolerant taxa	1	1	1	1	3	3	1	1	1	1
I % Tolerant taxa	18.92	5	29.56	3	10.99	5	6.63	5	10.16	5
D % Predator	20.26	5	6.94	1	16.17	3	15.28	3	27.1	5
D Number of clinger taxa	11	3	9	1	16	3	15	3	14	3
I % Dominance (3 taxa)	27.03	5	78.7	1	54.69	3	76.09	1	37.71	5

TOTAL SCORE		28		14		28		26		28
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	89	275	370	416	283
D EPT taxa richness	6	3	8	9	7
D Predator richness	5	6	7	8	9
D Scraper richness	1	1	5	5	6
D Shredder richness	7	3	6	5	5
D %Intolerant taxa	1.35	0.43	0.96	0.29	0.42
I Hilsenhoff Biotic Index	5.08	6.56	5.3	5.23	5.04
I %Collector	41.89	39.97	57.89	71.77	37.27
I %Parasite	2.7	0.43	1.29	0.86	1.27
I %Oligochaeta	8.11	1.74	7.44	3.17	6.78
I Number tolerant taxa	3	4	7	2	6
I %Simuliidae	9.46	1.74	37.86	63.98	11.86
I %Chironomidae	31.08	81.3	26.21	6.63	33.47

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Palm Creek @ Pleasant Glade NE

Water Body	Palm Creek	Palm Creek	Palm Creek	Palm Creek
Station	Pleasant Glade NE	Pleasant Glade NE	Pleasant Glade NE	Pleasant Glade NE
Client	Stream Team	Stream Team	Stream Team	Stream Team
Date	8/27/04	8/22/05	8/14/06	7/31/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	57	5	61	5	56	5	54	5		
D Number Ephemeroptera taxa	6	3	6	3	4	1	6	3		
D Number Plecoptera taxa	8	5	9	5	11	5	9	5		
D Number Trichoptera taxa	11	5	11	5	9	3	10	5		
D Number of long-lived taxa	6	5	5	5	5	5	4	3		
D Number of intolerant taxa	2	1	4	5	3	3	5	5		
I % Tolerant taxa	3.58	5	1.07	5	3.17	5	2.04	5		
D % Predator	27.31	5	26.93	5	26.58	5	45.93	5		
D Number of clinger taxa	>20	5	>20	5	>20	5	>20	5		
I % Dominance (3 taxa)	36.95	5	39.05	5	32.56	5	36.56	5		

TOTAL SCORE		44		48		42		46		0
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BIOLOGICAL CONDITION CATEGORY


















































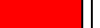


Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	968		1849		1136		1175			
D EPT taxa richness	25		26		24		25			
D Predator richness	16		20		17		15			
D Scraper richness	11		8		6		7			
D Shredder richness	11		11		12		11			
D %Intolerant taxa	0.37		5.33		0.64		1.83			
I Hilsenhoff Biotic Index	3.5		4.03		4.07		3.23			
I %Collector	39.4		49.64		56.16		33.92			
I %Parasite	9.39		7.13		4.96		2.44			
I %Oligochaeta	2.72		1.81		1.26		0.71			
I Number tolerant taxa	7		2		6		4			
I %Simuliidae	1.24		1.34		3.58		2.55			
I %Chironomidae	18.79		34.13		32.46		19.04			

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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 Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.
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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Percival Creek

Water Body	Percival Creek	Percival Creek	Percival Creek	Percival Creek
Station	SPSCC	Mouth @ ft bridge	SPSCC	Mouth @ ft bridge
Client	Stream Team	Public Health	Stream Team	Public Health
Date	8/5/06	8/31/06	8/4/07	9/19/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	40	3	23	3	39	3	37	3
D Number Ephemeroptera taxa	5	3	3	1	4	1	4	1
D Number Plecoptera taxa	9	3	7	3	7	3	10	5
D Number Trichoptera taxa	7	3	4	1	7	3	7	3
D Number of long-lived taxa	5	5	3	1	5	5	3	3
D Number of intolerant taxa	1	1	0	1	1	1	1	1
I % Tolerant taxa	18.42	5	8.35	5	9.45	5	22.67	3
D % Predator	15.66	3	10.19	3	21.21	5	3.94	1
D Number of clinger taxa	>20	5	18	3	27	5	28	5
I % Dominance (3 taxa)	53.81	3	69.6	3	60.97	3	69.24	3
TOTAL SCORE		34		24		34		28

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
 Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1255	516	988	1596
D EPT taxa richness	21	14	18	21
D Predator richness	11	9	11	10
D Scraper richness	8	6	8	9
D Shredder richness	8	3	9	6
D %Intolerant taxa	0.1	0	0.12	0.08
I Hilsenhoff Biotic Index	3.46	2.81	3.53	1.96
I %Collector	49.91	55.44	59.86	23.44
I %Parasite	0.86	0	1.33	0.23
I %Oligochaeta	5.73	6.26	4.36	0.38
I Number tolerant taxa	4	4	5	6
I %Simuliidae	1.81	2.09	1.21	1.65
I %Chironomidae	3.44	0.93	3.03	1.13

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat
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Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Perry Creek

Water Body	Perry Creek		Perry Creek		Perry Creek		Perry Creek		Perry Creek	
Station										
Client	Public Health		Public Health		Public Health		Public Health		Public Health	
Date	9/4/03		9/8/04		8/26/05		8/30/06		8/8/07	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	55	5	58	5	59	5	48	5	61	5
D Number Ephemeroptera taxa	9	5	8	3	10	5	7	3	9	5
D Number Plecoptera taxa	11	5	11	5	9	5	6	3	12	5
D Number Trichoptera taxa	8	3	9	3	8	3	7	3	9	3
D Number of long-lived taxa	4	3	6	5	4	3	4	3	7	5
D Number of intolerant taxa	3	3	6	5	4	5	2	1	5	5
I % Tolerant taxa	7.95	5	16.1	5	9.33	5	10.68	5	11.84	5
D % Predator	21.69	5	32.97	5	8.17	1	36.92	5	18.09	3
D Number of clinger taxa	>20	5	>20	5	>20	5	>20	5	>20	5
I % Dominance (3 taxa)	45.65	5	45.31	5	59.37	3	38.17	5	38.84	5

9 square feet total area sampled starting 2002

TOTAL SCORE		44		46		40		38		46
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BIOLOGICAL CONDITION CATEGORY


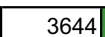








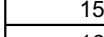

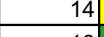


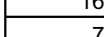

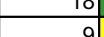


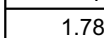

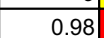







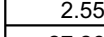

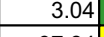


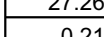

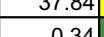


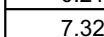

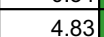


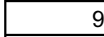

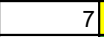


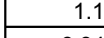

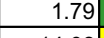


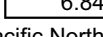
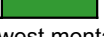
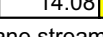


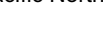
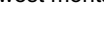
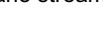


Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Each metric scored: 1=low, 3=moderate, 5=high

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	3689		3644		3947		941		6468	
D EPT taxa richness	28		28		27		20		30	
D Predator richness	15		14		17		11		17	
D Scraper richness	16		18		17		15		18	
D Shredder richness	7		9		6		4		8	
D %Intolerant taxa	1.78		0.98		0.73		0.89		0.87	
I Hilsenhoff Biotic Index	2.55		3.04		4.46		3.31		3.45	
I %Collector	27.26		37.84		60.21		31.91		39.37	
I %Parasite	0.21		0.34		0.24		0.76		1.96	
I %Oligochaeta	7.32		4.83		11.31		7.63		3.81	
I Number tolerant taxa	9		7		10		8		8	
I %Simuliidae	1.1		1.79		0.15		1.78		0.09	
I %Chironomidae	6.84		14.08		36.72		14.89		23.35	

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integr

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L= Low biological integrity.

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BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Schneider Creek (Budd Inlet)

Water Body	Schneider Creek	Schneider Creek
Station	West Bay Drive	West Bay Drive
Client	Stream Team	Stream Team
Date	8/14/06	7/6/07

METRIC	Value	Score		Value	Score				
D Total number of taxa	37	3		32	3				
D Number Ephemeroptera taxa	2	1		3	1				
D Number Plecoptera taxa	6	3		8	5				
D Number Trichoptera taxa	3	1		2	3				
D Number of long-lived taxa	1	1		2	3				
D Number of intolerant taxa	2	1		2	3				
I % Tolerant taxa	10.23	5		18.77	5				
D % Predator	11.92	3		13.7	3				
D Number of clinger taxa	17	3		19	3				
I % Dominance (3 taxa)	42.97	5		50.25	3				
TOTAL SCORE		26		32					

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
 Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1217			472					
D EPT taxa richness	11			13					
D Predator richness	11			8					
D Scraper richness	5			6					
D Shredder richness	3			5					
D %Intolerant taxa	0.99			0.76					
I Hilsenhoff Biotic Index	4.99			3.86					
I %Collector	56.65			44.92					
I %Parasite	1.08			0.76					
I %Oligochaeta	4.13			1.02					
I Number tolerant taxa	1			3					
I %Simuliidae	17.7			3.05					
I %Chironomidae	46.51			41.37					

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

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BIBI scores between 0-24.
 BIBI scores between 25-39.
 BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team

Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.

Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.

Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Schneider Creek (Totten Inlet Watershed)

Water Body	Schneider Creek	Schneider Creek
Station	at Pneumonia Gulch Ln	at Pneumonia Gulch Ln
Client	Public Health	Public Health
Date	8/24/06	9/10/07

METRIC	Value	Score	Value	Score
D Total number of taxa	41	5	55	5
D Number Ephemeroptera taxa	7	3	7	3
D Number Plecoptera taxa	7	3	10	5
D Number Trichoptera taxa	6	3	8	3
D Number of long-lived taxa	4	3	7	5
D Number of intolerant taxa	2	1	5	5
I % Tolerant taxa	22.16	3	32.52	3
D % Predator	26.3	5	17.76	3
D Number of clinger taxa	>20	5	>20	5
I % Dominance (3 taxa)	49.21	5	40.48	5

TOTAL SCORE		36		42
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BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50.

Note that this BIBI based on average/summation of 3 replicates, not on each individual replicate.

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	1301		4950	
D EPT taxa richness	20		25	
D Predator richness	12		16	
D Scraper richness	12		16	
D Shredder richness	4		4	
D %Intolerant taxa	0.18		0.91	
I Hilsenhoff Biotic Index	2.87		3.14	
I %Collector	13.59		25.44	
I %Parasite	0.18		0.82	
I %Oligochaeta	4.42		2.32	
I Number tolerant taxa	6		4	
I %Simuliidae	0.64		0.87	
I %Chironomidae	1.84		1.93	

L, M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity.

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BIBI scores between 0-24.

BIBI scores between 25-39.

BIBI scores >40.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

WA: Thurston County Public Health and Social Services Department and Water & Waste Management-Stream Team
 Surber sampler, 500 micron mesh, 3 point composite per replicate= 3 ft2 per replicate after 2002, 1 ft2 before 2002, erosional habitat.
 Subsampling: 500 organism minimum per replicate or entire sample. Level 3 PNW standard taxonomic effort.
 Abundances adjusted to a full sample and square meter basis. Analysis by Aquatic Biology Associates, Inc., Corvallis, OR.

Woodard Creek

Water Body	Woodard Creek		Woodard Creek		Woodard Creek		Woodard Creek		Woodard Creek	
Station										
Client	Public Health		Public Health		Public Health		Public Health		Public Health	
Date	8/29/03		8/12/04		9/9/05		9/8/06		9/11/07	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	53	5	48	5	60	5	38	3	47	5
D Number Ephemeroptera taxa	7	3	7	3	10	5	4	1	7	3
D Number Plecoptera taxa	10	5	8	5	9	5	9	5	9	5
D Number Trichoptera taxa	9	3	11	5	10	5	8	3	10	5
D Number of long-lived taxa	5	5	6	5	5	5	4	3	4	3
D Number of intolerant taxa	2	1	1	1	2	1	2	1	1	1
I % Tolerant taxa	5.16	5	6.78	5	6.98	5	9.59	5	7.93	5
D % Predator	29.03	5	23.13	5	20.92	5	22.28	5	32.13	5
D Number of clinger taxa	>20	5	>20	5	>20	5	>20	5	>20	5
I % Dominance (3 taxa)	53.73	3	49.27	5	42.45	5	39.12	5	50.28	3
9 square feet total area sampled starting 2002										
TOTAL SCORE	40		44		46		36		40	

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
 Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high
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OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	3214	1484	2926	463	1735
D EPT taxa richness	26	26	29	21	26
D Predator richness	15	10	16	12	12
D Scraper richness	15	15	15	9	10
D Shredder richness	8	9	8	5	9
D %Intolerant taxa	0.77	0.65	1.31	0.52	0.21
I Hilsenhoff Biotic Index	3.5	3.78	3.79	3.86	3.46
I %Collector	53.73	62.98	54.57	59.07	52.27
I %Parasite	0.14	0.89	0.98	0.78	0.76
I %Oligochaeta	10.86	7.1	18.28	10.62	3.31
I Number tolerant taxa	4	4	7	3	4
I %Simuliidae	7.31	10.48	7.98	10.62	8.83
I %Chironomidae	13.48	12.66	13.01	13.73	11.45

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Woodland Creek @ Pleasant Glade Road

Water Body	Woodland Creek	Woodland Creek	Woodland Creek
Station	Pleasant Glade Rd.	Pleasant Glade Rd.	Pleasant Glade Rd.
Client	Stream Team	Stream Team	Stream Team
Date	8/13/05	8/12/06	7/26/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	37	3	44	5	44	5		
D Number Ephemeroptera taxa	4	1	5	3	4	1		
D Number Plecoptera taxa	4	1	8	3	8	5		
D Number Trichoptera taxa	6	3	8	3	7	3		
D Number of long-lived taxa	3	3	4	3	4	3		
D Number of intolerant taxa	0	1	1	1	1	1		
I % Tolerant taxa	5.64	5	8.98	5	6.71	5		
D % Predator	13.98	3	8.99	1	12.43	3		
D Number of clinger taxa	19	3	>20	5	27	5		
I % Dominance (3 taxa)	53.15	3	67.21	3	64.89	3		

TOTAL SCORE 26 32 34 0 0

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.
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OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	532	1402	2647		
D EPT taxa richness	14	21	19		
D Predator richness	6	12	13		
D Scraper richness	8	9	8		
D Shredder richness	5	7	6		
D %Intolerant taxa	0	0.09	0.05		
I Hilsenhoff Biotic Index	4.27	4.45	4.58		
I %Collector	64.9	75.33	73.88		
I %Parasite	1.35	1.11	0.36		
I %Oligochaeta	4.73	3.07	4.34		
I Number tolerant taxa	2	3	5		
I %Simuliidae	35.36	43.55	48.46		
I %Chironomidae	11.04	4.7	6.92		

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Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

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Woodland Creek @ Draham Road

Water Body	Woodland Creek	Woodland Creek	Woodland Creek
Station	Draham Road	Draham Road	Draham Road
Client	Stream Team	Stream Team	Stream Team
Date	8/13/05	8/13/06	8/28/07

METRIC	Value	Score	Value	Score	Value	Score	Value	Score
D Total number of taxa	46	5	45	5	43	5		
D Number Ephemeroptera taxa	4	1	1	1	4	1		
D Number Plecoptera taxa	8	5	8	3	10	5		
D Number Trichoptera taxa	8	3	9	3	7	3		
D Number of long-lived taxa	3	3	4	3	3	3		
D Number of intolerant taxa	1	1	2	1	2	1		
I % Tolerant taxa	12.92	5	7.24	5	8.99	5		
D % Predator	18.19	3	7.34	1	21.14	5		
D Number of clinger taxa	>20	5	>20	5	>20	5		
I % Dominance (3 taxa)	42.94	5	74.67	3	44.5	5		

TOTAL SCORE	36	30	38	0	0
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BIOLOGICAL CONDITION CATEGORY

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OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

Total abundance (m2)	4587	2626	6005		
D EPT taxa richness	20	18	21		
D Predator richness	13	12	13		
D Scraper richness	9	7	7		
D Shredder richness	6	9	6		
D %Intolerant taxa	0.08	0.44	0.59		
I Hilsenhoff Biotic Index	3.91	5.2	4.04		
I %Collector	63.2	84.45	57.65		
I %Parasite	2.03	1.94	1.58		
I %Oligochaeta	1.88	1.06	0.65		
I Number tolerant taxa	6	6	4		
I %Simuliidae	7.1	60.64	25.96		
I %Chironomidae	18.71	9.21	12.04		

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