Technical Report WAS04-001

Assessment of Thermo Fluids Spill on Macroinvertebrate Communities of Johnson Creek

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Introduction

The Oregon Department of Environmental Quality (ODEQ) Watershed Assessment Section was asked to perform a Natural Resource Damage Assessment on the benthic community of Johnson Creek following the suppression of a fire and the subsequent run-off of contaminated water from the Thermo Fluids facility in Southeast Portland. The Thermo Fluids facility is located at 6400 Se 101st near Interstate 205 and Foster Road in Portland, Oregon. Contaminated water from the site flowed into a series of ditches that ultimately discharged into Johnson Creek at approximately river mile 12.

To assess the impact on the benthic community a set of six sites were sampled upstream and downstream of the discharge of run-off water. Our primary objective was to document the macroinvertebrate community composition and determine if biological impairment due to the spill/run-off was apparent. No chemical samples or physical habitat measurements were collected as part of this macroinvertebrate assessment. Separate chemical samples of Johnson Creek were collected and analyzed by DEQ staff but are not discussed here.

Sample sites

The following table lists the sample sites in Johnson Creek that were sampled. Sites were selected based on suitable riffle habitat, relatively easy access, and previously established sampling locations. Three sites were upstream of the Thermo Fluids outfall and were intended to approximate a less impacted condition. Three sites downstream were chosen to document any near field impact from the spill, as well as, the extent of any far field impact downstream.

Table 1- Johnson Creek Sampling Sites for Macroinvertebrates – March 18th, 2004

Station_Key	Site	Location
11325	Johnson Creek at Foster Road	~3.7 miles upstream
10856	Johnson Creek at Leach Botanical Gardens	~2.2 miles upstream
31340	Johnson Creek at just u/s Thermo Fluids outfall	100 feet upstream
31335	Johnson Creek at just d/s Thermo Fluids outfall	150 feet downstream
11625	Johnson Creek at 82nd Avenue	~1.0 miles downstream
30346	Johnson Creek at Tideman Johnson Park	~4.0 miles downstream

Methods

We sampled all sites on 18 March 2004 between 1315 and 1630 hours. Macroinvertebrate samples were collected from riffles at each site according to standardized ODEQ protocols (ODEQ 2003). Samples were collected from a one-foot by one-foot substrate area using a 500-micron D-frame kick net. Eight randomly selected areas were sampled at each stream site. The eight samples were composited in a single container and preserved with 95% ethanol. Macroinvertebrates (target of 500 specimens) were sorted from each sample at the contract laboratory, and all organisms were identified to the lowest possible taxon (usually genus).

Data Analysis. We calculated ten community structure metrics for each macroinvertebrate sample collected. From these metrics we can calculate a multimetric score. These metrics are used in an analysis which integrates community, population, and biological functions (Barbour et

al. 1994). Each metric was individually scored (1, 3, or 5) with higher scores (>30) indicating lower levels of biological impairment (Table 2). The metrics and scoring criteria were based on the Level 3 Assessment from Oregon Watershed Enhancement Board's Oregon Plan for Salmon and Watershed protocol (OWEB 2003). After calculating each individual metric score, they were added together for the total biotic index score.

The metrics and associated scoring criteria for Level 3 metric assessments are described below.

Taxa Richness - The total number of invertebrate taxa identified from the sample. **Mayfly Richness** - The total number of mayfly taxa identified from the sample. **Stonefly Richness** - The total number of stonefly taxa identified from the sample. **Caddisfly Richness** - The total number of caddisfly taxa identified from the sample. **Sensitive Taxa** - The number of taxa identified that are known to be very sensitive to stream disturbance. The list of taxa that qualify as "sensitive" are listed in Appendix F. **Sediment Sensitive Taxa** - Taxa known to be very sensitive to inputs of fine sediment. The presence of one or more of these taxa indicate that fine sediments are probably not a major concern**. Modified HBI** - "HBI" stands for Hilsenhof Biotic Index. This is an index of a taxa's sensitivity to organic enrichment that typically occurs as a result of excessive nutrient inputs. Index values for individual taxa range from 1 to 10. Low scores indicate high sensitivity (found only in waters with low organic enrichment). High scores indicate low sensitivity (tolerant of waters with high organic enrichment). HBI index values for each taxa are listed in the taxa list for Oregon streams in Appendix F (OWEB 2003) **% Tolerant Taxa** - The percent of the invertebrate community made up of taxa tolerant to disturbance. Divide the abundance of tolerant taxa by the total number of organisms sorted from the sample, and multiply by 100. **% Sediment Tolerant Taxa -** The percent of the invertebrate community made up of taxa tolerant to fine sediments (see Appendix F). Divide the abundance of sediment tolerant taxa by the total number of organisms sorted from the sample, and multiply by 100. **% Dominant (single taxa)** - The total abundance of the single most abundant taxon in the sample divided by the total number of organisms sorted from the sample, multiplied by 100. A high percent of a single taxon indicates some disturbance has likely occurred to the invertebrate community.

Table 2. Macroinvertebrate metrics and scoring criteria for Oregon (OWEB 2003).

Metric	1	3	5
Total taxa richness	<19	19-35	>35
Ephemeroptera (Mayfly) taxa richness	<4	4-8	>8
Stonefly (Plecoptera) richness	<3	3-5	>5
Caddisfly (Trichoptera) richness	<2	2-4	>4
Number of sensitive taxa	<2	2-4	>4
Number of sediment-intolerant taxa	0	1	>2
Percent dominant (top 3) taxa	>40	20-40	<20
Percent tolerant taxa	>45	15-45	<15
Percent sediment-tolerant taxa	>25	10-25	<10
Modified Hilsenhoff Biotic Index	>5.0	4-5	<4.0

Stream condition level for each site is based on the total scores of the ten metrics listed above. Each site was then assigned an impairment category (minimal, moderate, or severe impairment) based on the following total score ranges: >39, minimally impaired; 30-39, slight impairment; 20-29, moderate impairment; and <20, severe impairment.

Results

Macroinvertebrate composition among the sample sites was similar; all yielding multimetric scores less than 20 which indicate severe impairment for every site. Every site community was dominated by tolerant taxa, typically oligochaetes (worms) or Juga (snails).

The tables below summarize the raw metric values and metrics scores for the six Johnson Creek sites. Appendix 1 is a complete list of taxa and number present for every site.

Table 3. Johnson Creek macroinvertebrate raw metric results

	Total Taxa	Mayfly Taxa	Stonefly Taxa	Caddis Taxa	Sens. Taxa	Sed Sens Taxa	% Dom	% Toler	% Sed tol	HBI
Johnson Cr. @ Foster Road	10	0	0	1	0	1	46	66	54	5.4
Johnson Cr. @ Leach Gardens	16	3	0	1	1	0	42	69	66	6.3
Johnson Cr. just u/s Thermo Fluids outfal	11	1	0	1	0	0	72	81	81	6.0
Johnson Cr. just d/s Thermo Fluids outfall	13	1	0	1	0	0	62	76	73	6.1
Johnson Cr. @ 82nd Avenue	13	1	0	1	0	0	65	86	77	6.0
Johnson Cr. @ Park	11	1	0	1	0	0	77	84	81	6.0

Table 4. Johnson Creek macroinvertebrate metric scoring results

	Total Taxa	Mayfly Taxa	Stonefly Taxa	Caddis Taxa	Sens. Taxa	Sed Sens Taxa	% Dom	% Toler	% Sed tol	HBI	**Total**
Johnson Cr. @ Foster Road	1	1	1	1	1	3	1	1	1	1	**12**
Johnson Cr. @ Leach Gardens	1	1	1	1	1	1	1	1	1	1	**10**
Johnson Cr. just u/s Thermo Fluids outfal	1	1	1	1	1	1	1	1	1	1	**10**
Johnson Cr. just d/s Thermo Fluids outfall	1	1	1	1	1	1	1	1	1	1	**10**
Johnson Cr. @ 82nd Avenue	1	1	1	1	1	1	1	1	1	1	**10**
Johnson Cr. @ Park	1	1	1	1	1	1	1	1	1	1	**10**

Discussion

Johnson Creek is a heavily urbanized stream that travels from an agricultural upper watershed into the city limits of Portland. The stream is degraded with a number of significant stressors. Chief stress in the watershed is the agricultural, residential, and industrial land uses that exist throughout its length. These activities result in a number of water quality and physical habitat impairments. The stream is water quality limited for temperature, nutrients and sedimentation.

The results from this survey corroborate the stream's chemical and physical habitat condition. The macroinvertebrate community at each site was of low diversity and abundance. Normally our stream samples yield 500 organisms when sub-sorting a fraction of the sample. The entire sample for every site was sorted and in none of the samples were the target of 500 bugs achieved. The multimetric analysis showed severe impairment at every site. In fact every metric showed impairment. The results confirm earlier observations made on the day of sampling that no impact due to the Thermo Fluids spill could be discerned in Johnson Creek. Johnson Creek's benthic condition is currently so degraded that the spill did not have a noticeable effect on the community.

There is no apparent difference in the benthic community from upstream to downstream. It is impossible to discern any additional impact to Johnson Creek due to the Thermo Fluids spill based on the already impaired macroinvertebrate community present.

Based on fish kill reports following the spill, it appears that the fish community may be a better indicator of actual natural resource damage for this event. The macroinvertebrates that are present in Johnson Creek consist of a very tolerant assemblage and even an event like the Thermo Fluids spill did little to change the overall biological condition of the macroinvertebrates in the creek. At this time it is not recommended that follow-up macroinvertebrate sampling be performed given the results of this survey.

Acknowledgments

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References

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APPENDIX 1: Johnson Creek - Thermo Fluids macroinvertebrate results - taxa list and counts

Site	Order/Class	Family	Genus	Species	Count
Johnson Creek at Foster Road	Oligochaeta				18
	Diptera	Chironomidae			6
	Amphipoda	Gammaridae	Gammarus		5
	Diptera	Empididae	Chelifera/Metachela		3
	Mesogastropoda	Pleuroceridae	Juga		2
		Sphaeriidae			1
	Nematoda				1
	Limnophila	Planorbidae	Promenetus		1
	Trichoptera	Philopotamidae	Wormaldia		1
	Trombidiformes	"Hydracarina"			1
Johnson Creek at Leach Botanical Gardens	Mesogastropoda	Pleuroceridae	Juga		165
	Oligochaeta				88
	Ephemeroptera	Baetidae	Baetis	tricaudatus	48
	Diptera	Chironomidae			32
	Diptera	Chironomidae			16
	Nematoda				8
	Mesogastropoda	Hydrobiidae	Fluminicola		7
	Diptera	Chironomidae			5
	Trichoptera	Hydropsychidae	Cheumatopsyche		5
	Limnophila	Ancylidae	Ferrisia		3
	Diptera	Chironomidae			2
	Diptera	Chironomidae			2
	Ephemeroptera	Heptageniidae	Epeorus	longimanous	2
		Sphaeriidae			1
	Coleoptera	Elmidae	Lara		1
	Diptera	Chironomidae			1
	Ephemeroptera	Heptageniidae	Cinygma		1
Johnson Creek at just u/s Thermo Fluids outfall	Oligochaeta				277
	Diptera	Chironomidae			31
	Mesogastropoda	Pleuroceridae	Juga		29
	Diptera	Chironomidae			16
	Diptera	Chironomidae			10
	Diptera	Chironomidae			5
	Ephemeroptera	Baetidae	Baetis	tricaudatus	5
	Turbellaria				2
	Decapoda	Astacidae	Pacifastacus		2
	Trichoptera	Hydropsychidae	Cheumatopsyche		2
	Coleoptera	Elmidae	Lara		1

APPENDIX 1 continued: Johnson Creek - Thermo Fluids macroinvertebrate results - taxa list and counts

Site	Order/Class	Family	Genus	Species	Count
Johnson Creek at just d/s Thermo Fluids outfall	Oligochaeta				159
	Mesogastropoda	Pleuroceridae	Juga		28
	Ephemeroptera	Baetidae	Baetis	tricaudatus	19
	Diptera	Chironomidae			16
	Diptera	Chironomidae			10
	Diptera	Chironomidae			6
	Trichoptera	Hydropsychidae	Cheumatopsyche		6
	Diptera	Chironomidae			4
	Nematoda				3
	Turbellaria				2
	Mesogastropoda	Hydrobiidae	Fluminicola		2
	Diptera	Ceratopogonidae			1
	Diptera	Chironomidae			1
	Limnophila	Ancylidae	Ferrisia		1
Johnson Creek at 82'ᴺᵈ Avenue	Oligochaeta				97
	Mesogastropoda	Pleuroceridae	Juga		17
	Ephemeroptera	Baetidae	Baetis	tricaudatus	9
	Trichoptera	Hydropsychidae	Cheumatopsyche		7
	Mesogastropoda	Hydrobiidae	Fluminicola		6
	Diptera	Chironomidae			4
		Sphaeriidae			2
	Diptera	Chironomidae			2
	Nematoda				1
	Turbellaria				1
	Amphipoda	Gammaridae	Gammarus		1
	Decapoda	Astacidae	Pacifastacus		1
	Diptera	Chironomidae			1
Johnson Creek at Tideman Johnson Park	Oligochaeta				226
	Ephemeroptera	Baetidae	Baetis	tricaudatus	23
	Diptera	Chironomidae			13
	Mesogastropoda	Pleuroceridae	Juga		12
	Amphipoda	Gammaridae	Gammarus		6
					3
	Diptera	Chironomidae			2
	Diptera	Chironomidae			2
	Trichoptera	Hydropsychidae	Cheumatopsyche		2
	Basommatomorpha	Planorbidae	Menetus		1
	Diptera	Chironomidae			1
	Diptera	Chironomidae			1
	Mesogastropoda	Hydrobiidae	Fluminicola		1