

DRAFT MEMORANDUM

To: Port of Seattle project files

5
April 20, 2000

From: Doug Henderson / Linda Logan

556-2912-001 (61)

Subject: Range-Finding Water-effect ratio results Round 2.

This memorandum summarizes results of range-finding toxicity tests conducted as part of the water-effect ratio (WER) study for copper in streams receiving STIA stormwater. The purpose of these range-finding WERs is to determine if the final WERs would be robust enough to warrant the expense of conducting definitive studies. Although range-finding WERs were conducted in February 1999, these tests were conducted on simulated receiving water samples that were mixtures of outfall SDS3 stormwater and instream receiving water. Mixture ratios of these two samples were prepared in the laboratory by combining measured volumes of stormwater and upstream receiving water in proportions estimated to occur in the receiving water (based on hydrographs generated using HSPF). In the event that mixing zones cannot be granted for the creeks, it was agreed that two additional types of range-finding WERs be conducted, one without any mixing with stormwater (i.e., receiving water only) and the other one after complete mix, below outfall discharges.

Sampling

Samples were collected at five pre-determined locations during a qualifying storm event on the morning of 15 April 2000. This storm event started at Xh on 15 April and ended at Xh on 15 April 2000. The dry antecedent period preceding this storm was at least 24 hours. Approximately X inches of rain fell at STIA during this x-hour storm.

Taylor Associates collected flow-weighted composite samples for X hours during the storm event from each of the five sampling sites (Miller Creek Upstream, Miller Creek Detention Facility, Northwest Ponds Outlet, Northwest Ponds Inlet, and Des Moines Creek Weir). ISCO samplers automatically composite samples based on flow.

Quality assurance and quality control elements were followed according to the Port's Procedure Manual for Stormwater Monitoring (POS, 1999).

The samples were delivered to Parametrix's toxicology laboratory with completed chain-of-custody forms in sufficient time to meet the applicable holding times. The synthetic laboratory water was prepared according to U.S. EPA (1993).

Analysis

The procedure for determining a WER involves using an indicator species to evaluate and quantify the toxicity and bioavailability of a compound in a particular site water compared to that in "clean" laboratory water. To accomplish this, the chemical of concern (in this case, copper) is spiked into both the clean laboratory water and site water at known concentrations. A median lethal concentration (LC50) is then determined for each water, and the two are compared to generate a WER:

$$\frac{\text{LC50 Site Water}}{\text{LC50 Laboratory Water}} = \text{WER}$$

The WER is then applied to the generic water quality standard to derive a site-specific standard:

$$\text{WER} * \text{Generic WQS} = \text{Site-specific WQS}$$

For example, if the water quality standard for a chemical is 3 µg/L, and a WER of 3 is derived for a particular site, the resulting site-specific water quality standard would be 9 µg/L.

Nominal copper test concentrations were prepared using a 500 mg/L copper stock solution made from copper sulfate pentahydrate (CuSO₄•5H₂O) (CAS#7758-99-8). Since these were preliminary tests, concentrations were not measured; thus the WERs were calculated using nominal test concentrations. However, the stock solution was analyzed by Battelle and verified to be 500.0 mg/L copper.

The toxicity tests were conducted according to *Short-term Methods for Estimating the Acute Toxicity of Effluents and Receiving Waters to Freshwater Organisms and Marine Organisms*. EPA/600/4-90/027F, August 1993. A summary of test conditions for the *D. magna* toxicity tests is presented in Table 1.

Table 1. Summary of test conditions for the acute *Daphnia magna* toxicity tests.

Job Name: Port of Seattle	Job Number: 556-2912-001 (61) Date: 15-17 April 2000
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Test Protocol:	<i>Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms</i> (Fourth Edition), EPA/600/4-90/027F, August 1993.
Test Material:	Copper-spiked site waters Copper-spiked synthetic laboratory water
Test Organisms/age:	<i>Daphnia magna</i> ; ≤ 24 hrs old
Source:	In-house culture
Number/Test Chamber:	5
Volume/Test Chamber:	20 mL
Nominal Test Concentrations:	Site water: 0, 12.5, 25, 50, 100, 150, and 200 $\mu\text{g/L}$ copper Synthetic laboratory water: 0, 5, 10, 20, 40, and 80 $\mu\text{g/L}$ copper
Replicates:	Four
Test Duration:	48 hours
Control:	Unspiked synthetic laboratory water Unspiked site water
Test Chambers:	30 mL polystyrene cups
Lighting:	Fluorescent bulbs (50-100 foot candles)
Photoperiod:	16 hours light; 8 hours dark
Aeration:	None
Feeding:	None
Temperature:	$25 \pm 1^\circ\text{C}$
Chemical Data:	Dissolved oxygen, temperature, and pH at test initiation and every 24 hours; specific conductivity at test initiation and termination; hardness, alkalinity, ammonia, and residual chlorine at test initiation for 100% site water sample; hardness and alkalinity for laboratory and site water
Effect Measured:	Mortality
Test Acceptability:	Control mortality $\leq 10\%$

Results

Results of the range-finding water-effect ratio tests are presented in Table 2. Reference toxicant results were within acceptable ranges. All raw data sheets and statistical analyses are located in the project files at Parametrix.

Table 2. Summary of *Daphnia magna* range-finding water-effect ratio for POS:

Test Water	Hardness (mg/L)	ω TR/L	Cu LC50 (μ g/L)	ω diss. μ g/L	Normalized ¹ LC50 (μ g/L)	WER	WER
NPIN DMU Cu-Spiked Northwest Ponds Inlet Site Water	60	10	143.6	8	120.93	64	28.43387
(complete mix) NPOUT DMO Cu-Spiked Northwest Ponds Outlet Site Water (west branch)	90	4.3	132	3.3	75.87	96	17.83784
(complete mix) MCOF Cu-Spiked Miller Creek Detention Facility Site Water	92	4.4	168.8	4.7	95.03	95	22.34329
MCUP Cu-Spiked Miller Creek Upstream Site Water	46	5.6	111.6	4.0	120.72	64	28.38372
(complete mix) DMWEIR Cu-Spiked Des Moines Creek Weir Site Water (includes influent of East branch)	65	5.8	136.6	5.6	106.68	73	25.08299
Cu-Spiked Laboratory Water	90	5.0	7.4		4.25		n/a
Reference Toxicant (LC50) =			Acceptable				

WER = Calculated water effect ratio

n/a = not applicable

¹ LC50 adjusted to a hardness of 50 mg/L

In summary, given the results of WERs estimated based on nominal concentrations (17.8 – 28.4), we recommend pursuing a definitive WER and application of a site-specific water quality standard for copper.

REFERENCES

Parametrix, Inc. 1999. Water-effect ratio screening study at Seattle-Tacoma International Airport: Toxicity evaluation of site water. Prepared for the Port of Seattle, February 1999.

U.S. EPA. 1993. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms. EPA/600/4-90/027F, August 1993. U.S. Environmental Protection Agency, Cincinnati, Ohio.

POS. 1999. Procedure Manual for Stormwater Monitoring. Port of Seattle, April 1999.

DRAFT MEMORANDUM

To: Scott Tobiason April 24, 2000

From: Doug Henderson / Linda Logan

Subject: Sampling and Analysis for Range-Finding WERs in the Absence of a Mixing Zone
Round 2

This memorandum provides a summary of our 7 March 2000 meeting regarding the sampling locations and testing requirements for conducting a second round of range-finding water-effect ratios (WERs). The purpose of these range-finding WERs is to determine if the final WERs would be robust enough to warrant the expense of conducting definitive studies. Although range-finding WERs were conducted in February 1999, these tests were conducted on simulated receiving water samples that were mixtures of outfall SDS3 stormwater and instream receiving water. Mixture ratios of these two samples were prepared in the laboratory by combining measured volumes of stormwater and upstream receiving water in proportions estimated to occur in the receiving water (based on hydrographs generated using HSPF). In the event that mixing zones cannot be granted for the creeks, it was agreed that two additional types of range-finding WERs be conducted, one without any mixing with stormwater (i.e., receiving water only) and the other one after complete mix, below outfall discharges. The rationale for choosing these two types of WERs is described below.

Background

The U.S. EPA has developed guidelines for determining and using WERs. However, the *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals* (the Guidelines, U.S. EPA. 1994) were developed for continuous discharges. Therefore, applying the Guidelines to stormwater discharges will require some interpretation. The Guidelines describe three approaches that may be used relative to sampling and discharge locations in the streams. These three approaches are summarized below:

1. Upstream water: U.S. EPA describes this as the least useful method as it does not take into account the presence of the effluent (or in this case, stormwater). Furthermore, the Guidelines emphasize that a WER should be determined using the water to which the site-specific criterion is to apply. However, given the complexity of the STIA discharges—and that third runway discharges do not yet occur—this option should be evaluated. If it can be demonstrated that upstream water is

appropriately conservative and representative of receiving waters (i.e., the magnitude of the WER with upstream water would not be significantly higher than it would be downstream after receiving stormwater discharges) and still provides a robust WER, then this may be the method of choice for the definitive WER study.

2. Actual downstream water: U.S. EPA states that the most useful samples of actual downstream receiving waters are probably those taken just downstream of the point at which complete mixing occurs or at the most distant point that is within the site to which the site-specific criterion is to apply. However, the use of actual downstream receiving water samples to quantitatively define the WER for a given discharge is problematic, as the concentration of discharge in the water can only be approximate rather than measured, as is done with the simulated downstream receiving water.. Therefore, U.S. EPA only recommends this approach for the "sample-specific WER approach". The sample-specific approach requires a WER to be developed concurrent with *every* metal sample collected for compliance. In this approach, a quotient would be calculated by dividing the concentration of metal in the sample by the product of the national criterion times the WER obtained for that sample:

$$\frac{\text{Measured Metal Concentration in Stormwater}}{(WQC \times WER)}$$

A quotient less than one indicates compliance; greater than one indicates a violation.

This approach has several advantages, including:

- Spatial and temporal variation among WERs within a body of water is not a problem,
- it eliminates problems concerning the unknown relationship between toxicity and complex receiving water analytical chemistry, and
- it automatically accounts for synergism, antagonism, and additivity between toxicants (U.S. EPA. 1994).

Pros &
Cons.

The main drawback of this approach is that it may lead to additional, rigorous and costly instream and outfall sampling in future NPDES permit strategies. The benefit of this approach is that actual instream biological effects would be quantified frequently and conclusively, in contrast to the application of single numeric water quality criteria. Based upon previous work, it is likely that results would be favorable.

Without a mixing zone or an upstream location that is representative of the water body to which the site-specific water quality criterion is to apply, this may be the only option for the Port. Mixing zones, which must be established by an administrative order or other regulatory means, do not yet exist for POS stormwater discharges. Because STIA is located relatively high in the Des Moines Creek watershed, a source of representative upstream receiving water is not readily available. However, it does appear that suitable upstream waters exist in Miller Creek.

3. Simulated downstream receiving water: U.S. EPA recommends this method because the stormwater discharge and the upstream water samples are mixed at a measured ratio. In other words, the simulated downstream receiving water is prepared in the laboratory by combining measured volumes of stormwater and receiving water in proportions estimated to occur in the receiving water. This is important, as the magnitude of the WER will often depend on the concentration of the discharge. This is the approach that was used in the February 1999 range-finding tests. However, this approach requires a physical mixing zone or modeling to determine the ratio of discharge and upstream water. Given that a mixing zone may not be granted for the creeks in question, this method may not be feasible.

WER Study Using Upstream and Downstream Water

Sampling Locations

Given that the February 1999 WERs were conducted using the third option described above, it was agreed to compare the results of testing using options 1 and 2. Therefore, for Miller Creek, the upstream sample will be collected above the outlet of Lake Reba, but downstream of State Route 518 ("Miller Creek Upstream"). The actual downstream water will be collected at the Miller Creek Detention Facility (MCDF) which is downstream of the Lake Reba outlet, and just upstream of Lora Lake ("Miller Creek Complete Mix"). Samples were collected from these same locations for the 1999 preliminary WER studies.

For Des Moines Creek, the upstream sample will be collected at the inlet to the Northwest Ponds ("Des Moines Creek Upstream"), which is actually just below where this drainage exits from a culvert. This location is the only available known source of streamflow in the West Branch of the creek above STIA outfalls. Open channel flow in this reach is limited to just a few hundred feet before entering the NWP. Due to this limited development of actual "stream" character in this reach, samples may not well represent aquatic conditions. Actual downstream water will be collected at two locations to evaluate the influence of the east branch of the Des Moines Creek which contains stormwater runoff from STIA (primarily SDE4, SDS1). One actual downstream sample will be collected below the outlet of the Northwest Ponds (NWP), but above the outlet from SDS4 ("Des Moines Creek Complete Mix West"). This location engenders mixing of runoff from outfall SDS3 within NWP. Outfall SDS3 drains the majority (74%) of the existing STIA airfield and 48% of the entire STIA SDS. The other actual downstream sample will be collected below the confluence of the east branch of the Des Moines Creek at the upper most Des Moines Creek Weir ("Des Moines Creek Complete Mix").

It should be noted that except for the NWP inlet sampling station, the three other instream sampling locations are existing King County flow gaging stations. Importantly, other non-STIA sources of stormwater exist in both upstream catchments, including several miles of state highways 509, 518 and local city streets and other urban areas.

Sampling Methods

To maximize information, samples will be collected concurrently with the quarterly NPDES monitoring requirements during a qualifying rain event as described in the Port's Procedure Manual for Stormwater Monitoring (POS, 1999a). A qualifying rain event requires at least 24 hours of antecedent conditions with less than 0.1 inches of rain. All samples will be flow-weighted composites, consistent with the Port's NPDES sampling protocols. These samples will represent the discharge that occurs approximately between the first 0.2 and 0.6 inches of rainfall. A minimum of two liters of sample will be collected for each site: approximately one liter for the analytical chemistry, and one liter (minimum) for the range-finding WERs. Field personnel will split samples for delivery to each of the two laboratories involved. Fieldwork and sample handling will be in accordance with EPA 1664 "clean techniques" adapted for stormwater monitoring as described in POS, 1999b.

Analysis

Stormwater and receiving water samples will be analyzed for total and dissolved copper, lead and zinc to calculate WERs [REDACTED]

[REDACTED]. For supporting information about sample characteristics, samples will also be analyzed for hardness, total suspended solids, total organic carbon and dissolved organic carbon. These parameters will be measured by Aquatic Research Incorporated. The above parameters will be measured within the parameter-specific holding time requirements.

Receiving water samples will be used in determining the range-finding WERs. The WERs will be calculated based upon acute bioassays conducted at Parametrix's Environmental Toxicology Laboratory in Kirkland. Samples will be delivered to the Parametrix's Laboratory in the one-gallon glass jars used in the field. Parametrix will transfer the samples into collapsible LDPE cubitainers, sign the chain-of-custody forms, and return the glass jars to the Port. The range-finding WER bioassays will be initiated within 36 hours to meet sample holding time requirements for toxicity tests.

The range-finding tests will consist of concurrent acute toxicity tests using *Ceriodaphnia dubia* or *Daphnia magna* with copper-spiked receiving water sample and copper-spiked laboratory water. Copper will be spiked into the test solutions from a 500 mg/L copper (as cupric sulfate, CAS #7758-99-8) stock solution. Unlike a definitive WER study, exposure concentrations will not be analytically verified. The resulting LC50s will be based on concentrations calculated from the known copper additions only. Although this approach falls short of the requirements associated with proposing a site-specific criterion to the state and federal agencies, it does provide an inexpensive estimate of the magnitude of the WER that could be obtained from a definitive study.

References

POS 1999a. Procedure Manual for Stormwater Monitoring. Port of Seattle, April 1999

POS 1999b. Adapting Clean Sampling Techniques for POS NPDES Stormwater and other Stormwater Monitoring Project Needs. Scott Tobiason, Port of Seattle, June 1999.



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*Round 2
Range finding.*

CASE FILE NUMBER:	POS005-29A	PAGE 1
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/14/00	DATE RECEIVED: 04/15/00
FINAL REPORT. LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM PORT OF SEATTLE		

CASE NARRATIVE

Six water samples were received by the laboratory in good condition. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	TSS (mg/l)	TURBIDITY (NTU)	TOC (mg/l)	DOC (mg/l)
NPIN041400	17	8.0	12.6	12.1
NPOUT041400	12	2.5	7.63	7.84
DMWEIR041400	36	8.5	7.55	7.22
MCUP041400	63	14	12.5	10.9
MCDF041400	21	6.4	14.1	12.1
MCUP041400 D	102	15	10.6	10.2



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CASE FILE NUMBER:	POS005-29B	PAGE 1	
REPORT DATE:	05/11/00		
DATE SAMPLED:	04/14/00	DATE RECEIVED:	04/15/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER			
SAMPLES FROM PORT OF SEATTLE			

CASE NARRATIVE

Six water samples were received by the laboratory in good condition. Samples for total recoverable metals analysis were digested according to EPA procedures. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on the subsequent page.

SAMPLE DATA

SAMPLE ID	TOTAL RECOVERABLE METALS			DISSOLVED METALS			HARDNESS (mgCaCO ₃ /l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
NFIN041400	0.0100	<0.0020	0.040	0.0080	<0.0020	0.026	63.7
NPOUT041400	0.0043	<0.0020	<0.005	0.0033	<0.0020	<0.005	96.0
DMWEIRO41400	0.0058	<0.0020	0.014	0.0056	<0.0020	0.005	72.7
MCUP041400	0.0056	<0.0020	0.020	0.0040	<0.0020	0.007	64.1
MCDFO41400	0.0044	<0.0020	0.011	0.0047	<0.0020	<0.005	95.2
MCUP041400 D	0.0050	<0.0020	0.021	0.0044	<0.0020	0.010	64.1



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CASE FILE NUMBER: POS005-29A PAGE 2
REPORT DATE: 05/11/00
DATE SAMPLED: 04/14/00 DATE RECEIVED: 04/15/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER
SAMPLES FROM PORT OF SEATTLE

QA/QC DATA

QC PARAMETER	TSS (mg/l)	TURBIDITY (NTU)	TOC (mg/l)	DOC (NTU)
CAS NUMBER	NA	NA	NA	NA
METHOD	EPA 180.2	EPA 180.1	EPA 180.2	EPA 180.1
DATE ANALYZED	04/18/00	04/15/00	04/20/00	04/20/00
PRACTICAL QUANTITATION LIMIT	0.50	0.10	0.250	0.250
DETECTION LIMIT	0.50	0.10	0.100	0.100
DUPLICATE				
SAMPLE ID	IMW02R041400	MCDP041400	BATPCE	BATPCE
ORIGINAL	36	6.4	<0.250	<0.250
DUPLICATE	35	6.5	<0.250	<0.250
RPD	2.82%	1.55%	NC	NC
SPIKE SAMPLE				
SAMPLE ID			BATPCE	BATPCE
ORIGINAL			<0.250	<0.250
			3.86	3.81
			3.60	3.60
SPIKE ADDED	NA	NA	107.22%	105.83%
% RECOVERY				
QC CHECK				
mg/l				
FOUND	10	8.2	2.01	2.01
TRUE	10	8.0	2.00	2.00
% RECOVERY	102.00%	102.50%	100.25%	100.25%
BLANK	<0.50	NA	<0.250	<0.250

RPD - RELATIVE PERCENT DIFFERENCE
NA - NOT APPLICABLE OR NOT AVAILABLE
NC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT
CR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION

Steven Lazoff
Laboratory Director



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CASE FILE NUMBER:	POS005-29B	PAGE 2	
REPORT DATE:	05/11/00		
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FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER			
SAMPLES FROM PORT OF SEATTLE			

QA/QC DATA - TOTAL & DISSOLVED METALS

QC PARAMETER	TOTAL METALS			DISSOLVED METALS			HARDNESS (mgCaCO ₃ /l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
CAS NUMBER	7440-50-8	7439-92-1	7440-66-6	7440-50-8	7439-92-1	7440-66-6	NA
METHOD	EPA 220.2	EPA 238.2	EPA 200.7	EPA 220.2	EPA 238.2	EPA 200.7	EPA 130.2
DATE ANALYZED	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	04/18/00
PRACTICAL QUANTITATION LIMIT	0.0020	0.0020	0.005	0.0020	0.0020	0.005	2.00
DETECTION LIMIT	0.0010	0.0010	0.005	0.0010	0.0010	0.005	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	MCDP041400	MCDP041400	BATCH	MCDP041400
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	63.7
DUPLICATE	0.0427	<0.0020	0.017	0.0053	<0.0020	0.007	63.7
RPD	3.45%	NC	6.05%	12.00%	NC	25.00%	0.00%
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	MCDP041400	MCDP041400	BATCH	MCDP041400
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	63.7
SPIKED SAMPLE	0.0551	0.0118	1.01	0.0149	0.0106	1.04	83.6
SPIKE ADDED	0.0125	0.0125	1.00	0.0125	0.0125	1.00	20.0
% RECOVERY	87.20%	94.40%	99.40%	81.60%	84.80%	103.20%	98.67%
QC CHECK (mg/l)							
TRUE	0.0264	0.0259	1.02	0.0264	0.0259	1.03	40.7
% RECOVERY	0.0250	0.0250	1.00	0.0250	0.0250	1.00	40.0
	105.60%	103.60%	101.70%	101.20%	96.00%	102.80%	101.63%
PREP BLANK	<0.0010	<0.0010	<0.005	<0.0010	<0.0010	<0.005	<2.00
BLANK SPIKE % RECOVERY	98.3%	101.0%	103.0%	98.3%	101.0%	NA	NA

RPD - RELATIVE PERCENT DIFFERENCE.
 NA - NOT APPLICABLE OR NOT AVAILABLE.
 NC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
 OR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

Submitted By: *[Signature]*
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CASE FILE NUMBER:	POS005-30A	PAGE 1
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/18/00	DATE RECEIVED: 04/18/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

CASE NARRATIVE

One water sample was received by the laboratory in good condition. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	TSS (mg/l)	TURBIDITY (NTU)	TOC (mg/l)	DOC (mg/l)
NP1N041807-B	<0.50	0.35	<0.250	<0.250

← EQUIPMENT (FIELD) BLANK



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CASE FILE NUMBER: POS005-30B
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 DATE SAMPLED: 04/18/00 DATE RECEIVED: 04/18/00
 FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER
 SAMPLES FROM PORT OF SEATTLE

CASE NARRATIVE

Four water samples were received by the laboratory in good condition. Samples for total recoverable metals analysis were digested according to EPA procedures. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on the subsequent page.

SAMPLE DATA

SAMPLE ID	TOTAL RECOVERABLE METALS			DISSOLVED METALS			HARDNESS (mgCaCO ₃ /l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
NPIN041800-B	<0.0020	<0.0020	<0.005	<0.0020	<0.0020	<0.005	6.84



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FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

QA/QC DATA

QC PARAMETER	TSS (mg/l)	TURBIDITY (NTU)	TOC (mg/l)	DOC (NTU)
CAS NUMBER	NA	NA	NA	NA
METHOD	EPA 160.2	EPA 180.1	EPA 160.2	EPA 180.1
DATE ANALYZED	04/18/00	04/18/00	04/20/00	04/20/00
PRACTICAL QUANTITATION LIMIT	0.50	0.10	0.250	0.250
DETECTION LIMIT	0.50	0.10	0.100	0.100
DUPLICATE				
SAMPLE ID	BATCH	NP19041800-B	NP19041800-B	NP19041800-B
ORIGINAL	36	0.35	<0.250	<0.250
DUPLICATE	35	0.35	<0.250	<0.250
RPD	2.82%	0.00%	NC	NC
SPIKE SAMPLE				
SAMPLE ID			NP19041800-B	NP19041800-B
ORIGINAL			<0.250	<0.250
			3.86	3.81
			3.60	3.60
SPIKE ADDED	NA	NA	107.22%	105.83%
% RECOVERY				
QC CHECK				
mg/l				
FOUND	10	0.80	2.01	2.01
TRUE	10	0.80	2.00	2.00
% RECOVERY	102.00%	100.00%	100.25%	100.25%
BLANK	<0.50	NA	<0.250	<0.250

RPD = RELATIVE PERCENT DIFFERENCE.
 NA = NOT APPLICABLE OR NOT AVAILABLE.
 NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
 RCR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

Steven Lazoff
 Laboratory Director



AQUATIC RESEARCH INCORPORATED
LABORATORY & CONSULTING SERVICES
 3827 AURORA AVENUE NORTH, SEATTLE, WA 98103
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PO0400P0000000

CASE FILE NUMBER:	POS005-30B	PAGE 2
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/18/00	DATE RECEIVED: 04/18/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

QA/QC DATA -TOTAL & DISSOLVED METALS

QC PARAMETER	TOTAL METALS			DISSOLVED METALS			HARDNESS (mgCaCO3/l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
CAS NUMBER	7440-50-8	7439-92-1	7440-86-6	7440-50-8	7439-92-1	7440-86-6	NA
METHOD	EPA 220.2	EPA 239.2	EPA 200.7	EPA 220.2	EPA 239.2	EPA 200.7	EPA 130.2
DATE ANALYZED	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	04/18/00
FRACTICAL QUANTITATION LIMIT	0.0020	0.0020	0.005	0.0020	0.0020	0.005	2.00
DETECTION LIMIT	0.0010	0.0010	0.005	0.0010	0.0010	0.005	1.00
DUPLICATE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	17.6
DUPLICATE	0.0427	<0.0020	0.017	0.0053	<0.0020	0.007	17.8
RPD	3.45%	NC	6.06%	12.00%	NC	25.00%	1.10%
SPIKE SAMPLE							
SAMPLE ID	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH	BATCH
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	17.6
SPIKED SAMPLE	0.0551	0.0118	1.01	0.0149	0.0106	1.04	37.7
SPIKE ADDED	0.0125	0.0125	1.00	0.0125	0.0125	1.00	20.0
% RECOVERY	87.20%	94.40%	99.40%	81.60%	84.80%	103.20%	100.65%
QC CHECK (mg/l)							
	0.0264	0.0259	1.02	0.0264	0.0259	1.03	40.7
TRUE	0.0250	0.0250	1.00	0.0250	0.0250	1.00	40.0
% RECOVERY	105.60%	103.60%	101.70%	101.20%	96.00%	102.80%	101.63%
PREP BLANK	<0.0010	<0.0010	<0.005	<0.0010	<0.0010	<0.005	<2.00
BLANK SPIKE % RECOVERY	98.3%	101.0%	103.0%	98.3%	101.0%	NA	NA

RPD - RELATIVE PERCENT DIFFERENCE.
 NA - NOT APPLICABLE OR NOT AVAILABLE.
 NC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
 CR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

Submitted By:

 Steven Lazoff
 Laboratory Director



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CASE FILE NUMBER:	POS005-28A	PAGE 1
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/13,14/00	DATE RECEIVED: 04/14/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

CASE NARRATIVE

Eight water samples were received by the laboratory in good condition. Samples analyzed for NWTPH-Dx were subjected to sulfuric acid/silica gel cleanup after extraction but prior to final sample concentration. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	pH	FEDAL COLIFORM (#/100ml)	NWTPH-DX	
			DIESEL (mg/l)	MOTOR OIL (mg/l)
SDE4041300 GRAB	6.69	130	<0.05	0.29
SDS3041300 GRAB	7.69	8	<0.05	<0.10
SDN4041300 GRAB	7.39	33	0.17	0.35
SDN1041300 GRAB	5.94	< 2	0.10	0.18

SAMPLE ID	TSS (mg/l)	TURBIDITY (NTU)	BOD5 (mg/l)	GLYCOLS		
				ETHYLENE (mg/l)	PROPYLENE (mg/l)	TOTAL (mg/l)
SDE4041300 COMP	59	2.2	8.88	<2.00	<2.00	<2.00
SDS3041400 COMP	15	7.2	18.1	<2.00	<2.00	<2.00
SDN4041300 COMP	4.7	4.5	5.62	<2.00	<2.00	<2.00
SDN1041300 COMP	46	15	6.54	<2.00	<2.00	<2.00

SAMPLE ID	TOC (mg/l)	DOC (mg/l)
SDE4041300 COMP	7.11	6.27
SDS3041400 COMP	12.0	8.88
SDN4041300 COMP	5.32	4.90
SDN1041300 COMP	6.35	5.93



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CASE FILE NUMBER:	POS005-28B	PAGE 1
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/13,14/00	DATE RECEIVED: 04/14/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

CASE NARRATIVE

Four water samples were received by the laboratory in good condition. Samples for total recoverable metals analysis were digested according to EPA procedures. No difficulties were encountered in the preparation or analysis of this sample. Sample data follows while QA/QC data is contained on the subsequent page.

SAMPLE DATA

SAMPLE ID	TOTAL RECOVERABLE METALS			DISSOLVED METALS			HARDNESS (mgCaCO ₃ /l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
SDE4041300 COMP	0.0176	<0.0020	0.139	0.0153	<0.0020	0.103	16.8
SDSS041400 COMP	0.0244	<0.0020	0.029	0.0212	<0.0020	0.016	39.7
SDN4041300 COMP	0.0442	<0.0020	0.016	0.0417	<0.0020	0.009	45.9
SDN1041300 COMP	0.0347	<0.0020	0.410	0.0258	<0.0020	0.356	(17.6)

AR 024987



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CASE FILE NUMBER: POS005-28A	PAGE 2		
REPORT DATE: 05/11/00			
DATE SAMPLED: 04/13,14/00	DATE RECEIVED:	04/14/00	
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER			
SAMPLES FROM PORT OF SEATTLE			

QC PARAMETER	pH	FECAL COLIFORM (#/100ml)	DIESEL (mg/l)	MOTOR OIL (mg/l)
CAS NUMBER	NA	NA	NA	NA
METHOD	EPA 150.1	SM 18 9221E	NWTPH-DX	NWTPH-DX
DATE ANALYZED	04/14/00	04/14/00	04/18/00	04/18/00
METHOD DETECTION LIMIT	0.10	2	0.05	0.10
PRACTICAL QUANTITATION LIMIT	0.10	2	0.05	0.10
DUPLICATE				
SAMPLE ID		EDW1041300 GRAB	EDW1041300 GRAB	EDW1041300 GRAB
ORIGINAL		< 2	0.10	0.13
DUPLICATE		< 2	0.05	0.16
RPD	NA	NC	NC	NC
SPIKE SAMPLE				
SAMPLE ID				
ORIGINAL				
SPIKED SAMPLE				
SPIKE ADDED	NA	NA	NA	NA
% RECOVERY				
QC CHECK				
mg/l			0.50	1.02
FOUND			0.50	1.00
TRUE			100.00%	102.00%
% RECOVERY	NA	NA		
BLANK				
	NA	< 2	<0.05	<0.10

RPD = RELATIVE PERCENT DIFFERENCE.
 NA = NOT APPLICABLE OR NOT AVAILABLE.
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 CR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



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CASE FILE NUMBER:	POS005-28A	PAGE 3
REPORT DATE:	05/11/00	
DATE SAMPLED:	04/13,14/00	DATE RECEIVED: 04/14/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER		
SAMPLES FROM PORT OF SEATTLE		

QA/QC DATA

QC PARAMETER	GLYCOLS				
	TSS (mg/l)	TURBIDITY (NTU)	BOD5 (mg/l)	ETHYLENE (mg/l)	PROPYLENE (mg/l)
CAS NUMBER	NA	NA	NA	107-21-1	57-55-6
METHOD	EPA 160.2	EPA 180.1	EPA 405.1	AR SOP	AR SOP
DATE ANALYZED	04/18/00	04/15/00	04/14/00	05/03/00	05/03/00
PRACTICAL QUANTITATION LIMIT	0.50	0.10	4.00	2.00	2.00
DETECTION LIMIT	0.50	0.10	2.00	2.00	2.00
DUPLICATE					
SAMPLE ID	SDR4041300 COMP	SDW1041300 COMP	SDW1041300 COMP		
ORIGINAL	59	15	6.54		
DUPLICATE	62	16	6.76		
RPD	4.96%	6.45%	3.31%		
SPIKE SAMPLE					
SAMPLE ID				BATCH	BATCH
ORIGINAL				< 2.00	< 2.00
SPIKED SAMPLE				27.4	33.6
DPLICATE SPIKE				28.2	33.5
RPD				2.88%	0.30%
SPIKE ADDED				25.0	25.0
% RECOVERY	NA	NA	NA	111.20%	134.20%
QC CHECK					
mg/l					
FOUND	10	8.2	4.59	24.7	24.1
TRUE	10	8.0	4.62	25.0	25.0
% RECOVERY	102.00%	102.50%	99.35%	98.80%	96.40%
BLANK					
	<0.50	NA	<2.00	<2.00	<2.00

RPD - RELATIVE PERCENT DIFFERENCE.
 NA - NOT APPROPRIATE OR NOT AVAILABLE.
 INC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
 OR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.



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CASE FILE NUMBER: POS005-28A
REPORT DATE: 05/11/00
DATE SAMPLED: 04/18,14/00
DATE RECEIVED: 04/14/00
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER
SAMPLES FROM PORT OF SEATTLE

QA/QC DATA

QC PARAMETER	TOC (mg/l)	DOC (NTU)
CAS NUMBER	NA	NA
METHOD	EPA 160.2	EPA 180.1
DATE ANALYZED	04/20/00	04/20/00
PRACTICAL QUANTITATION LIMIT	0.250	0.250
DETECTION LIMIT	0.100	0.100
DUPLICATE		
SAMPLE ID	BATCH	BATCH
ORIGINAL	<0.25	<0.25
DUPLICATE	<0.25	<0.25
RPD	NC	NC
SPIKE SAMPLE		
SAMPLE ID	BATCH	BATCH
ORIGINAL	<0.25	<0.25
SPIKED SAMPLE	3.86	3.81
SPIKE ADDED	3.60	3.60
% RECOVERY	107.22%	105.83%
QC CHECK		
mg/l		
FOUND	2.01	2.01
TRUE	2.00	2.00
% RECOVERY	100.25%	100.25%
BLANK	<0.250	<0.250

RPD - RELATIVE PERCENT DIFFERENCE.
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NC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

Steven Lazoff
Laboratory Director

AR 024990



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PAGE 2

CASE FILE NUMBER: POS005-28B
 REPORT DATE: 05/11/00
 DATE SAMPLED: 04/18,14/00 DATE RECEIVED: 04/14/00
 FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER
 SAMPLES FROM PORT OF SEATTLE

QA/QC DATA - TOTAL & DISSOLVED METALS

QC PARAMETER	TOTAL METALS			DISSOLVED METALS			HARDNESS (mgCaCO3/l)
	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	LEAD (mg/l)	ZINC (mg/l)	
CAS NUMBER	7440-50-8	7439-92-1	7440-66-6	7440-50-8	7439-92-1	7440-66-6	NA
METHOD	EPA 220.2	EPA 238.2	EPA 200.7	EPA 220.2	EPA 238.2	EPA 200.7	EPA 130.2
DATE ANALYZED	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	04/18/00
PRACTICAL QUANTITATION LIMIT	0.0020	0.0020	0.005	0.0020	0.0020	0.005	2.00
DETECTION LIMIT	0.0010	0.0010	0.005	0.0010	0.0010	0.005	1.00
DUPLICATE							
SAMPLE ID	SEN4041300 COMP	SEN4041300 COMP	SEN4041300 COMP	BATCH	BATCH	SEN4041300 COMP	SEN1041300 COMP
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	17.6
DUPLICATE	0.0427	<0.0020	0.017	0.0053	<0.0020	0.007	17.8
RPD	3.45%	NC	6.06%	12.00%	NC	25.00%	1.10%
SPIKE SAMPLE							
SAMPLE ID	SEN4041300 COMP	SEN4041300 COMP	SEN4041300 COMP	BATCH	BATCH	SEN4041300 COMP	SEN1041300 COMP
ORIGINAL	0.0442	<0.0020	0.016	0.0047	<0.0020	0.009	17.6
SPIKED SAMPLE	0.0551	0.0118	1.01	0.0149	0.0106	1.04	37.7
SPIKE ADDED	0.0125	0.0125	1.00	0.0125	0.0125	1.00	20.0
% RECOVERY	87.20%	94.40%	99.40%	81.60%	84.80%	103.20%	100.65%
QC CHECK (mg/l)							
TRUE	0.0264	0.0259	1.02	0.0264	0.0259	1.03	40.7
% RECOVERY	0.0250	0.0250	1.00	0.0250	0.0250	1.00	40.0
	105.80%	103.60%	101.70%	101.20%	96.00%	102.80%	101.63%
PREP BLANK	<0.0010	<0.0010	<0.005	<0.0010	<0.0010	<0.005	<2.00
BLANK SPIKE % RECOVERY	98.3%	101.0%	103.0%	98.3%	101.0%	NA	NA

RPD - RELATIVE PERCENT DIFFERENCE.
 NA - NOT APPLICABLE OR NOT AVAILABLE.
 NC - NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
 CR - RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TOO LOW RELATIVE TO SAMPLE CONCENTRATION.

Submitted By:

 Steven Lazoff
 Laboratory Director

Chain of Custody Record

POS Sea-Tac Airport Stormwater Program: Sample Chain of Custody Record

Laboratory: Aquatic Research Inc., 3921 Aurora Ave. N, Seattle, WA 98103 206-632-2715

Project: XNFD5 Spill X Other Date: 7/14/00
 Contact: Scott Tobiason, 728-3171/MER Page 1 of 1
 Sampling Personnel: Scott Tobiason Case File#
 Turnaround Requirement:
48 hour day week X standard

Item	Sample ID	Contig?	Date Taken	Time	Lab ID	Matrix	# Containers	pH	Feas. MPD	TCH, WPH, MK	TSS	Turbidity	BODS	Total Recover Cu	Total Recover Pb	Total Recover Zn	Total Glycols	dis. Cu	dis. Pb	dis. Zn	Address	TOC	DOC	S.S.	Turb	Color	Sheen	Odor	Notes						
1	SDE10Y1900	X	4/13/00	13:38		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	0	0	0	0	0	0	0	0			
2	SDE10Y1900	Grab	4/13/00	15:49		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	B	0	0	0	0	0	0	0			
3	SOS30Y1900	X	4/14/00	0:30		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0			
4	SOS30Y1900	Grab	4/14/00	6:00		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0			
5	SIN20Y1900	X	4/14/00	17:29		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0			
6	SIN20Y1900	Grab	4/14/00	21:42		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0			
7	SIN20Y1900	X	4/13/00			W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0			
8	SIN20Y1900	Grab	4/13/00	21:21		W	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0	0	0		
9																																			
10																																			
11																																			
12																																			
13																																			
14																																			
15																																			
16																																			
17																																			
18																																			

pH=7.14
 pH=6.69
 pH=7.67
 pH=7.57
 pH=5.94

B=brown

Printed Name:	Relinquished by:	Received by:
Signature: <u>Diana Sales</u>	Relinquished by: <u>HALON C/O TTS</u>	Received by: <u>ALYSON</u>
Affiliation: <u>Test. to Accounts</u>	Relinquished by: <u>ALYSON</u>	Received by: <u>ALYSON</u>
Date: <u>7/14/00</u>	Relinquished by: <u>ALYSON</u>	Received by: <u>ALYSON</u>
Time: <u>13:30</u>	Relinquished by: <u>ALYSON</u>	Received by: <u>ALYSON</u>

TOC'S PRES W/H2SO4 Hydrogen Peroxide

revised 4/10/00

Miscellaneous Notes: