

**DRAFT**

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**DEVELOPING A SITE-SPECIFIC WATER  
QUALITY STANDARD FOR COPPER**

**BIOASSAY STATUS REPORT**

Prepared for

**Port of Seattle**  
Seattle-Tacoma International Airport  
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Prepared by

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**AR 026684**

# 1. INTRODUCTION

## 1.1 BACKGROUND

The Port of Seattle (POS) is conducting a water quality assessment to determine the feasibility of complying with state water quality standards after construction of the third runway at the Seattle-Tacoma International Airport (STIA). The POS is evaluating several options to provide a weight of evidence for compliance after the construction of the third runway, including best management practices (BMPs) and application of a water-effect ratio (WER) to determine a site-specific water quality standard for copper. A multiphase approach is being used to develop a WER for copper in Miller, Walker, and Des Moines Creeks. The first two phases, an initial toxicity screen to determine if the receiving waters were toxic to daphnids and two range finding bioassays to determine the approximate magnitude of the WERs, have been completed. The final phase, which has not been completed, includes the development of a site-specific water-effect ratio, which will be used to adjust the state water quality criterion (WQC) for copper. This memorandum summarizes the results from the screening level and range finding studies, with bioassay results presented in Tables 2, 3, and 4 and Appendices A, B and C.

## 1.2 LABORATORY AND TEST METHODS

The following section summarizes the testing procedures for bioassays conducted for the Port of Seattle. All testing was conducted by Parametrix's Environmental Toxicology Laboratory in Kirkland, Washington.

### 1.2.1 SAMPLE COLLECTION

Samples were collected during qualifying storm events employing clean metals sampling techniques following quality assurance and quality control elements in the P.O.S. Procedure Manual for Stormwater Monitoring (POS 1999). Sample collection sites for the screening level and range finding bioassays are presented in Figure 1.

### 1.2.2 BIOASSAY METHODS

Acute toxicity bioassays were conducted with *Ceriodaphnia dubia* and *Daphnia magna* in general accordance with standard test protocols (U.S. EPA 1993, WDOE 1995). A general summary of the experimental design and conditions used to conduct the toxicity tests appears in Table 1. Ranges are provided, with respect to test volume, test chamber size, dilution water and test temperature; these reflect minor variations in test design.

### 1.2.3 WATER-EFFECT RATIO

The U.S. EPA first published guidelines for developing site-specific water quality criteria (WQC) in 1983 (U.S. EPA 1983), and modified them in 1994 (U.S. EPA 1994). The assumption behind the WER approach is that bioavailability may be reduced by the presence of certain constituents (e.g.,

**Figure 1. Screening Level and Range-Finding Bioassay Sample Locations.**

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hardness, suspended solids, organic carbon) in the site water. Since the generic water quality standard (WQS) is based on toxicity studies that were conducted in "clean" laboratory water (i.e., water lacking suspended solids and organic carbon which might reduce bioavailability), the generic standard has the potential to be overprotective for site-specific conditions. The WER approach uses concurrent toxicity tests to calculate the ratio of the LC50 in site-water and the LC50 in laboratory water. This ratio provides an empirical determination of the difference in metal bioavailability attributed to site water and is used to adjust the generic WQS.

The procedure for determining a WER involves using an indicator species to evaluate and quantify the site-specific bioavailability of a chemical. To accomplish this, the chemical of concern is spiked into both the clean laboratory water and site water at known concentrations. Site water used in testing is simulation of the water that would exist in the receiving waters (Miller, Walker and Des Moines Creeks) during storm events using critical flows. 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:

$$(\text{WER}) \times (\text{Generic WQS}) = \text{Site-specific WQS}$$

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.

### 1.3 DATA ANALYSIS

Mortality data were used to generate concentration-response curves with the statistical computer package ToxCalc 5.0.23A (Ives 1999) and statistically estimate LC50s and the 95% confidence limits. To account for differences in water hardness, the LC50s were normalized to 50 mg/L as CaCO<sub>3</sub> (USEPA 1985) with the following equation:

$$\frac{\text{EXP}(0.9422 * \text{LN}(50) - 1.7)}{\text{EXP}(0.9422 * \text{LN}(\text{dilution water hardness}) - 1.7)} \times (\text{LC50}) = \text{Normalized LC50}$$

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

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<b>Test Protocol:</b>	<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; WDOE Publication No. WQ-R-95-80.
<b>Test Material:</b>	Copper-spiked site water (Prepared in the laboratory to simulate conditions in the receiving water bodies during storm events); Copper-spiked synthetic laboratory water
<b>Test Organism/age:</b>	<i>Ceriodaphnia dubia</i> and <i>Daphnia magna</i> ; $\leq 24$ hrs old
<b>Source:</b>	In-house cultures
<b>Number/Test Chamber:</b>	5
<b>Volume/Test Chamber:</b>	25 mL (screening-level); 100 mL (range-finding)
<b>Test Concentrations:</b>	5 concentrations + control (range-finding)
<b>Replicates:</b>	Four (+ 1 replicate for water quality measurements)
<b>Reference Toxicant:</b>	Copper (copper sulfate)
<b>Test Duration:</b>	48 hours
<b>Renewal:</b>	None
<b>Control:</b>	Unspiked natural spring water (screening level); Synthetic laboratory water (range-finding); Unspiked site water
<b>Test Chambers:</b>	30 mL polystyrene cups (screening level); 250 mL HDPE beakers (range-finding)
<b>Lighting:</b>	Fluorescent bulbs (50-100 foot candles)
<b>Photoperiod:</b>	16 hours light; 8 hours dark
<b>Aeration:</b>	None
<b>Feeding:</b>	None
<b>Temperature:</b>	20 or $25 \pm 1^\circ\text{C}$
<b>Effect Measured:</b>	Mortality
<b>Test Acceptability:</b>	Control mortality $\leq 10\%$

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## 2. BIOASSAY RESULTS

### 2.1 BACKGROUND TOXICITY SCREEN

The first phase of the study, conducted on 14 January 1999 with *Ceriodaphnia dubia* using samples collected from Miller, Walker, and Des Moines Creeks during a storm event. These screening level bioassays indicated no toxicity, with 100% survival in each sample. The bioassay data are presented in Table 2 and Appendix A.

Table 2. Summary of *Ceriodaphnia dubia* screening level bioassays in 100% site water (January 1999).

Sample	Percent Survival	NOEC <sup>1</sup>	LOEC <sup>2</sup>
Miller Creek Downstream	100	100	>100
Miller Creek Upstream	100	100	>100
STIA Outfall SDS-3	100	100	>100
City of Sea-Tac Storm Outfalls	100	100	>100
Walker Creek	100	100	>100
Des Moines Creek -West	100	100	>100
Des Moines Creek -East	100	100	>100
Lake Reba	100	100	>100
Mixture: SDS-3 + Miller Downstream	100	100	>100
Mixture: SDS-3 + Walker Creek	100	100	>100

<sup>1</sup> NOEC: no observed effect concentration.

<sup>2</sup> LOEC: lowest observed effect concentration.

### 2.2 RANGE-FINDING STUDIES

To determine the approximate magnitude of the WERs, two range-finding WER studies were conducted using copper spiked simulated stormwater (Round I) and receiving water (Round II). Unlike a definitive WER study, exposure concentrations were not analytically verified, and the resulting LC50s were based on hardness normalized, nominal total copper concentrations.

Results of the Round I study, conducted with *Ceriodaphnia dubia*, indicated that WERs for Miller, Walker and Des Moines Creeks were approximately 16, 7 and 15, respectively. The results of these tests are presented in Table 3 and Appendix B. The Round II study, conducted with *Daphnia magna*, used mixtures of Miller Creek and Walker Creek with SDS3 stormwater in ratios anticipated for the new outfalls following construction of the third runway. The results of Round II testing are presented in Table 4 and Appendix C, with WERs ranging from 18 to 28.

Round 1 - assumed MZ

Round 2 - assumed no MZ.

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**Table 3. Summary of Round I *Ceriodaphnia dubia* range-finding water-effect ratio bioassays with simulated downstream water (SDS3 + Receiving Stream); February 1999.**

Cu-Spiked Test Water	Hardness (mg/L)	Cu LC50 (µg/L)	Normalized <sup>1</sup> LC50 (µg/L)	WER
Miller Creek + SDS3	44	70.711	79.762	16
Walker Creek + SDS3	50	33.259	33.259	7
Des Moines Creek + SDS3	60	88.087	74.184	15
Laboratory Water	96	9.208	4.980	N/A
Reference Toxicant (LC50) =		Acceptable		

N/A = not applicable

<sup>1</sup> LC50 adjusted to a hardness of 50 mg/L (as CaCO<sub>3</sub>)

**Table 4. Summary of Round II *Daphnia magna* range-finding water-effect ratio bioassays with upstream and complete mix water; April 2000.**

Cu-Spiked Test Water <sup>1</sup>	Total Rec. Cu (µg/L)	Dissolved Cu (µg/L)	Hardness (mg/L)	Cu LC50 (µg/L)	Normalized <sup>2</sup> LC50 (µg/L)	WER
NPIN / DMU	10	8	60	143.6	120.93	28 upstream
NPOUT / DMD	4.3	3.3	90	132	75.87	18 complete mix
MCDF / MCD	4.4	4.7	92	168.8	95.03	22 complete mix
MCUP / MCU	5.6	4.0	46	111.6	120.72	28 upstream
DMWEIR	5.8	5.6	65	136.6	106.68	25 complete mix
Laboratory Water	5.0	N/A	90	7.4	4.25	N/A
Reference Toxicant (LC50) =		Acceptable				

N/A = not applicable

<sup>1</sup> Test water identification: P.O.S. sample code / Parametrix sample code

NPIN / DMU = Northwest Ponds Inlet / Des Moines Upstream

NPOUT / DMD = Northwest Ponds Outlet / Des Moines Downstream

MCDF / MCD = Miller Creek Detention Facility / Miller Creek Downstream

MCUP / MCU = Miller Creek Up / Miller Creek Upstream

DMWEIR = Des Moines Weir

<sup>2</sup> LC50 adjusted to a hardness of 50 mg/L (as CaCO<sub>3</sub>)

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### 3. REFERENCES

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**APPENDIX A**  
**SCREENING LEVEL BIOASSAY RESULTS**  
**WITH *Ceriodaphnia dubia***

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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample MC  
 Test Dates 1/15-1/17/99

Sample Collection Date  
 Test Initiation Time  
 Source/Age of Organisms

1/14/99  
1400  
In house, <24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.3	8.4	8.4	8.9	8.7	327	261
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.6	8.3	8.4	8.5	8.8	8.7	131	136
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JP BQB BQB JM BQB BQB JM BQB BQB JM BQB  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

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Comments \_\_\_\_\_

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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client  
Sample  
Test Dates

POS  
MGR MC V JP Vis  
1/15-1/17/99

Sample Collection Date  
Test Initiation Time  
Source/Age of Organisms

1/14/99  
1400  
In house, 274 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.3	8.4	8.4	8.9	8.7	327	261
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.8	8.4	8.4	8.7	8.8	8.7	82	163
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
Initials		JP	BGB	BGB	JP	BGB	BGB	JP	BGB	BGB	JP	BGB
Date		1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample SDS3  
 Test Dates 1-15-99 - 1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms In house, < 24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.2	8.3	8.4	9.0	8.8	324	365
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.5	8.4	8.4	8.9	9.0	8.8	53	108
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JL BGB BGB JM BGB BGB JM BGB BGB JM BGB  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample STO  
 Test Dates 1/15/99 - 1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms In house, <24 hrs

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.2	8.3	8.4	9.0	8.8	327	305
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.5	8.3	8.4	8.3	8.9	8.8	166	77
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JD BJD BJB MM BJD BJB MM BJD BJB MM BJD  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

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*DEO*

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample WC  
 Test Dates 1/15 - 1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms In house, < 24 hrs

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.2	8.2	8.4	9.0	9.0	324	399
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.7	8.2	8.2	8.8	9.0	9.0	131	183
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JG BGB BGB HM BGR BGB HM BGR BGB HM BGR BGB  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17

Shading represents areas for which data collection is not required.  
 NT = Not Taken

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Comments \_\_\_\_\_  
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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample DMC-west  
 Test Dates 1/15-1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms In house, <24 hrs

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
		Control	A	5	5	5	8.2	8.2	8.2	8.4	9.0	9.0
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.4	8.3	8.3	8.6	9.0	9.0	159	89
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
Initials		JG	BGB	BGB	AM	BGR	BGR	AM	BGR	BGR	AM	BGR
Date		1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.  
 NT = Not Taken

QEO

Comments \_\_\_\_\_  
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 \_\_\_\_\_

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample DMC-east  
 Test Dates 1/15-1/17/99

Sample Collection Date  
 Test Initiation Time  
 Source/Age of Organisms

1/14/99  
1400  
In house, 424 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
		Control	A	5	5	5	8.2	8.3	8.2	8.4	9.0	9.1
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.6	8.4	8.3	8.8	9.0	9.1	52	80
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
Initials		JA	BGB	BGB	JM	BGB	BGB	JM	BGB	BGB	JM	BGB
Date		1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.  
 NT = Not Taken

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STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample LR  
 Test Dates 1/15 - 1/17/99

Sample Collection Date \_\_\_\_\_  
 Test Initiation Time \_\_\_\_\_  
 Source/Age of Organisms \_\_\_\_\_

1/14/99  
1400  
In house, <24 hrs

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.7	8.3	8.2	8.4	9.0	9.1	327	414
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 S <sub>2</sub>	A	5	5	5	7.6	8.5	8.4	8.7	9.0	9.1	251	314
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JP BQB BQB JMM BQB BQB JMM BQB BQB JMM BQB  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.  
 NT = Not Taken

Comments \_\_\_\_\_  
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2650  
 DCW

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client POS  
 Sample S053-MC  
 Test Dates 1/15/99 - 1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms In house, <24h

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.1	8.5	8.4	9.0	9.2	327	319
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.1	8.2	8.5	8.9	8.9	9.2	118	199
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials JA BQB BQB JMM BQB BQB JMM BQB BQB JMM BQB  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.  
 NT = Not Taken

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

*DEO*

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client 105  
 Sample SDS? WC  
 Test Dates 1-15-99 - 1/17/99

Sample Collection Date 1/14/99  
 Test Initiation Time 1400  
 Source/Age of Organisms 1.5 hrs = 24 hrs

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.1	8.5	8.4	9.0	9.2	327	319
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	6.9	8.3	8.5	8.9	8.8	9.1	70	107
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											

Initials AS RJB BJS MM RJB BJS MM RJB AMB MM BJS  
 Date 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/16 1/17 1/15 1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

*DEO*

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**APPENDIX B**  
**RANGE-FINDING BIOASSAY RESULTS (ROUND I)**  
**WITH *Ceriodaphnia dubia***

**AR 026703**

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client Port of Seattle  
 Sample Cu in Des Moines Creek Site Water  
 Test Dates 2/23/99 through 2/25/99

Sample Collection Date 2/22/99  
 Test Initiation Time 1600  
 Source/Age of Organisms In House / <24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	7.2	8.2	8.2	9.1	8.9	8.8	142	149
	B	5	5	5								
1.5625 µg/L	A	5	5	5	7.3	8.2	8.2	9.1	8.9	8.8	142	152
	B	5	5	5								
3.125 µg/L	A	5	5	5	7.3	8.2	8.2	9.1	9.0	8.9	141	156
	B	5	5	5								
6.25 µg/L	A	5	5	5	7.2	8.2	8.2	9.1	9.0	8.9	141	159
	B	5	5	5								
12.5 µg/L	A	5	5	5	7.2	8.2	8.2	9.1	9.1	8.9	141	156
	B	5	5	5								
25 µg/L	A	5	5	5	7.2	8.2	8.2	9.1	9.1	8.9	141	160
	B	5	5	5								
50 µg/L	A	5	5	5	7.2	8.2	8.2	9.1	9.2	8.9	141	158
	B	5	5	5								
100 µg/L	A	5	2-3	2	7.2	8.2	8.2	9.1	9.1	8.9	141	158
	B	5	4-1	2-2								
150 µg/L	A	5	0-5	0	7.3	8.2	8.2	9.1	9.1	8.9	141	160
	B	5	0-5	0								
200 µg/L	A	5	0-5	0	7.2	8.2	8.2	9.1	9.1	8.9	141	152
	B	5	0-5	0								
Initials		AM	AM	NM	AM	AM	NM	AM	AM	NM	AM	NM
Date		2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/25

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client Port of Seattle  
 Sample Cu in Walker Creek Site Water  
 Test Dates 2/23/99 through 2/25/99

Sample Collection Date 2/22/99  
 Test Initiation Time 1650  
 Source/Age of Organisms In House / <24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	7.1	8.1	7.9	8.9	8.4	8.4	79	82
	B	5	5	5								
1.5625 µg/L	A	5	5	5	7.1	8.0	7.9	8.9	8.5	8.4	79	87
	B	5	5	5								
3.125 µg/L	A	5	5	5	7.1	8.0	7.8	8.9	8.4	8.5	78	87
	B	5	5	5								
6.25 µg/L	A	5	5	4-1	7.1	7.9	7.8	8.9	8.5	8.5	79	87
	B	5	5	5								
12.5 µg/L	A	5	5	5	7.1	7.9	7.8	8.9	8.5	8.5	79	85
	B	5	5	5								
25 µg/L	A	5	3-2	3	7.1	7.9	7.8	8.9	8.5	8.5	79	86
	B	5	5	5								
50 µg/L	A	5	4-1	1-3	7.1	7.9	7.8	8.9	8.6	8.6	79	85
	B	5	2-3	2								
100 µg/L	A	5	0-5	0	7.1	7.9	-	8.9	8.6	-	79	-
	B	5	0-5	0								
150 µg/L	A	5	0-5	0	7.0	7.9	-	9.0	8.6	-	79	-
	B	5	0-5	0								
200 µg/L	A	5	0-5	0	7.0	7.9	-	9.0	8.6	-	79	-
	B	5	0-5	0								

Initials AMM BMB gmc JF BMB gmc JF BMB gmc JF BMB gmc JF gmc  
 Date 2/23 2/24 2/25 2/23 2/24 2/25 2/23 2/24 2/25 2/23 2/25

NT = Not Taken

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client Port of Seattle  
 Sample Cu in Miller Creek Site Water  
 Test Dates 2/23/99 through 2/25/99

Sample Collection Date \_\_\_\_\_  
 Test Initiation Time \_\_\_\_\_  
 Source/Age of Organisms \_\_\_\_\_

2/22/99  
11:45  
In House / <24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	7.1	8.0	8.0	9.0	8.5	8.5	111	115
	B	5	5	5								
1.5625 µg/L	A	5	5	5	7.1	8.0	8.0	9.0	8.4	8.5	111	130
	B	5	5	5								
3.125 µg/L	A	5	5	5	7.1	8.0	8.0	9.0	8.4	8.5	111	130 (1)
	B	5	5	5								
6.25 µg/L	A	5	5	5	7.1	8.0	8.1	9.1	8.4	8.5	111	124
	B	5	5	5								
12.5 µg/L	A	5	5	5	7.1	8.0	8.1	9.1	8.5	8.5	111	128
	B	5	5	5								
25 µg/L	A	5	5	5	7.1	8.0	8.1	9.1	8.5	8.5	111	117
	B	5	5	5								
50 µg/L	A	5	5	5	7.0	7.9	8.1	9.1	8.4	8.5	111	119
	B	5	5	5								
100 µg/L	A	5	3-2	0-3	7.0	7.9	8.0	9.1	8.4	8.5	111	121
	B	5	2-3	0-2								
150 µg/L	A	5	0-5	0	6.9	8.0	8.0	9.2	8.5	8.6	111	123
	B	5	0-5	0								
200 µg/L	A	5	0-5	0	6.9	8.0	8.0	9.2	8.6	8.6	111	117
	B	5	0-5	0								
Initials		JHM	JHM	gjm	NM	JHM	gjm	NM	JHM	gjm	NM	gjm
Date		2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/25

NT = Not Taken

Comments (1) DC gjm showed read: 127 2/25/99

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client Port of Seattle  
 Sample Cu in Lab Water  
 Test Dates 2/23/99 through 2/25/99

Sample Collection Date n/a  
 Test Initiation Time 1630  
 Source/Age of Organisms In House / <24 hours

Temp (°C) Day 0 20 Day 1 20 Day 2 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	4-1	8.2	8.3	8.3	8.4	9.0	8.6	330	378
	B	5	5	5								
1.25 µg/L	A	5	5	5	8.2	8.3	8.3	8.4	9.0	8.6	329	382
	B	5	5	5								
2.5 µg/L	A	5	5	5	8.2	8.3	8.3	8.4	9.0	8.6	328	386
	B	5	5	5								
5 µg/L	A	5	5	5	8.2	8.3	8.3	8.4	9.0	8.6	329	391
	B	5	5	5								
10 µg/L	A	5	5	2-3	8.2	8.3	8.3	8.4	9.0	8.7	329	373
	B	5	5	2-3								
20 µg/L	A	5	0-5	0	8.2	8.3	-	8.4	9.0	-	329	-
	B	5	0-5	0								
40 µg/L	A	5	0-5	0	8.2	8.3	-	8.4	9.0	-	329	-
	B	5	0-5	0								
	A											
	B											
	A											
	B											
	A											
	B											
Initials		AM	BGB	NM	AM	BGB	NM	AM	BGB	NM	AM	NM
Date		2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/24	2/25	2/23	2/25

NT = Not Taken

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



**APPENDIX C**  
**RANGE-FINDING BIOASSAY RESULTS (ROUND II)**  
**WITH *Daphnia magna***

**AR 026708**

PARAMETRIX, INC.  
Environmental Toxicology Laboratory

STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Lab Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 1415  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water EPA synthetic freshwater

Temp (°C) Day 0 25 Day 1 25 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	4-1	7.9	7.6	7.9	8.3	8.1	8.3	251	365
	B	5	5	5								
	C	5	5	3-2								
	D	5	5	5								
5 µg/L	A	5	5	4-1	7.9	7.7	7.9	8.3	8.1	8.3	251	316
	B	5	5	4-1								
	C	5	5	3-2								
	D	5	5	3-2								
10 µg/L	A	5	3-2	0-3	7.9	7.7	7.9	8.3	8.2	8.3	251	390
	B	5	4-1	0-4								
	C	5	5	2-3								
	D	5	2-3	2								
20 µg/L	A	5	1-4	0-1	7.9	7.7	7.9	8.3	8.3	8.3	251	332
	B	5	3-2	0-3								
	C	5	0-5	0								
	D	5	0-5	0								
40 µg/L	A	5	0-5	0	7.9	7.8	8.0	8.3	8.3	8.1	251	318
	B	5	0-5	0								
	C	5	0-5	0								
	D	5	0-5	0								
80 µg/L	A	5	0-5	0	7.9	7.8	8.0	8.3	8.3	8.1	251	293
	B	5	0-5	0								
	C	5	0-5	0								
	D	5	0-5	0								
	A											
	B											
	C											
	D											
Initials		JK	JK	PM	JK	JK	PM	JK	JK	PM	JK	PM
Date		4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17
QC												

Shading represents areas for which data collection is not required.

NT = Not Taken

Reviewed by: [Signature] 4/20/00

Comments \_\_\_\_\_

Test: AD-Acute Daphid Test ID: 2861  
 Species: DM-Daphnia magna Protocol: EPAA 91-EPA Acute  
 Sample ID: WA0024651-Port of Seattle Sample Type: SRW2-Industrial stormwater  
 Start Date: 04/15/2000 14:15 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	4			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	3			
	4	4	D-Control	5	5	5			
	5	1	5.000	5	5	4			
	6	2	5.000	5	5	4			
	7	3	5.000	5	5	3			
	8	4	5.000	5	5	3			
	9	1	10.000	5	3	0			
	10	2	10.000	5	4	0			
	11	3	10.000	5	5	2			
	12	4	10.000	5	2	2			
	13	1	20.000	5	1	0			
	14	2	20.000	5	3	0			
	15	3	20.000	5	0	0			
	16	4	20.000	5	0	0			
	17	1	40.000	5	0	0			
	18	2	40.000	5	0	0			
	19	3	40.000	5	0	0			
	20	4	40.000	5	0	0			
	21	1	80.000	5	0	0			
	22	2	80.000	5	0	0			
	23	3	80.000	5	0	0			
	24	4	80.000	5	0	0			

Comments: Port of Seattle - Cu in Lab Water

PREPARED BY cat 4/20/00

CHECKED BY [Signature] 4/20/00

AR 026710

Test: AD-Acute Daphid  
 Species: DM-Daphnia magna  
 Sample ID: WA0024651-Port of Seattle  
 Start Date: 04/15/2000 14:15      End Date: 04/17/2000

Test ID: 2861  
 Protocol: EPAA 91-EPA Acute  
 Sample Type: SRW2-Industrial stormwater  
 Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	4			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	3			
	4	4	D-Control	5	5	5			
	5	1	5.000	5	5	4			
	6	2	5.000	5	5	4			
	7	3	5.000	5	5	3			
	8	4	5.000	5	5	3			
	9	1	10.000	5	3	0			
	10	2	10.000	5	4	0			
	11	3	10.000	5	5	2			
	12	4	10.000	5	2	2			
	13	1	20.000	5	1	0			
	14	2	20.000	5	3	0			
	15	3	20.000	5	0	0			
	16	4	20.000	5	0	0			
	17	1	40.000	5	0	0			
	18	2	40.000	5	0	0			
	19	3	40.000	5	0	0			
	20	4	40.000	5	0	0			
	21	1	80.000	5	0	0			
	22	2	80.000	5	0	0			
	23	3	80.000	5	0	0			
	24	4	80.000	5	0	0			

Comments: Port of Seattle - Cu in Lab Water

AR 026711

**Acute Daphnid-48 Hr Survival**

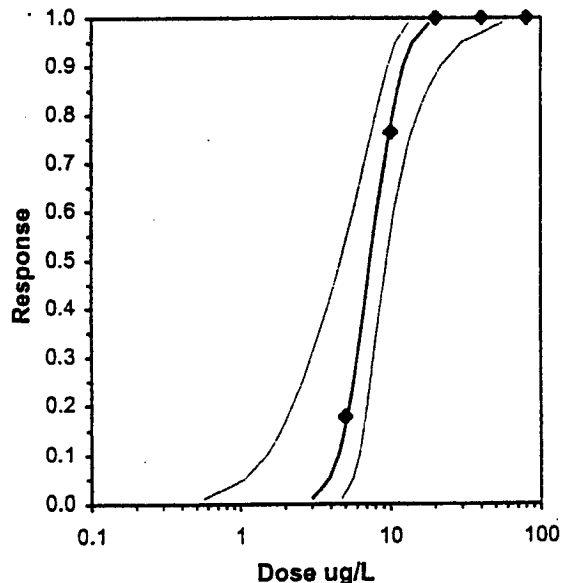
Start Date: 04/15/2000 14:15 Test ID: 2861 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: Port of Seattle - Cu in Lab Water

Conc-ug/L	1	2	3	4
D-Control	0.8000	1.0000	0.6000	1.0000
5	0.8000	0.8000	0.6000	0.6000
10	0.0000	0.0000	0.4000	0.4000
20	0.0000	0.0000	0.0000	0.0000
40	0.0000	0.0000	0.0000	0.0000
80	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Mean	N-Mean	Transform: Arcsin Square Root					N	t-Stat	1-Tailed Critical	MSD	Number Resp	Total Number
			Mean	Min	Max	CV%							
D-Control	0.8500	1.0000	1.1709	0.8861	1.3453	18.840	4				3	20	
5	0.7000	0.8235	0.9966	0.8861	1.1071	12.807	4	1.161	2.180	0.3273	6	20	
*10	0.2000	0.2353	0.4551	0.2255	0.6847	58.254	4	4.768	2.180	0.3273	16	20	
20	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20	
40	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20	
80	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20	

Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.88728	0.805	-0.1968	-1.6982						
Bartlett's Test indicates equal variances (p = 0.52)	1.29929	9.21035								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	5	10	7.07107		0.29035	0.3422	0.55735	0.04508	0.00262	2, 9

Maximum Likelihood-Probit											
Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	5.93176	1.81345	2.37741	9.48612	0.15	0.13572	7.81472	0.99	0.86892	0.16858	5
Intercept	-0.1542	1.70483	-3.4957	3.18724							
TSCR	0.15469	0.07987	-0.0019	0.31123							
Point	Probits	ug/L	95% Fiducial Limits								
EC01	2.674	2.99733	0.55368	4.72012							
EC05	3.355	3.90502	1.05825	5.63791							
EC10	3.718	4.49645	1.48967	6.2191							
EC15	3.964	4.9453	1.87202	6.65964							
EC20	4.158	5.33378	2.24052	7.04519							
EC25	4.326	5.69129	2.60919	7.40717							
EC40	4.747	6.70207	3.78501	8.50415							
EC50	5.000	7.39467	4.67005	9.36801							
EC60	5.253	8.15886	5.66233	10.5014							
EC75	5.674	9.60787	7.37291	13.432							
EC80	5.842	10.2519	8.01687	15.1249							
EC85	6.036	11.0572	8.73009	17.5857							
EC90	6.282	12.161	9.58322	21.558							
EC95	6.645	14.0028	10.8068	29.6849							
EC99	7.326	18.2433	13.1615	55.6444							

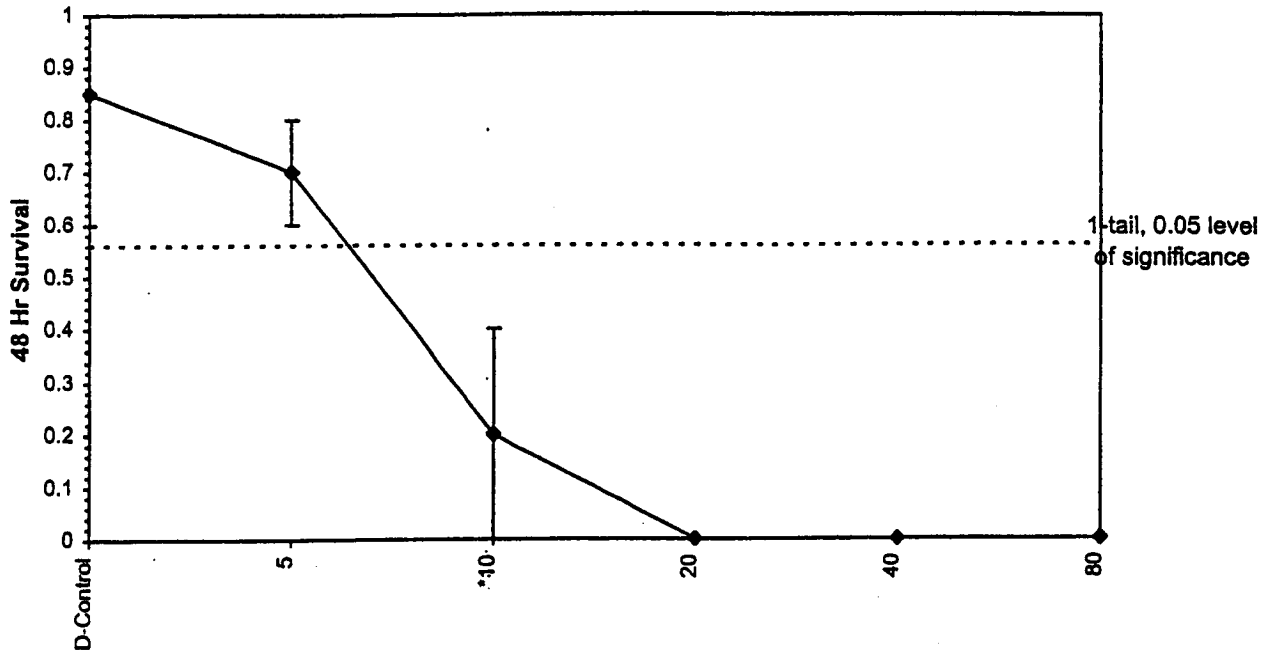


**AR 026712**

Acute Daphnid-48 Hr Survival

Start Date: 04/15/2000 14:15 Test ID: 2861 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: Port of Seattle - Cu in Lab Water

Dose-Response Plot



AR 026713

STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Northwest Ponds Inlet Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 1430  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water Northwest Ponds Inlet Water

Temp (°C) Day 0 25 Day 1 25 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	7.9	7.8	8.1	8.2	8.0	8.4	157	184
	B	5	5	4-1								
	C	5	5	4-1								
	D	5	5	5								
12.5 µg/L	A	5	5	5	7.9	7.9	8.1	8.2	8.0	8.3	152	187
	B	5	5	5								
	C	5	5	4-1								
	D	5	5	4-1								
25 µg/L	A	5	5	3-2	7.9	7.9	8.1	8.2	8.0	8.3	152	185
	B	5	5	5								
	C	5	4-1	2-2								
	D	5	5	2-3								
50 µg/L	A	5	5	2-3	7.9	7.9	8.1	8.2	8.0	8.2	157	192
	B	5	5	3-2								
	C	5	5	5								
	D	5	5	5								
100 µg/L	A	5	5	5	7.9	7.9	8.1	8.2	8.0	8.2	152	180
	B	5	5	4-1								
	C	5	5	3-2								
	D	5	4-1	3-1								
200 µg/L	A	5	5*	0-5	7.9	7.9	8.1	8.2	8.0	8.0	157	172
	B	5	5*	0-5								
	C	5	5*	1-4								
	D	5	4-1	0-4								
	A											
	B											
	C											
	D											
Initials	DT	DT	DT	DT	DT	DT	DT	DT	DT	DT	DT	DT
Date	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17	4/17
QC												

Shading represents areas for which data collection is not required.

NT = Not Taken

Reviewed by: [Signature] 4/20/00

Comments \* Very limited mobility

Test: AD-Acute Daphid Test ID: 2862  
 Species: DM-Daphnia magna Protocol: EPAA 91-EPA Acute  
 Sample ID: WA0024651-Port of Seattle Sample Type: SRW2-Industrial stormwater  
 Start Date: 04/15/2000 14:30 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	4			
	3	3	D-Control	5	5	4			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	4			
	8	4	12.500	5	5	4			
	9	1	25.000	5	5	3			
	10	2	25.000	5	5	5			
	11	3	25.000	5	4	2			
	12	4	25.000	5	5	2			
	13	1	50.000	5	5	2			
	14	2	50.000	5	5	3			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	4			
	19	3	100.000	5	5	3			
	20	4	100.000	5	4	3			
	21	1	200.000	5	5	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	5	1			
	24	4	200.000	5	4	0			

Comments: POS - Cu in NW Ponds Inlet Water

PREPARED BY cat 4/22/00  
 CHECKED BY jr 4/20/00

AR 026715



Test: AD-Acute Daphid Species: DM-Daphnia magna Sample ID: WA0024651-Port of Seattle Start Date: 04/15/2000 14:30	Test ID: 2862 Protocol: EPAA 91-EPA Acute Sample Type: SRW2-Industrial stormwater Lab ID: WAPTL-Parametrix Tox Lab End Date: 04/17/2000
--	---

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	4			
	3	3	D-Control	5	5	4			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	4			
	8	4	12.500	5	5	4			
	9	1	25.000	5	5	3			
	10	2	25.000	5	5	5			
	11	3	25.000	5	4	2			
	12	4	25.000	5	5	2			
	13	1	50.000	5	5	2			
	14	2	50.000	5	5	3			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	4			
	19	3	100.000	5	5	3			
	20	4	100.000	5	4	3			
	21	1	200.000	5	5	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	5	1			
	24	4	200.000	5	4	0			

Comments: POS - Cu in NW Ponds Inlet Water

**AR 026716**

**Acute Daphid-48 Hr Survival**

Start Date: 04/15/2000 14:30 Test ID: 2862 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: POS - Cu in NW Ponds Inlet Water

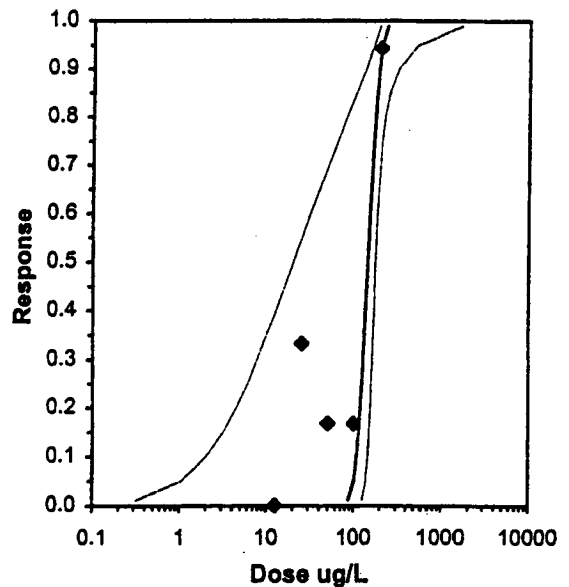
Conc-ug/L	1	2	3	4
D-Control	1.0000	0.8000	0.8000	1.0000
12.5	1.0000	1.0000	0.8000	0.8000
25	0.6000	1.0000	0.4000	0.4000
50	0.4000	0.6000	1.0000	1.0000
100	1.0000	0.8000	0.6000	0.8000
200	0.0000	0.0000	0.2000	0.0000

Conc-ug/L	Transform: Arcsin Square Root							t-Stat	1-Tailed Critical	MSD	Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%	N					
D-Control	0.9000	1.0000	1.2262	1.1071	1.3453	11.212	4				2	20
12.5	0.9000	1.0000	1.2262	1.1071	1.3453	11.212	4	0.000	2.410	0.3863	2	20
25	0.6000	0.6667	0.9002	0.6847	1.3453	34.607	4	2.034	2.410	0.3863	8	20
50	0.7500	0.8333	1.0653	0.6847	1.3453	31.308	4	1.004	2.410	0.3863	5	20
100	0.7500	0.8333	1.0561	0.8861	1.3453	20.748	4	1.061	2.410	0.3863	5	20
*200	0.0500	0.0556	0.2850	0.2255	0.4636	41.771	4	5.872	2.410	0.3863	19	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95795	0.884	0.41562	-0.3207						
Bartlett's Test indicates equal variances (p = 0.40)	5.17099	15.0863								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	200	141.421		0.33147	0.37417	0.49698	0.05138	1.3E-04	5, 18

**Maximum Likelihood-Probit**

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	10.6117	4.76948	1.26356	19.9599	0.1	5.88238	7.81472	0.12	2.15722	0.09424	9
Intercept	-17.892	10.7861	-39.033	3.24892							
TSCR	0.2125	0.04574	0.12286	0.30214							
Point	Probits	ug/L	95% Fiducial Limits								
EC01	2.674	86.6949	0.30845	127.403							
EC05	3.355	100.511	1.0603	138.812							
EC10	3.718	108.755	2.0446	145.537							
EC15	3.964	114.696	3.18124	150.403							
EC20	4.158	119.648	4.51697	154.505							
EC25	4.326	124.067	6.09755	158.226							
EC40	4.747	135.939	12.9302	168.743							
EC50	5.000	143.621	20.2227	176.274							
EC60	5.253	151.737	31.4131	185.401							
EC75	5.674	166.256	63.181	208.466							
EC80	5.842	172.396	81.3097	223.935							
EC85	6.036	179.84	105.178	252.51							
EC90	6.282	189.664	133.834	319.086							
EC95	6.645	205.22	163.273	528.79							
EC99	7.326	237.926	193.908	1667.6							

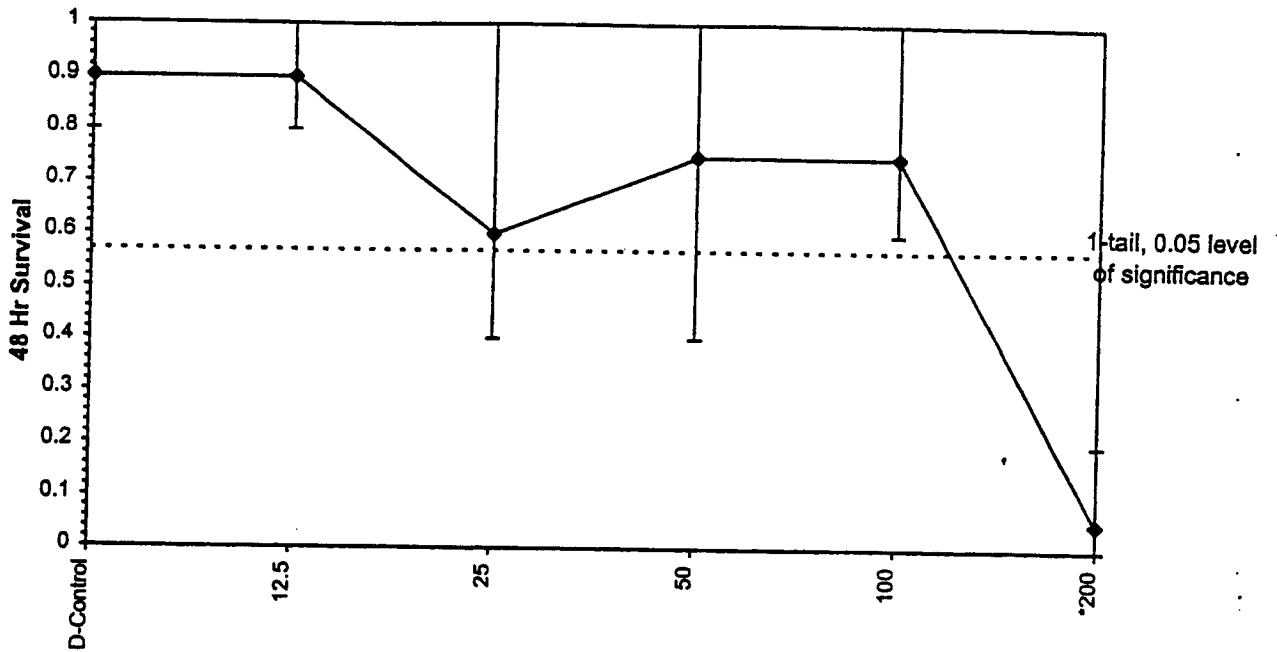


**AR 026717**

Acute Daphnid-48 Hr Survival

Start Date: 04/15/2000 14:30 Test ID: 2862 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: POS - Cu in NW Ponds Inlet Water

Dose-Response Plot



AR 026718

STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Des Moines Creek Weir Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 1530  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water Des Moines Creek Weir Water

Temp (°C) Day 0 25 Day 1 25 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	7.9	8.0	8.0	8.3	8.1	8.4	159	182
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
12.5 µg/L	A	5	5	5	7.9	8.0	8.1	8.3	8.1	8.4	159	187
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
25 µg/L	A	5	5	5	7.9	8.0	8.1	8.3	8.2	8.4	159	190
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
50 µg/L	A	5	5	5	7.9	8.0	8.1	8.3	8.1	8.2	159	188
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 µg/L	A	5	5	5	7.9	8.0	8.1	8.3	8.3	8.1	159	187
	B	5	5	5								
	C	5	5	5								
	D	5	5	4								
200 µg/L	A	5	4-1	0-4	7.9	8.0	8.1	8.3	8.3	8.0	159	176
	B	5	5	0-5								
	C	5	2-3	0-2								
	D	5	4-1	0-4								
	A											
	B											
	C											
	D											
Initials		DT	DT	PM	DT	DT	PM	DT	DT	PM	DT	PM
Date		4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17
QC												

Shading represents areas for which data collection is not required.

NT = Not Taken

Reviewed by: pc 4/20/00

Comments \* Very limited mobility

Test: AD-Acute Daphid  
 Species: DM-Daphnia magna  
 Sample ID: WA0024651-Port of Seattle

Test ID: 2864  
 Protocol: EPAA 91-EPA Acute  
 Sample Type: SRW2-Industrial stormwater  
 Lab ID: WAPTL-Parametrix Tox Lab

Start Date: 04/15/2000 15:30 End Date: 04/17/2000

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	5			
	20	4	100.000	5	5	4			
	21	1	200.000	5	4	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	2	0			
	24	4	200.000	5	4	0			

Comments: POS - Cu in Des Moines Creek Weir Water

PREPARED BY cast 4/20/00  
 CHECKED BY JP 4/20/00

AR 026720

Test: AD-Acute Daphid  
 Species: DM-Daphnia magna  
 Sample ID: WA0024651-Port of Seattle  
 Start Date: 04/15/2000 15:30

Test ID: 2864  
 Protocol: EPAA 91-EPA Acute  
 Sample Type: SRW2-Industrial stormwater  
 Lab ID: WAPTL-Parametrix Tox Lab  
 End Date: 04/17/2000

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	5			
	20	4	100.000	5	5	4			
	21	1	200.000	5	4	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	2	0			
	24	4	200.000	5	4	0			

Comments: POS - Cu in Des Moines Creek Weir Water

AR 026721

**Acute Daphnid-48 Hr Survival**

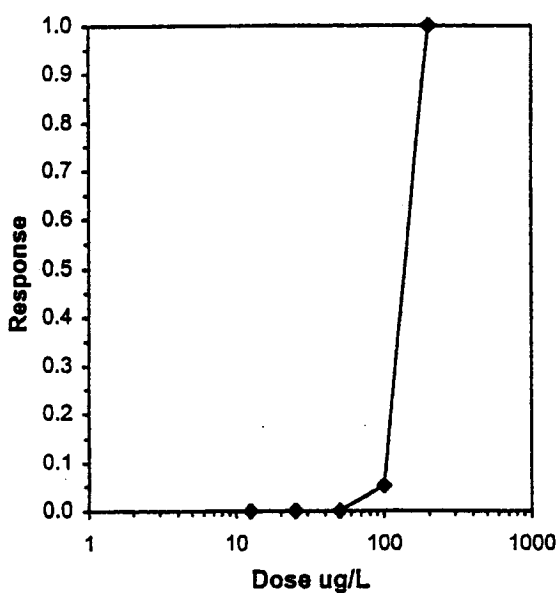
Start Date: 04/15/2000 15:30 Test ID: 2864 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: POS - Cu in Des Moines Creek Weir Water

Conc-ug/L	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	1.0000	1.0000	1.0000	1.0000
100	1.0000	1.0000	1.0000	0.8000
200	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Mean	N-Mean	Transform: Arcsin Square Root				N	Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%					
D-Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4			0	20
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
50	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
100	0.9500	0.9500	1.2857	1.1071	1.3453	9.261	4	16.00	10.00	1	20
200	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

Auxillary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.5089	0.868	-2.7962	11.6732
Equality of variance cannot be confirmed				
Prothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Miel's Many-One Rank Test	100	200	141.421	

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	136.60	127.68	146.15
5.0%	138.87	133.76	144.16
10.0%	138.87	133.76	144.16
20.0%	138.87	133.76	144.16
Auto-0.0%	136.60	127.68	146.15

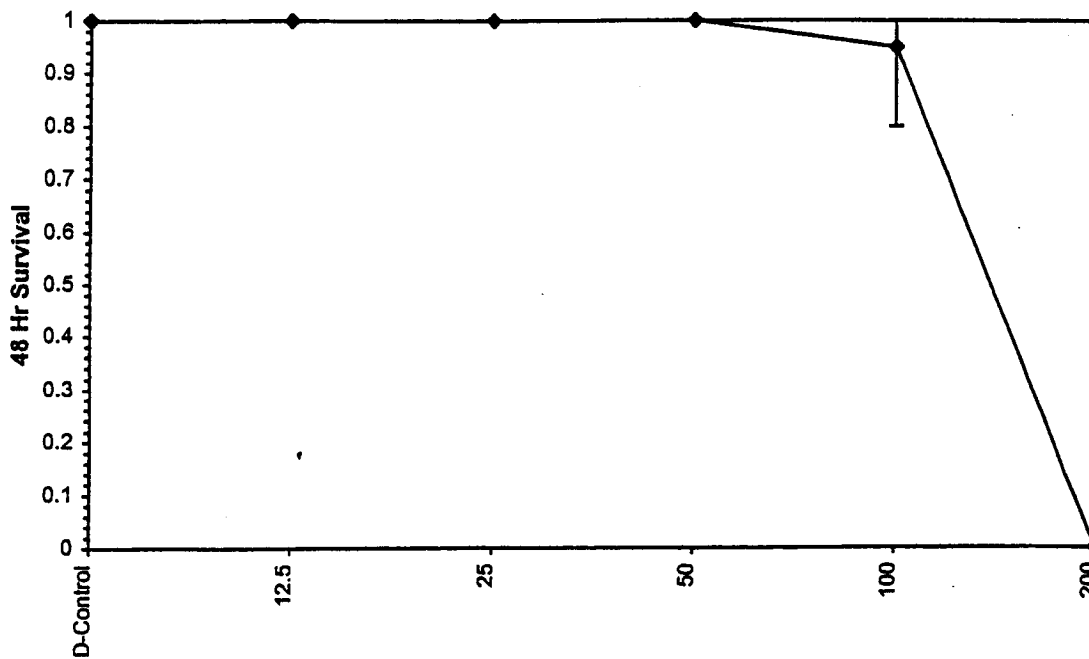


**AR 026722**

Acute Daphid-48 Hr Survival

Start Date: 04/15/2000 15:30 Test ID: 2864 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: POS - Cu in Des Moines Creek Weir Water

Dose-Response Plot



AR 026723



STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Miller Creek Upstream Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 1500  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water Miller Creek Upstream Water

Temp (°C) Day 0 21 Day 1 26 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	4-1	7.7	7.5	7.6	8.3	8.2	8.1	121	147
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
12.5 µg/L	A	5	5	5	7.7	7.5	7.7	8.3	8.2	8.1	121	149
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
25 µg/L	A	5	5	5	7.7	7.6	7.8	8.3	8.3	8.2	121	154
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
50 µg/L	A	5	5	5	7.7	7.6	7.8	8.3	8.3	8.2	121	157
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 µg/L	A	5	5	3-2	7.7	7.6	7.9	8.3	8.3	8.1	121	152
	B	5	5	3-2								
	C	5	5	4-1								
	D	5	5	3-2								
200 µg/L	A	5	0-5	0	7.7	7.7	7.9	8.3	8.4	8.0	121	155
	B	5	4-1	0-4								
	C	5	5	0-5								
	D	5	5	0-5								
	A											
	B											
	C											
	D											
Initials		DH	DH	PM	DH	DH	PM	DH	DH	PM	DH	PM
Date		4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17
QC												

Shading represents areas for which data collection is not required.

NT = Not Taken

Reviewed by: [Signature] 4/20/00

Comments \_\_\_\_\_

Test: AD-Acute Daphid

Test ID: 2866

Species: DM-Daphnia magna

Protocol: EPAA 91-EPA Acute

Sample ID: WA0024651-Port of Seattle

Sample Type: SRW2-Industrial stormwater

Start Date: 04/15/2000 15:00

End Date: 04/17/2000

Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	4			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	3			
	18	2	100.000	5	5	3			
	19	3	100.000	5	5	4			
	20	4	100.000	5	5	3			
	21	1	200.000	5	0	0			
	22	2	200.000	5	4	0			
	23	3	200.000	5	5	0			
	24	4	200.000	5	5	0			

Comments: POS - Cu in Miller Creek Upstream Water

PREPARED BY caj 4/20/00  
 REVIEWED BY jl 4/20/00

AR 026725

Test: AD-Acute Daphid  
 Species: DM-Daphnia magna  
 Sample ID: WA0024651-Port of Seattle  
 Start Date: 04/15/2000 15:00      End Date: 04/17/2000  
 Test ID: 2866  
 Protocol: EPAA 91-EPA Acute  
 Sample Type: SRW2-Industrial stormwater  
 Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	4			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	3			
	18	2	100.000	5	5	3			
	19	3	100.000	5	5	4			
	20	4	100.000	5	5	3			
	21	1	200.000	5	0	0			
	22	2	200.000	5	4	0			
	23	3	200.000	5	5	0			
	24	4	200.000	5	5	0			

Comments: POS - Cu in Miller Creek Upstream Water

AR 026726

**Acute Daphnid-48 Hr Survival**

Start Date: 04/15/2000 15:00 Test ID: 2866 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: POS - Cu in Miller Creek Upstream Water

Conc-ug/L	1	2	3	4
D-Control	0.8000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	1.0000	1.0000	1.0000	1.0000
100	0.6000	0.6000	0.8000	0.6000
200	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Transform: Arcsin Square Root							Rank Sum	1-Tailed Critical	Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%	N				
D-Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4			1	20
12.5	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0	20
25	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0	20
50	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0	20
100	0.6500	0.6842	0.9413	0.8861	1.1071	11.742	4	10.50	10.00	7	20
200	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

**Auxiliary Tests**

Shapiro-Wilk's Test Indicates non-normal distribution (p <= 0.01)      Statistic: 0.81017      Critical: 0.868      Skew: -0.22      Kurt: 4.10888

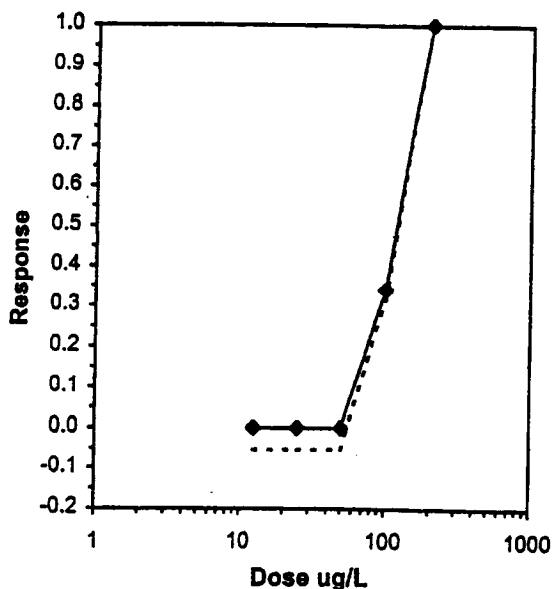
Equality of variance cannot be confirmed

Hypothesis Test (1-tail, 0.05)      NOEC      LOEC      ChV      TU

Steel's Many-One Rank Test      100      200      141.421

**Trimmed Spearman-Kärber**

Trim Level	EC50	95% CL	
0.0%	111.59	96.33	129.27
5.0%	112.81	95.68	133.00
10.0%	114.00	94.32	137.79
20.0%	116.22	88.21	153.11
Auto-0.0%	111.59	96.33	129.27

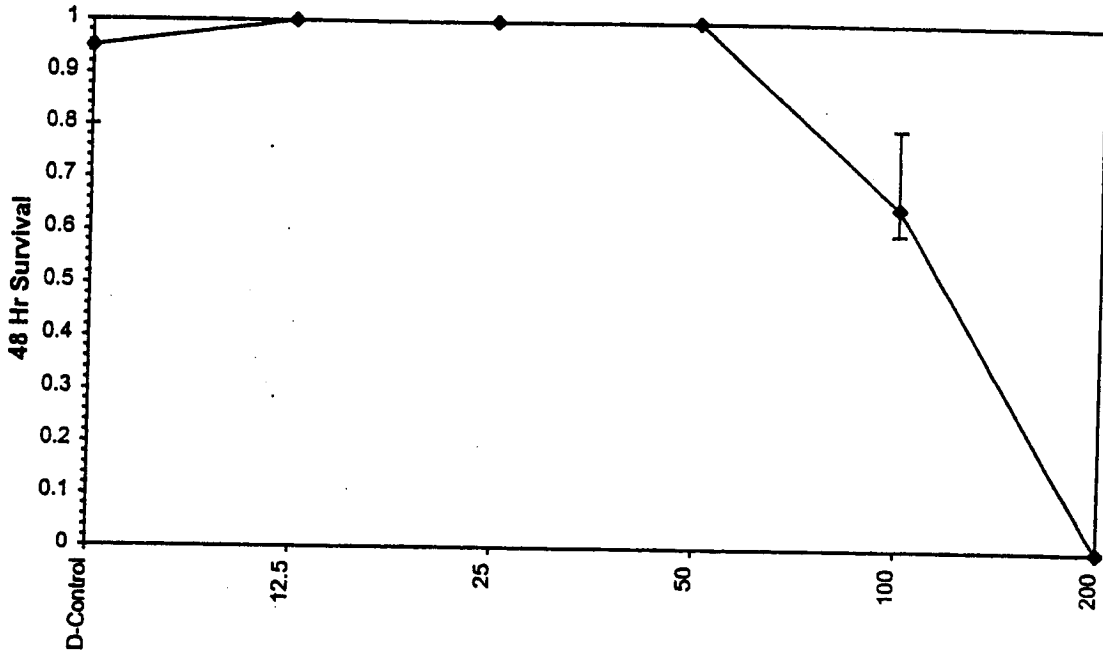


**AR 026727**

Acute Daphnid-48 Hr Survival

Start Date: 04/15/2000 15:00 Test ID: 2866 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: POS - Cu in Miller Creek Upstream Water

Dose-Response Plot



AR 026728

STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Miller Creek Detention Facility Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 15:55  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water Miller Creek Detention Facility Water

Temp (°C) Day 0 25 Day 1 25 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.0	8.3	8.3	8.2	8.3	8.3	218	257
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
12.5 µg/L	A	5	5	4-1	8.0	8.3	8.3	8.2	8.3	8.3	218	255
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
25 µg/L	A	5	5	5	8.0	8.3	8.3	8.2	8.3	8.3	218	256
	B	5	5	5								
	C	5	5	4-1								
	D	5	5	4-1								
50 µg/L	A	5	5	5	8.0	8.3	8.3	8.2	8.3	8.2	218	255
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 µg/L	A	5	5	5	8.0	8.3	8.3	8.2	8.3	8.1	218	251
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
200 µg/L	A	5	5	1-4	8.0	8.3	8.3	8.2	8.3	8.0	218	245
	B	5	4-1	2-2								
	C	5	5	2-3								
	D	5	3-2	2-1								
	A											
	B											
	C											
	D											
Initials		SH	SH	PM	SH	SH	PM	SH	SH	PM	SH	PM
Date		4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17
QC												

Shading represents areas for which data collection is not required.  
NT = Not Taken

Reviewed by: JZ 4/24/00

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Test: AD-Acute Daphid

Test ID: 2865

Species: DM-Daphnia magna

Protocol: EPAA 91-EPA Acute

Sample ID: WA0024651-Port of Seattle

Sample Type: SRW2-Industrial stormwater

Start Date: 04/15/2000 15:15

End Date: 04/17/2000

Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	4			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	4			
	12	4	25.000	5	5	4			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	5			
	20	4	100.000	5	5	5			
	21	1	200.000	5	5	1			
	22	2	200.000	5	4	2			
	23	3	200.000	5	5	2			
	24	4	200.000	5	3	2			

Comments: POS - Cu in Miller Creek Detention Facility Water

PREPARED BY ced 4/20/00

ANALYZED BY 92 4/20/00

AR 026730

Test: AD-Acute Daphid Test ID: 2865  
 Species: DM-Daphnia magna Protocol: EPAA 91-EPA Acute  
 Sample ID: WA0024651-Port of Seattle Sample Type: SRW2-Industrial stormwater  
 Start Date: 04/15/2000 15:15 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	4			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	4			
	12	4	25.000	5	5	4			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	5			
	20	4	100.000	5	5	5			
	21	1	200.000	5	5	1			
	22	2	200.000	5	4	2			
	23	3	200.000	5	5	2			
	24	4	200.000	5	3	2			

Comments: POS - Cu in Miller Creek Detention Facility Water

AR 026731



**Acute Daphid-48 Hr Survival**

Start Date: 04/15/2000 15:15 Test ID: 2865 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: POS - Cu in Miller Creek Detention Facility Water

Conc-ug/L	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
12.5	0.8000	1.0000	1.0000	1.0000
25	1.0000	1.0000	0.8000	0.8000
50	1.0000	1.0000	1.0000	1.0000
100	1.0000	1.0000	1.0000	1.0000
200	0.2000	0.4000	0.4000	0.4000

Conc-ug/L	Mean	N-Mean	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%	N				
D-Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4			0	20
12.5	0.9500	0.9500	1.2857	1.1071	1.3453	9.261	4	16.00	10.00	1	20
25	0.9000	0.9000	1.2262	1.1071	1.3453	11.212	4	14.00	10.00	2	20
50	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
100	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
*200	0.3500	0.3500	0.6295	0.4636	0.6847	17.561	4	10.00	10.00	13	20

**Auxiliary Tests**

Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)      Statistic: 0.83783      Critical: 0.884      Skew: -0.952      Kurt: 0.83974

Equality of variance cannot be confirmed

Hypothesis Test (1-tail, 0.05)      NOEC      LOEC      ChV      TU

Fel's Many-One Rank Test      100      200      141.421

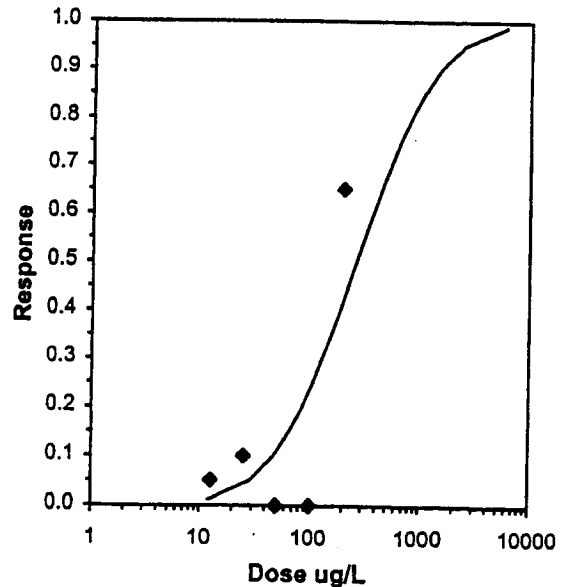
**Maximum Likelihood-Probit**

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	1.71858	1.15876	-1.9691	5.40626	0	17.4984	7.81472	5.6E-04	2.42024	0.58188	5
Intercept	0.84061	2.28474	-6.4305	8.11168							

TSCR

Point	Probits	ug/L	95% Fiducial Limits
EC01	2.674	11.6574	
EC05	3.355	29.0499	
EC10	3.718	47.2652	
EC15	3.964	65.6401	
EC20	4.158	85.2169	
EC25	4.326	106.605	
EC40	4.747	187.425	
EC50	5.000	263.175	
EC60	5.253	369.539	
EC75	5.674	649.701	
EC80	5.842	812.761	
EC85	6.036	1055.16	
EC90	6.282	1465.37	
EC95	6.645	2384.21	
EC99	7.326	5941.4	

Significant heterogeneity detected (p = 5.58E-04)

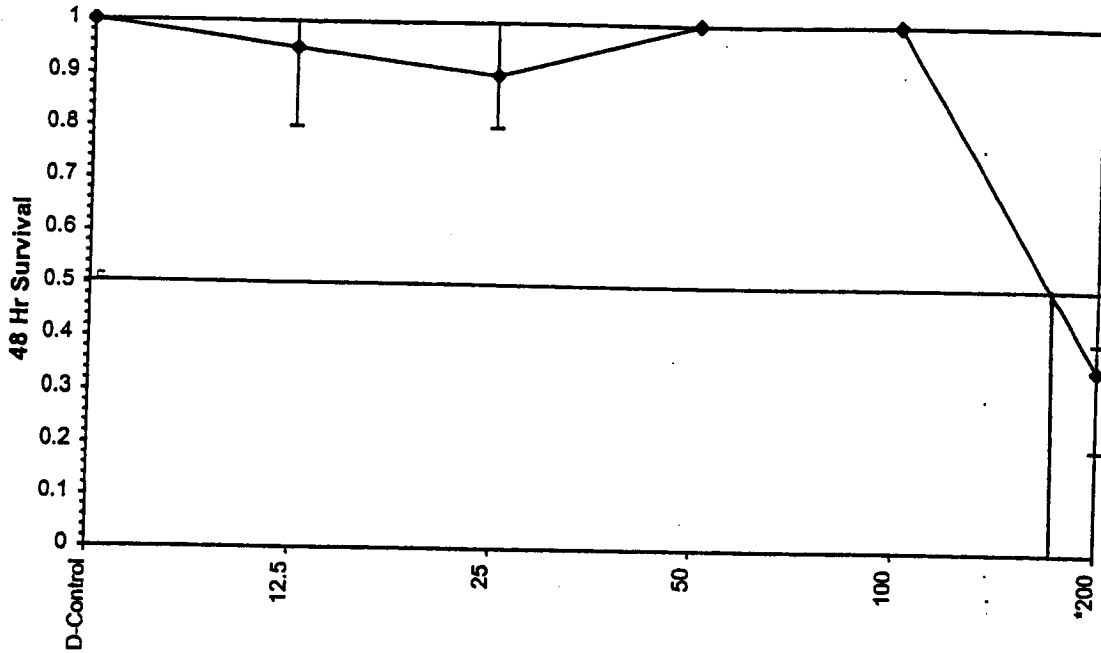


**AR 026732**

Acute Daphnid-48 Hr Survival

Start Date: 04/15/2000 15:15 Test ID: 2865 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: POS - Cu in Miller Creek Detention Facility Water

Dose-Response Plot



AR 026733

TRIMMED SPEARMAN-KARBER METHOD. MONTANA STATE UNIV

FOR REFERENCE, CITE:

MILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.  
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN  
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.  
ENVIRON. SCI. TECHNOL. 11(7): 714-719;  
CORRECTION 12(4):417 (1978).

DATE: 4/15/00  
CHEMICAL: CU

TEST NUMBER: POS

DURATION: 48 HOURS  
SPECIES: DM

RAW DATA:

CONCENTRATION(UG/L)	12.50	25.00	50.00	100.00	200.00
NUMBER EXPOSED:	20	20	20	20	20
MORTALITIES:	1	2	0	0	13
SPEARMAN-KARBER TRIM:		35.00%			

SPEARMAN-KARBER ESTIMATES: LC50: 168.78  
95% LOWER CONFIDENCE: 140.44  
95% UPPER CONFIDENCE: 202.83

NOTE: MORTALITY PROPORTIONS WERE NOT MONOTONICALLY INCREASING.  
ADJUSTMENTS WERE MADE PRIOR TO SPEARMAN-KARBER ESTIMATION.

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AR 026734

STATIC ACUTE *Daphnia magna* TOXICITY TEST

Client Port of Seattle  
Sample Cu in Northwest Ponds Outlet Water  
Test Dates 4/15/2000 - 4/17/2000

Sample Collection Date 4/14/00  
Test Initiation Time 1445  
Source/Age of Organisms In house cultures / <24 hours  
Dilution Water Northwest Ponds Outlet Water

Temp (°C) Day 0 25 Day 1 25 Day 2 25

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.0	8.3	8.2	8.3	8.3	7.8	202	213
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
12.5 µg/L	A	5	5	5	8.0	8.3	8.2	8.3	8.3	7.9	202	215
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
25 µg/L	A	5	5	5	8.0	8.3	8.3	8.3	8.3	7.9	202	231
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
50 µg/L	A	5	5	5	8.0	8.4	8.3	8.3	8.3	7.9	202	234
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 µg/L	A	5	5	5	8.0	8.4	8.3	8.3	8.3	7.8	202	225
	B	5	5	5								
	C	5	5	3-2								
	D	5	5	5								
200 µg/L	A	5	5	0-5	8.0	8.4	8.3	8.3	8.3	7.8	202	214
	B	5	5	0-5								
	C	5	5	0-5								
	D	5	5	0-5								
	A											
	B											
	C											
	D											
Initials		JH	JH	DM	JH	PM	PM	JH	JH	PM	JH	PM
Date		4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/16	4/17	4/15	4/17
QC												

Shading represents areas for which data collection is not required.

NT = Not Taken

Reviewed by: JH 4/20/00

Comments \_\_\_\_\_

Test: AD-Acute Daphid

Test ID: 2863

Species: DM-Daphnia magna

Protocol: EPAA 91-EPA Acute

Sample ID: WA0024651-Port of Seattle

Sample Type: SRW2-industrial stormwater

Start Date: 04/15/2000 14:45

End Date: 04/17/2000

Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	3			
	20	4	100.000	5	5	5			
	21	1	200.000	5	5	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	5	0			
	24	4	200.000	5	5	0			

Comments: POS - Cu in NW Ponds Outlet Water

PREPARED BY cat 4/20/00  
 CHECKED BY g2 4/20/00

AR 026736

Test: AD-Acute Daphid

Test ID: 2863

Species: DM-Daphnia magna

Protocol: EPAA 91-EPA Acute

Sample ID: WA0024651-Port of Seattle

Sample Type: SRW2-Industrial stormwater

Start Date: 04/15/2000 14:45

End Date: 04/17/2000

Lab ID: WAPTL-Parametrix Tox Lab

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	5	5	5			
	2	2	D-Control	5	5	5			
	3	3	D-Control	5	5	5			
	4	4	D-Control	5	5	5			
	5	1	12.500	5	5	5			
	6	2	12.500	5	5	5			
	7	3	12.500	5	5	5			
	8	4	12.500	5	5	5			
	9	1	25.000	5	5	5			
	10	2	25.000	5	5	5			
	11	3	25.000	5	5	5			
	12	4	25.000	5	5	5			
	13	1	50.000	5	5	5			
	14	2	50.000	5	5	5			
	15	3	50.000	5	5	5			
	16	4	50.000	5	5	5			
	17	1	100.000	5	5	5			
	18	2	100.000	5	5	5			
	19	3	100.000	5	5	3			
	20	4	100.000	5	5	5			
	21	1	200.000	5	5	0			
	22	2	200.000	5	5	0			
	23	3	200.000	5	5	0			
	24	4	200.000	5	5	0			

Comments: POS - Cu in NW Ponds Outlet Water

AR 026737

**Acute Daphid-48 Hr Survival**

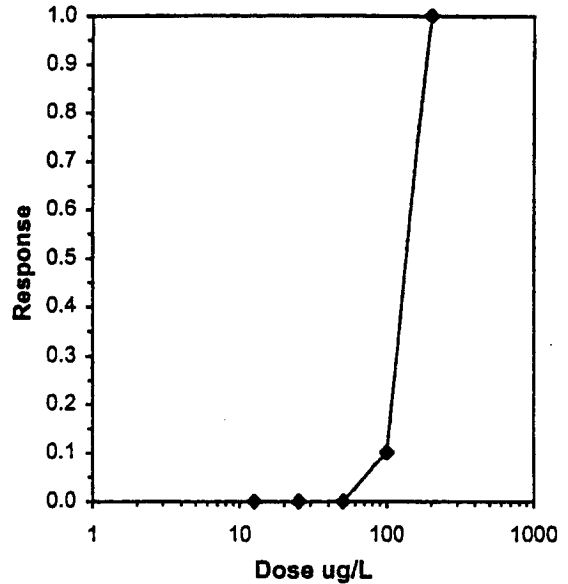
Start Date: 04/15/2000 14:45 Test ID: 2863 Sample ID: WA0024651-Port of Seattle  
 End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
 Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
 Comments: POS - Cu In NW Ponds Outlet Water

Conc-ug/L	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	1.0000	1.0000	1.0000	1.0000
100	1.0000	1.0000	0.6000	1.0000
200	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Transform: Arcsin Square Root							Rank Sum	1-Tailed Critical	Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%	N				
D-Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4			0	20
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
50	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
100	0.9000	0.9000	1.2305	0.8861	1.3453	18.660	4	16.00	10.00	2	20
200	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ( $p \leq 0.01$ )	0.5089	0.868	-2.7962	11.6732
Equality of variance cannot be confirmed				
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Mann-Whitney U Test	100	200	141.421	

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	131.95	120.23	144.81
5.0%	134.92	120.13	151.53
10.0%	136.08	128.49	144.12
20.0%	136.08	128.49	144.12
Auto-0.0%	131.95	120.23	144.81

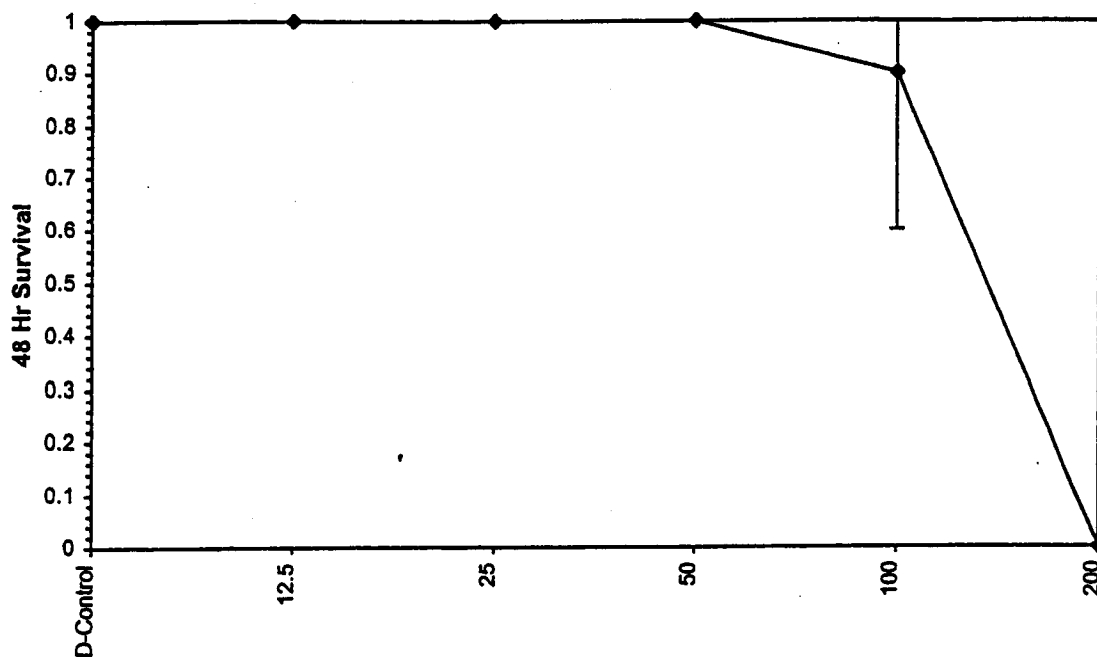


**AR 026738**

Acute Daphnid-48 Hr Survival

Start Date: 04/15/2000 14:45 Test ID: 2863 Sample ID: WA0024651-Port of Seattle  
End Date: 04/17/2000 Lab ID: WAPTL-Parametrix Tox Lab Sample Type: SRW2-Industrial stormwater  
Sample Date: 04/14/2000 Protocol: EPAA 91-EPA Acute Test Species: DM-Daphnia magna  
Comments: POS - Cu in NW Ponds Outlet Water

Dose-Response Plot



AR 026739



# Cum Sum Control Chart for *D. magna* Survival

CV% = 83.9

