



**Bruce J. Donald**  
Reclamation Manager

September 28, 2005

Prairie & Northern Region  
Environment Canada  
Room 200, 4999 98<sup>th</sup> Ave.  
Edmonton, AB T6B 2X3

**Attention: Jenny Ferone, Regional EEM Coordinator**  
**Peter Blackall, Regional Director of Environmental Protection**

Dear Jenny Ferone and Peter Blackall;

**Re: REVISED Polaris Mine 2004 Annual MMER and EEM Report**

This revised report is being submitted in response to the August 9, 2005 letter from Jenny Ferone (Environment Canada) to Bruce Donald (Teck Cominco Metals Ltd.), regarding purported reporting deficiencies for the Polaris Mine 2004 Annual Report (provided in Appendix F). Azimuth staff prepared the initial 2004 Annual Report and have addressed the issues identified in the August 9<sup>th</sup> letter within this Revised 2004 Annual Report. In addition, Azimuth responded to each specific reporting issue in a letter sent to Environment Canada on behalf of Teck Cominco, dated September 14, 2005 (provided in Appendix G). Within this letter, Azimuth identified sections of the original report where some of the deficient data were presented and requested further guidance and clarification from Environment Canada on some of the reviewers' comments. Azimuth has not heard back to date, and has prepared this Revised 2004 Annual Report according to the assumptions and interpretations stated in the September 14<sup>th</sup> letter. Teck Cominco and Azimuth will ensure that all required information will be included in future reports.

Please find attached the REVISED 2004 Polaris Mine Annual Report. There was one non-compliant concentration related to Schedule 4 limits (TSS) as previously reported. There were no non-compliant results of the acute lethality tests during the year.

The following is included in our Revised 2004 Annual Report:

1. Requirements under Schedule 6
  - Identification of Site, Owner, Location, etc.
  - Non-Compliance information
  - Table 1 – Monthly Mean Concentrations, pH Range and Volume of Effluent
  - Table 2 – Results of Acute Lethality Tests and Daphnia Magna Monitoring Tests
2. Requirements under Part 1 Section 8
  - Results of studies conducted under Part 1, Section 4 (Effluent Characterization) (Table 3, Table 5)
  - Results of studies conducted under Part 1, Section 5 (Sublethal Toxicity Testing) (Table 6, Table 7, Appendix A, B, C and E) (Note that within Appendices A, B, and C, \*\* denotes the sections where reporting issues from the August 9<sup>th</sup> letter have been addressed)
  - Results of studies conducted under Part 1, Section 7 (Water Quality Monitoring) (Table 4, Table 5)
3. Additional Appendices
  - Appendix D – acute toxicity testing reports
  - Appendix F – Letter from Environment Canada to Teck Cominco Metals Ltd., dated August 9, 2005
  - Appendix G – Letter from Azimuth Consulting Group to Environment Canada, dated September 14, 2005.
  - Appendix H – Polaris Mine – Revised 2004 3rd Quarter Metal Mining Effluent Regulations Report (dated March 22, 2005)

As in the initial 2004 Annual Report, the revised 3<sup>rd</sup> Quarter regulatory data set is included in this submission in Appendix H. This data was revised to ensure consistency between the hardcopy and online RISS system reports.

The MMER and EEM data required to be reported in electronic format were submitted electronically through the RISS online system in March 2005, and no additional information was requested for this report format. In addition to this hardcopy report, an electronic pdf version of this report is being emailed to you (e-mailed September 28, 2005).

If you have any questions regarding the annual report or aspects of the application of the MMER to the Polaris Mine, please feel free to contact me.

Yours truly,

*Original signed by B. Donald*

Bruce Donald

Attachments: 2004 MMER Annual Report; Revised 2004 3<sup>rd</sup> Quarter Regulatory Data Tables

cc: Randy Baker (Azimuth Consulting Group)

Ken Russell (Environment Canada)

## INFORMATION TO BE INCLUDED IN ANNUAL REPORT SUMMARY

The following information is to be submitted for each final discharge point.

Mine Name : Polaris Mine  
Mine Operator : Cominco Mining Partnership and Teck Cominco Metals Ltd.  
Address : Bag 2000  
Kimberley, BC  
V1A 3E1  
Telephone : (250) 427-8405 Bruce Donald  
E-mail : [bruce.donald@teckcominco.com](mailto:bruce.donald@teckcominco.com)  
Location of Final Discharge point : Garrow Lake Former Dam at 75o22'32"N, 96o48'37"W.  
Reporting Period : January 1, 2004 to December 31, 2004.  
Date of Report : March 21, 2005.

### Non-Compliance Information

There was one non-compliant effluent discharge during 2004 (i.e., TSS of 117 mg/L, July 7, 2004), with respect to Schedule 4 limits. Upon receiving the results from the lab, this exceedance was reported to Environment Canada regulatory authorities in a letter dated August 12, 2004. The exceedance was due to the initial ice melt unplugging Garrow Lake, resulting in a flushing of sediment. There were no other non-compliant concentrations of substances during this initial flow, and TSS dropped to values of approximately 3-15 mg/L in all subsequent sampling events. Upon review of the information, Environment Canada recommended no further action in a letter dated January 11, 2005 from Sidney Bruinsma. There were no non-compliant acute lethality tests during 2004, including tests performed on the July 7, 2004 sample.

TABLE 1

MONTHLY MEAN CONCENTRATIONS, pH RANGE AND VOLUME OF EFFLUENT <sup>(1)(2)</sup>

Month	As (mg/L)	Cu (mg/L)	CN (mg/L)	Pb (mg/L)	Ni (mg/L)	Zn (mg/L)	TSS (mg/L)	Ra (Bq/L)	pH range	Effluent Volume (m3)
Jan.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Feb.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Mar.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Apr.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
May	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
June	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
July	0.0015	0.0011	0.0050	0.0014	0.0024	0.0980	32.0000	0.0090	7.90 - 8.05	4066913.00
Aug.	0.0004	0.0012	0.0051	0.0019	0.0081	0.0508	6.1000	0.0074	7.84 - 8.04	324551.00
Sept.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Oct.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Nov.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)
Dec.	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)

(1) Any measurement not taken because there was no deposit from the final discharge point shall be identified by the letters "ND" - (No Deposit)

(2) Any measurement not taken because no measurement was required in accordance with the conditions set out in section 13 of the Regulations shall be identified by the letters "NMR" - (No Measurement Required).

TABLE 2

RESULTS OF ACUTE LETHALITY TESTS AND  
*DAPHNIA MAGNA* MONITORING TESTS

Date Sample Collected	Effluent Acutely Lethal to Rainbow Trout (yes or no)	Effluent Acutely Lethal to <i>Daphnia magna</i> (yes or no)
7/7/2004	No	No
7/27/2004	No	No
8/24/2004	No	No

### REVISED Table 3. Effluent Characterization Results (Part 1, Section 4)

Effluent Characterization from Final Discharge Point - Garrow Lake Former Dam / Syphons

Northing: 75°22'32"

Easting: 96°48'37"

		Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)					
Facility Name:							
FDP Name:		Garrow Lake Syphons					
Sampling Date:		7/7/2004	7/27/2004	8/17/2004	8/24/2004		
Sample Method:		Grab	Grab	Grab	Grab		
Parameter	Units					Detection Limit	Methods <sup>1</sup>
Hardness	mg/L	1400	483	973	1380	2.7	EPA Method 3005A, ICPOES (EPA Method 6010B) <sup>4</sup>
Alkalinity	mg/L	138	62.4	111	128	1.0	APHA Method 2320 (potentiometric titration)
Aluminum	mg/L	0.34	0.021	<0.1	<0.1	0.1	SPR-IDA <sup>2</sup> , Graphite Furnace Atomic Absorption Spectrophotometry
Cadmium	mg/L	0.000588	0.00014	0.00023	0.000335	0.0002	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Iron	mg/L	0.487	0.084	0.042	0.014	0.01	SPR-IDA <sup>2</sup> , Flame Atomic Absorption Spectrophotometry
Mercury	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	Cold Vapour Atomic Florescence Spectrophotometry
Molybdenum	mg/L	<0.005	0.0013	<0.005	<0.005	0.005	ICPMS <sup>3</sup>
Ammonia	mg/L	0.071	<0.02	0.146	0.133	0.02	APHA Method 4500-NH3 (selective ion electrode)
Nitrate	mg/L	0.277	0.0644	0.525	0.531	0.01, 0.02	APHA Method 4110 (determination of inorganic ions by ion chromatography)
Arsenic	mg/L	<0.001	<0.001	<0.0002	<0.0002	0.001, 0.0002	Hydride-Vapour Atomic Absorption Spectrophotometry
Copper	mg/L	0.00265	0.000518	0.00121	0.00134	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Cyanide	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	APHA Method 4500-CN (cyanate hydrolysis using an ammonia selective electrode)
Lead	mg/L	0.00269	0.00157	0.00177	0.00119	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Nickel	mg/L	0.00442	0.00207	0.00644	0.00967	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Zinc	mg/L	0.198	0.0429	0.0418	0.0498	0.0005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
TSS	mg/L	117	<3	5.3	4.4	3.0	APHA Method 2540 (filtration through glass fibre filter)
Radium 226	Bq/L	0.02	<0.005	0.01	0.008	0.005	Radio Chemistry <sup>5</sup>
pH	pH units	8.05	7.87	7.95	7.84	0.01	APHA Method 4500-H (pH electrode)

Notes:

<sup>1</sup>Original data reports are available upon request

<sup>2</sup>SPR-IDA = Suspended Particulate Resin consisting of immobilized iminodiacetate on a divinyl benzene polymer is used to chelate and preconcentrate metals in seawater (preparation technique).

<sup>3</sup>Instrumental analysis is by ICPMS = Inductively Coupled Mass Spectrometry.

<sup>4</sup>This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 20th Edition 1998, published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the USEPA. The procedures may involve preliminary sample treatment by acid digestion, using either hotplate or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emissionspectrophotometry ICPOES (EPA Method 6010B).

<sup>5</sup>All radium isotopes in the sample solution are separated by coprecipitation with lead sulfate. The precipitate is redissolved and the radium isotopes are separated by coprecipitation with barium sulfate. The precipitate is filtered and mounted on a stainless steel disk. It is then counted on an alpha spectrometer. The radium 226 alpha energy is distinct and the peak can be clearly identified.

**REVISED Table 4. Water Quality Monitoring Results (Part 1, Section 7)**

Station:		Exposure Area			Reference Area			
Description:		Garrow Bay at Mouth of Garrow Creek Confluence			Garrow Bay ~1km NE of exposure station (confluence with Garrow Creek).			
Northing:		75°22'15"			75°22'40"			
Easting:		96°48'30"			96°47'12"			
Facility Name:		Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)			Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)			
FDP Name:		Garrow Lake Syphons			Garrow Lake Syphons			
Area Name:		Garrow Bay Exposure			Garrow Bay Reference			
Sampling Date:		7/27/2004	8/17/2004	8/24/2004	8/17/2004	8/24/2004		
Sample Method:		Grab	Grab	Grab	Grab	Grab		
Parameters	Units					Detection Limit	Methods <sup>1</sup>	
Hardness	mg/L	482	2270	1750	2960	1560	2.7	EPA Method 3005A, ICPOES (EPA Method 6010B) <sup>4</sup>
Alkalinity	mg/L	37.5	45	38.8	46	36.1	1.0	APHA Method 2320 (potentiometric titration)
Aluminum	mg/L	0.033	<0.1	<0.1	<0.1	<0.1	0.1	SPR-IDA <sup>2</sup> , Graphite Furnace Atomic Absorption Spectrophotometry
Cadmium	mg/L	0.00007	<0.00002	0.000028	<0.00002	<0.00002	0.0002	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Iron	mg/L	0.046	<0.01	<0.01	<0.01	<0.01	0.01	SPR-IDA <sup>2</sup> , Flame Atomic Absorption Spectrophotometry
Mercury	mg/L	<0.00005	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	Cold Vapour Atomic Fluorescence Spectrophotometry
Molybdenum	mg/L	0.00156	<0.005	<0.005	0.0062	<0.005	0.005	ICPMS <sup>3</sup>
Ammonia	mg/L	<0.02	<0.02	0.02	<0.02	<0.02	0.02	APHA Method 4500-NH3 (selective ion electrode)
Nitrate	mg/L	0.0372	<0.02	<0.02	<0.02	<0.02	0.02	APHA Method 4110 (determination of inorganic ions by ion chromatography)
Arsenic	mg/L	<0.001	<0.0002	0.00027	0.00044	<0.0002	0.001, 0.0002	Hydride-Vapour Atomic Absorption Spectrophotometry
Copper	mg/L	0.000405	0.000216	0.000209	0.000231	0.000205	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Cyanide	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	APHA Method 4500-CN (cyanate hydrolysis using an ammonia selective electrode)
Lead	mg/L	0.00026	<0.00005	0.000267	0.000052	<0.00005	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Nickel	mg/L	0.000979	0.000252	0.000267	0.000217	0.000186	0.00005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
Zinc	mg/L	0.0242	0.00118	0.00092	0.0005	<0.0005	0.0005	SPR-IDA <sup>2</sup> , ICPMS <sup>3</sup>
TSS	mg/L	3.7	3.3	8.4	9.3	7	3.0	APHA Method 2540 (filtration through glass fibre filter)
Radium226	Bq/L	<0.005	<0.005	0.006	<0.005	<0.005	0.005	Radio Chemistry <sup>5</sup>
pH	pH units	7.91	7.79	7.64	7.92	7.62	0.01	APHA Method 4500-H (pH electrode)
Water Temperature	°C	0.2	0.2	0.9	0.1	1.2	-	Field - Campbell Scientific Hydrolab Model H20, or YSI Meter Model 85
Dissolved Oxygen	mg/L	13.23	13.78	15.2	14.04	15.13	-	Field - Campbell Scientific Hydrolab Model H20, or YSI Meter Model 85

**Notes**

The Garrow Bay exposure area (mouth of the creek) was frozen during the July 7, 2004 sampling event.

Note that the reference area was ice free only during August 17 and August 24, 2004 sampling events.

<sup>1</sup>Original data reports are available upon request

<sup>2</sup>SPR-IDA = Suspended Particulate Resin consisting of immobilized iminodiacetate on a divinyl benzene polymer is used to chelate and preconcentrate metals in seawater (preparation technique).

<sup>3</sup>Instrumental analysis is by ICPMS = Inductively Coupled Mass Spectrometry.

<sup>4</sup>This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 20th Edition 1998, published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the USEPA. The procedures may involve preliminary sample treatment by acid digestion, using either hotplate or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emissions spectrophotometry ICPOES (EPA Method 6010B).

<sup>5</sup>All radium isotopes in the sample solution are separated by coprecipitation with lead sulfate. The precipitate is redissolved and the radium isotopes are separated by coprecipitation with barium sulfate. The precipitate is filtered and mounted on a stainless steel disk. It is then counted on an alpha spectrometer. The radium 226 alpha energy is distinct and the peak can be clearly identified.

**Table 5. QAQC Sample Results<sup>1</sup> Including Field Duplicates, Field Blanks, and Transport Blanks.**

Sample Type:	Field Duplicate	Original Sample		Field Duplicate	Original Sample		Field Duplicate	Original Sample		
Location:	Garrow Lake Syphons			Garrow Bay Exposure			Garrow Lake Syphons			
Description:	Final Discharge Point		RPD <sup>2</sup>	Mouth of Garrow Creek Confluence		RPD <sup>2</sup>	Final Discharge Point		RPD <sup>2</sup>	
Sampling Date:	7/7/2004		(%)	7/27/2004		(%)	8/17/2004		(%)	
Parameters	Parameter	Units								
Hardness	mg/L	1400	1400	0.00	532	482	10.37	997	973	2.47
Alkalinity	mg/L	132	138	4.35	38.6	37.5	2.93	113	111	1.80
Aluminum	mg/L	0.26	0.34	23.53	0.031	0.033	6.06	<0.10	<0.1	n/a
Cadmium	mg/L	0.000582	0.000588	1.02	0.000062	0.00007	11.43	0.000224	0.00023	2.61
Iron	mg/L	0.441	0.487	9.45	0.035	0.046	23.91	0.039	0.042	7.14
Mercury	mg/L	<0.000010	<0.00001	n/a	<0.000050	<0.00005	n/a	<0.000010	<0.00001	n/a
Molybdenum	mg/L	<0.0050	<0.005	n/a	0.00129	0.00156	17.31	<0.0050	<0.005	n/a
Ammonia	mg/L	0.069	0.071	2.82	<0.020	<0.02	n/a	0.163	0.146	11.64
Nitrate	mg/L	0.284	0.277	2.53	0.0371	0.0372	0.27	0.54	0.525	2.86
Arsenic	mg/L	<0.0010	<0.001	n/a	<0.0010	<0.001	n/a	<0.00020	<0.0002	n/a
Copper	mg/L	0.00252	0.00265	4.91	0.000342	0.000405	15.56	0.00121	0.00121	0.00
Cyanide	mg/L	<0.0050	<0.005	n/a	<0.0050	<0.005	n/a	<0.0050	<0.005	n/a
Lead	mg/L	0.0024	0.00269	10.78	0.000205	0.00026	21.15	0.00187	0.00177	5.65
Nickel	mg/L	0.00438	0.00442	0.90	0.000772	0.000979	21.14	0.00676	0.00644	4.97
Zinc	mg/L	0.196	0.198	1.01	0.019	0.0242	21.49	0.0418	0.0418	0.00
TSS	mg/L	120	117	2.56	7	3.7	89.19	<3.0	5.3	n/a
Radium226	Bq/L	0.02	0.02	0.00	<0.0050	<0.005	n/a	<0.0050	0.01	n/a
pH	pH units	8.06	8.05	0.12	7.76	7.91	1.90	8.02	7.95	0.88

**Notes**

<sup>1</sup>QAQC samples were collected during each EEM monitoring event. At least one field duplicate and/or one blank sample was collected during each event.

<sup>2</sup>RPD = Relative Percent Difference = [Absolute value (DUP-ORIG)/ORIG]\*100%

Cells in grey shading have RPD values >50% for co-located field duplicates

<sup>3</sup>Distilled water from onsite distiller.

**QAQC Results**

A total of 4 duplicate samples and 3 blank samples were collected during the 2004 EEM program at Polaris mine. All RPD values were less than 50%, with the exception of one measurement of TSS on July 27, 2004. This data indicate good reproducibility between co-located field duplicates (i.e., low measurement and analytical variability).

Blank samples were typically less than, or slightly higher than detection limits, revealing no background contamination issues.



**Table 5. QAQC Sample Results<sup>1</sup> Including Field Duplicates, Field Blanks, and Transport Blanks.**

Sample Type:	Field Duplicate	Original Sample		Field Blank	Transport Blank	Field Blank
Location:	Garrow Lake Syphons			n/a	n/a	n/a
Description:	Final Discharge Point		RPD <sup>2</sup>	Distilled Water <sup>3</sup>	Distilled Water <sup>3</sup>	Distilled Water <sup>3</sup>
Sampling Date:	8/24/2004		(%)	7/7/2004	7/7/2004	8/17/2004
Parameters	Units					
Hardness	mg/L	1380	1380	0.00	<0.54	<0.54
Alkalinity	mg/L	128	128	0.00	-	<1.0
Aluminum	mg/L	<0.10	<0.1	n/a	<0.10	<0.0010
Cadmium	mg/L	0.000342	0.000335	2.09	<0.000020	<0.000020
Iron	mg/L	0.015	0.014	7.14	<0.010	<0.030
Mercury	mg/L	<0.000010	<0.00001	n/a	<0.000010	<0.000010
Molybdenum	mg/L	<0.0050	<0.005	n/a	<0.0050	<0.0010
Ammonia	mg/L	0.114	0.133	14.29	-	0.028
Nitrate	mg/L	0.529	0.531	0.38	-	<0.0050
Arsenic	mg/L	<0.00020	<0.0002	n/a	<0.0010	<0.00020
Copper	mg/L	0.00140	0.00134	4.48	0.00012	<0.0010
Cyanide	mg/L	<0.0050	<0.005	n/a	-	<0.0050
Lead	mg/L	0.00116	0.00119	2.52	0.00017	<0.0010
Nickel	mg/L	0.00971	0.00967	0.41	<0.00050	<0.0010
Zinc	mg/L	0.0514	0.0498	3.21	0.0012	<0.0010
TSS	mg/L	3.7	4.4	15.91	-	<3.0
Radium226	Bq/L	<0.0050	0.008	n/a	<0.0050	<0.0050
pH	pH units	7.93	7.84	1.15	-	5.51

**Notes**

<sup>1</sup>QAQC samples were collected during each EEM monitoring event. At least one field duplicate and/or one blank sample was collected during each event.

<sup>2</sup>RPD = Relative Percent Difference = [Absolute value (DUP-ORIG)/ORIG]\*100%

Cells in grey shading have RPD values >50% for co-located field duplicates

<sup>3</sup>Distilled water from onsite distiller.

**QAQC Results**

A total of 4 duplicate samples and 3 blank samples were collected during the 2004 EEM program at Polaris mine. All RPD values were less than 50%, with the exception of one measurement of TSS on July 27, 2004. This data indicate good reproducibility between co-located field duplicates (i.e., low measurement and analytical variability).

Blank samples were typically less than, or slightly higher than detection limits, revealing no background contamination issues.

**Table 6. Sublethal Toxicity Testing Results EC50 (Part 1, Section 5)**

<b>Facility Name</b>	<b>FDP Name</b>	<b>EC25 Test Date</b>	<b>Species Test</b>	<b>Sublethal Test Type</b>	<b>Sample Method</b>	<b>Consultant Laboratory</b>
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/7/2004	Atherinops affinis	Growth	Grab	EVS Consultants, North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/27/2004	Atherinops affinis	Growth	Grab	EVS Consultants, North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/27/2004	Dendraster excentricus	Reproduction	Grab	EVS Consultants North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/27/2004	Champia parvula	Reproduction	Grab	Saskatchewan Research Council (SRC)
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	8/24/2004	Champia parvula	Reproduction	Grab	Saskatchewan Research Council (SRC)
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	8/24/2004	Dendraster excentricus	Reproduction	Grab	EVS Consultants North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	8/24/2004	Atherinops affinis	Growth	Grab	EVS Consultants North Vancouver, BC

**Table 6. Sublethal Toxicity Testing Results EC50 (Part 1, Section 5)**

EC25 Test Date	Species Test	EC25 or IC25	EC25 or IC25		Notes
			Lower Confidence Limit	Upper Confidence Limit	
7/7/2004	Atherinops affinis	> 72.6	72.6	72.6	IC25 (95%CL) was > 72.6%, the highest exposure concentration due to salinity adjustment.
7/27/2004	Atherinops affinis	> 69	69	69	IC25 (95% CL) was > 69%, the highest concentration tested due to salinity adjustment.
7/27/2004	Dendraster excentricus	8.7	7.6	9.9	July 7 sandollar test not initiated because sandollars did not spawn.
7/27/2004	Champia parvula	26.6	20.8	31.5	
8/24/2004	Champia parvula	45.3	36.3	58.1	
8/24/2004	Dendraster excentricus	17.5	11.6	22.6	
8/24/2004	Atherinops affinis	> 71	71	71	IC25 (95% CL) was > 71%, the highest concentration tested due to salinity adjustment.

**Table 7. Sublethal Toxicity Testing Results LC50 (Part 1, Section 5)**

<b>Facility Name</b>	<b>FDP Name</b>	<b>LC50 Test Date</b>	<b>Species Tested</b>	<b>Sublethal Test Type</b>	<b>Sample Method</b>	<b>Consultant Laboratory</b>
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/7/2004	Atherinops affinis	Survival	Grab	EVS Consultants, North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	7/27/2004	Atherinops affinis	Survival	Grab	EVS Consultants, North Vancouver, BC
Teck Cominco Metals Limited - Polaris Mine (Little Cornwallis Island)	Garrow Lake Syphons	8/24/2004	Atherinops affinis	Survival	Grab	EVS Consultants, North Vancouver, BC

**Table 7. Sublethal Toxicity Testing Results LC50 (Part 1, Section 5)**

<b>LC50 Test Date</b>	<b>Species Tested</b>	<b>LC50</b>	<b>LC50 Lower Limit</b>	<b>LC50 Upper limit</b>	<b>Notes</b>
7/7/2004	Atherinops affinis	> 72.6	72.6	72.6	LC50 (95% CL) was > 72.6%, the highest exposure concentration tested, due to salinity adjustment.
7/27/2004	Atherinops affinis	> 69	69	69	LC50 (95% CL) was > 69%, the highest concentration tested due to salinity adjustment.
8/24/2004	Atherinops affinis	> 71	71	71	LC50 (95% CL) was > 71%, the highest concentration tested due to salinity adjustment.

## **POLARIS MINE – MMER ANNUAL SUMMARY REPORT 2004**

### **APPENDIX A**

- i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPAW 95-EPA West Coast: 7-day Topsmelt Survival and Growth Tests.

### **APPENDIX B**

- i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPS 1/Rm/27-EC: 92 hr Echinoderm (sand dollar) Fertilization Test

### **APPENDIX C**

- i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPA/600/4-91-003, Method 1009.0: Algae (*Champia parvula*) 7-day Sublethal Growth Tests

### **APPENDIX D**

- i. Acute toxicity testing laboratory reports

### **APPENDIX E**

- i. Sublethal toxicity testing laboratory reports

### **APPENDIX F**

- i. Letter from Environment Canada to Teck Cominco Metals, Ltd. re: Polaris 2004 Annual Report (dated August 9, 2005)

### **APPENDIX G**

- i. Letter from Azimuth Consulting Group, Inc. to Environment Canada re: Clarification of reporting issues outlined in August 9, 2005 letter (dated September 14, 2005)

### **APPENDIX H**

- i. Polaris Mine – Revised 2004 3rd Quarter Metal Mining Effluent Regulations Report (dated March 22, 2005)

## **APPENDIX A**

### **7-d Topsmelt Growth and Survival Toxicity Test**

# Reporting Requirements for Reference Method EPAW 95-EPA West Coast (Topsmelt)

## Effluent Sample

- i. Name & location of operation generating the effluent
  - Polaris Mine, Little Cornwallis Island, Nunavut
  - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.
- ii. Date & time of sampling
  - Samples for sublethal toxicity testing were collected:
    - Test 1 - Wednesday July 7, 2004 – 1100h
    - Test 2 - Tuesday July 27, 2004 – 2130h
    - Test 3 – Tuesday Aug 24, 2004 – 1500h
- iii. Type of sample
  - Final effluent water from final discharge point
- iv. Brief description of sampling point
  - 20m downstream of the siphon discharge point at Garrow Lake dam
- v. Sampling method
  - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
  - Water was collected from the upstream direction
  - The pump was flushed with site water for at least one minute prior to sample collection
  - 3 x 20L sample bottles were filled
- vi. Name of person submitting samples
  - Dennis Lu (Gartner Lee) Tests 1 & 2
  - Patrick Allard (Azimuth) Test 3
- vii. \*\*Labeling/coding of sample (Sample IDs)
  - Test 1 - G-Creek\_sub\_070704
  - Test 2 - G-Creek\_Sublethal\_270704
  - Test 3 – G-Creek\_081704
- viii. \*\*Date & time of sample receipt
  - Samples for sublethal toxicity testing were collected:
    - Test 1 - Saturday July 10, 2004 – 1425h
    - Test 2 - Friday July 30, 2004 – 1200h
    - Test 3 – Friday Aug 27, 2004 – 0945h
- ix. \*\*Temperature upon sample receipt at laboratory
  - Test 1 – 11.6 °C
  - Test 2 – 13.0 °C
  - Test 3 – 15.4 °C

## Test Organisms Imported from External Supplier

- i. Species of test organism
  - Topsmelt (*Atherinops affinis*)
- ii. Name and city of testing laboratory
  - EVS Environment Consultants, North Vancouver, BC
- iii. Source of test species
  - Aquatic Bio Systems (ABS), Fort Collins, Colorado
- iv. Date test species acquired on
  - Test 1 – July 8, 2004
  - Test 2 – July 29, 2004
  - Test 3 – August 26, 2004
- v. Indications of deviations from EC guidance on the importation of test organisms
  - No deviations from EC requirements



## **Reporting Requirements for Reference Method EPAW 95-EPA West Coast (Topsmelt)**

- vi. Percent mortality of fish in 24-hour period preceding the test
  - Test 1 - <10% mortality
  - Test 2 - <10% mortality
  - Test 3 - <10% mortality
- vii. Age at start of test
  - Test 1 - 11 days post-hatch
  - Test 2 – 10 days post-hatch
  - Test 3 – 10 days post-hatch
- viii. Unusual appearance, behaviour, or treatment of larvae before their use in the test
  - None noted for any test.
- ix. Confirmation that larvae are actively feeding and swimbladders are not inflated
  - All tests - Larvae actively feeding and swimbladders not inflated
- x. Confirmation that temperature change was <3°C and dissolved oxygen was maintained at >6mg/L during transport
  - Temperature change was <2°C and dissolved oxygen supersaturated mg/L during transport
- xi. Test organism acclimation rate at the testing laboratory
  - Holding water conditions upon arrival were DO=supersaturated, pH = 7.9, T = 20°C
  - Organisms were acclimated slowly overnight
  - Addition of EVS lab seawater at intervals of 30 – 60min to reach acceptable conditions
  - Organisms were acclimated to DO = 7.4mg/L, salinity = 28ppt, T=20°C

### **Test Facilities and Conditions**

- i. Test type & method
  - 7-day Topsmelt (*Atherinops affinis*) Survival and Growth Toxicity Test
  - Static renewal
  - Sample water was renewed daily
  - Reference Method - EPA/600/R-95/136 (EPAW 95-EPA West Coast)
- ii. \*\*Dates or test days during test when subsamples or multiple samples were renewed
  - Samples were renewed daily for all tests (Test Day 1,2,3,4,5,6)
  - Three subsamples were used on days i) 0-1; ii) 2-3; and iii) 4-5-6-7
- iii. Indications of deviations from requirements in Sections 11 of Method EPA/600/R-95/136 (EPAW 95-EPA West Coast)
  - No deviations from requirements
  - Salinity controls were run
  - Sample water salinity for
    - Test 1 was 7ppt
    - Test 2 was 2.6 ppt
    - Test 3 was 5.2ppt
- iv. Date and time for start of definitive test
  - Test 1 Saturday July 10, 2004 – 1730h (within 3 days)
  - Test 2 Friday July 30, 2004 – 1500h (within 3 days)
  - Test 3 Tuesday August 27, 2004 – 1230h (within 3 days)
- v. \*\*Date for test completion
  - Test 1 July 17, 2004
  - Test 2 August 6, 2004
  - Test 3 September 3, 2004
- vi. Test vessel description
  - For all tests was a 600mL beaker
- vii. Person(s) performing the test and verifying the results

## **Reporting Requirements for Reference Method EPAW 95-EPA West Coast (Topsmelt)**

- Test 1: Testing by: Andy Diewald, Anja Fouche, Keven Goodearle, Ann-Marie Norris and Jenny Shao; Statistical analyses by Jenny Shao and QA/QC by Julianna Kalokai
  - Test 2: Testing by: Andy Diewald, Ann-Marie Norris and Jenny Shao; Statistical analysis by Jenny Shao and Kathryn Sentance; QA/QC by Armando Tang
  - Test 3: Testing by Andy Diewald, Anja Fouche and Jenny Shao; Statistics by Jenny Shao and Kathryn Sentance; QA/QC by Julianna Kalokai
- viii. pH, temperature, dissolved oxygen, and conductivity of unadjusted, undiluted effluent
- Test 1: pH 8.1, T 19.5 °C, DO 9.3 mg/L, C 11660 µmhos/cm
  - Test 2: pH 7.8, T 20.0 °C, DO 10.7 mg/L, C 4880 µmhos/cm
  - Test 3: pH 7.6, T 20.0 °C, DO 10.1 mg/L, C 9230 µmhos/cm
- ix. Confirmation that no adjustment of sample or solution pH occurred
- No pH adjustment
- x. Indication of aeration of test solutions before introduction of fish
- Pre-aeration at 6.5mL/min/L for 30mins due to supersaturation of sample with O<sub>2</sub> when sample was heated to 19°C
- xi. \*\*Indication that EC guidance document for salinity adjustment was followed
- The following was done for all 3 tests:
    - No deviations from EC guidance document on preparation of hypersaline brine (HSB)
    - HSB prepared from natural seawater concentrated to 90ppt (by filtering to at least 10 µm before placing it into the freezer and then freezing/refreezing to remove frozen layer and concentrate salts in the hypersaline brine)
    - No deviations from EC guidance document for salinity adjustment of sample
    - HSB was added to samples to salinity adjust them to 30ppt
    - For a 200mL volume the concentrations were prepared by adding:
      - Test 1: 145mL of effluent + 55mL of HSB for the highest concentration. This solution was then diluted using natural seawater for the lower test concentrations (i.e., 50% of the highest concentration + 50% of the dilution water, repeated for subsequent dilutions).
      - Test 2: 138mL of effluent + 62mL of HSB for the highest concentration. This solution was then diluted using natural seawater for the lower test concentrations (i.e., 50% of the highest concentration + 50% of the dilution water, repeated for subsequent dilutions).
      - Test 3: 142mL of effluent + 58mL of HSB for the highest concentration. This solution was then diluted using natural seawater to make the lower test concentrations (i.e., 50% of the highest concentration + 50% of the dilution water, repeated for subsequent dilutions).
- xii. Type and source of control/dilution water
- For all 3 tests, control/dilution water was UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium
- xiii. Concentrations and volumes tested:
- Concentrations (% effluent volume / total volume) tested and total volumes used were:
  - For Test 1:
    - Control (0%) - 200 mL
    - Salinity Control (0%) - 200 mL
    - 4.5% - 200mL
    - 9.1% - 200mL
    - 18.2% - 200mL

**Reporting Requirements for Reference Method EPAW 95-EPA West Coast  
(Topsmelt)**

- 36.3% - 200mL
- 72.6% - 200mL
- For Test 2:
  - Control (0%) - 200 mL
  - Salinity Control (0%) - 200 mL
  - 4.3% - 200mL
  - 8.6% - 200mL
  - 17.3% - 200mL
  - 34.5% - 200mL
  - 69.0% - 200mL
- For Test 3:
  - Control (0%) - 200 mL
  - Salinity Control (0%) - 200 mL
  - 4.4% - 200mL
  - 9.0% - 200mL
  - 18.0% - 200mL
  - 36.0% - 200mL
  - 71.0% - 200mL

xiv. Number of replicated per concentration

- For all 3 tests: 5 replicates per concentration

xv. Number of organisms added to each test vessel

- For all 3 tests: 5 fish per vessel

xvi. Manner and rate of exchange of test solutions

- For all 3 test: Daily renewal

xvii. \*\*Measurements of dissolved oxygen, pH and temperature, and salinity for each 24 hr period

- Test 1: See attached photocopied pages 1.1 and 1.2 of original laboratory report
- Test 2: See attached photocopied pages 2.1 and 2.2 of original laboratory report
- Test 3: See attached photocopied pages 3.1 and 3.2 of original laboratory report

**Results**

i. \*\*Number and % of mortalities of fish in each test solution. Note that this data is presented in units of number of SURVIVORS and % MORTLITY. (Data is entered from original handwritten tables in lab reports)

- Test 1: Totals from all 5 replicates are presented (see attached pages 1.3-1.4 for original lab data):

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality on the Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
<b>Control</b>	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	4	4	4	0	0	0	0	20	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
<b>Brine Control</b>	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	4	0	0	0	0	0	0	20
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
<b>4.5%</b>	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0

**Reporting Requirements for Reference Method EPAW 95-EPA West Coast  
(Topsmelt)**

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality on the Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
9.1%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
18.2%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
36.3%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	4	4	4	4	4	4	4	20	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
72.6%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	4	0	0	0	0	0	0	20
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	4	0	0	0	0	0	0	20

- Test 2: Totals from all 5 replicates are presented (see attached pages 2.3-2.4 for original lab data):

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality - Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Control	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
Brine Control	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
4.3%	A	5	5	5	5	5	5	4	0	0	0	0	0	0	20
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
8.6%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	4	0	0	0	0	0	0	20
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0

**Reporting Requirements for Reference Method EPAW 95-EPA West Coast  
(Topsmelt)**

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality - Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
17.3%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
34.5%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
69.0%	A	5	5	5	5	4	4	4	0	0	0	0	20	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0

- Test 3: Totals from all 5 replicates are presented (see attached pages 3.3-3.4 for original lab data):

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality - Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Control	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
Brine Control	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
4.4%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
9.0%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
18.0%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
36.0%	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	4	0	0	0	0	0	0	20

**Reporting Requirements for Reference Method EPAW 95-EPA West Coast  
(Topsmelt)**

Concentration (% effluent v/v)	Replicate	Number of Survivors - Day of Test							% Mortality - Day of Test						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0
<b>71.0%</b>	A	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	B	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	C	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	D	5	5	5	5	5	5	5	0	0	0	0	0	0	0
	E	5	5	5	5	5	5	5	0	0	0	0	0	0	0

ii. \*\*Average dry weight (mg) per original fish in test vessel. No preservation of fish was used. Fish were dried and then weighed.

- Test 1: Mean dry weight (mg) of each replicate and overall means are presented:

Concentration (% effluent v/v)	Replicate					Overall Mean	Standard Deviation
	1	2	3	4	5		
Neg Control (0%)	1.2120	1.0040	0.7980	0.7880	0.8460	0.9296	0.1800
Salinity Control	1.1300	0.8540	1.3000	1.1120	0.9940	1.0780	0.1661
4.5%	0.9500	0.9440	0.9500	1.1360	1.0260	1.0012	0.0826
9.1%	1.0520	1.0060	0.9040	1.0820	1.1360	1.0360	0.0876
18.2%	1.1100	0.9080	0.9340	0.9140	0.9160	0.9564	0.0864
36.3%	1.0560	1.2980	0.9260	1.0120	1.2220	1.1028	0.1533
72.6%	0.9560	1.3320	0.8120	0.8060	1.0460	0.9904	0.2161

- Test 2: Mean dry weight (mg) of each replicate are presented:

Concentration (% effluent v/v)	Replicate					Overall Mean	Standard Deviation
	1	2	3	4	5		
Neg Control (0%)	1.000	1.122	0.952	0.962	0.866	0.9804	0.0931
Salinity Control	1.170	0.812	1.042	0.880	1.030	0.9868	0.1418
4.3%	0.754	1.078	1.064	0.814	0.840	0.9100	0.1503
8.6%	1.098	0.866	0.884	0.726	0.778	0.8704	0.1426
17.3%	0.710	0.794	0.944	0.596	0.872	0.7832	0.1363
34.5%	0.912	0.874	0.918	0.854	0.924	0.8964	0.0307
69.0%	0.486	0.818	0.756	0.808	1.000	0.7736	0.1854

- Test 3: Mean dry weight (mg) of each replicate are presented:

Concentration (% effluent v/v)	Replicate					Overall Mean	Standard Deviation
	1	2	3	4	5		
Neg Control (0%)	0.9680	0.9700	0.9780	0.8460	0.8940	0.9312	0.0585
Salinity Control	0.9040	0.8600	1.2680	0.9720	0.8080	0.9624	0.1811
4.4%	0.9380	1.5180	1.0220	0.8620	0.9420	1.0564	0.2642
9.0%	0.8960	0.8600	0.9480	0.7900	0.8320	0.8652	0.0604
18.0%	0.9240	0.6960	1.1280	1.0860	0.9940	0.9656	0.1704
36.0%	1.0900	0.8140	0.7880	1.0300	0.8900	0.9224	0.1328
71.0%	0.6680	0.7620	1.0920	0.9280	0.9060	0.8712	0.1631

iii. Estimate of 7-d LC<sub>50</sub> (95% CL)

- Test 1: 7-d LC<sub>50</sub> concentration > 72.6% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 2: 7-d LC<sub>50</sub> concentration > 69.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 3: : 7-d LC<sub>50</sub> concentration > 71.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- Quantal statistic methods not applicable

iv. Estimate of 7-d IC<sub>25</sub> (95% CL) for growth

## **Reporting Requirements for Reference Method EPAW 95-EPA West Coast (Topsmelt)**

- Test 1: 7-d IC<sub>25</sub> concentration > 72.6% effluent (highest concentration tested due to dilution for salinity adjustment)
  - Test 2: 7-d IC<sub>25</sub> concentration > 69.0% effluent (highest concentration tested due to dilution for salinity adjustment)
  - Test 3: 7-d IC<sub>25</sub> concentration > 71.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- v. Current reference toxicity tests (95% CL) for 7-d LC<sub>50</sub> for survival and 7-d IC<sub>50</sub> for growth
- Test 1 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on July 10, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC<sub>50</sub> survival = 161mg/L Cu, 95% CL = 139-188mg/L
    - 7-d IC<sub>50</sub> growth = 147mg/L Cu, 95% CL = 119-169mg/L
  - Test 2 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on July 30, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC<sub>50</sub> survival = 130mg/L Cu, 95% CL = 115-147mg/L
    - 7-d IC<sub>50</sub> growth = 124mg/L Cu, 95% CL = 87-144mg/L
  - Test 3 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on August 27, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC<sub>50</sub> survival = 121mg/L Cu, 95% CL = 107-137mg/L
    - 7-d IC<sub>50</sub> growth = 128mg/L Cu, 95% CL = 85-150mg/L
- vi. Reference toxicity warning limits (+/- SD) for 7-d LC<sub>50</sub> for survival and 7-d IC<sub>50</sub> for growth
- Test 1: Reference toxicity tests for Toxicant: Copper
    - 7-d LC<sub>50</sub> survival = 137 ± 56mg/L Cu
    - 7-d IC<sub>50</sub> growth = 135 ± 51mg/L Cu
  - Test 2: Reference toxicity tests for Toxicant: Copper
    - 7-d LC<sub>50</sub> survival = 129 ± 48mg/L Cu,
    - 7-d IC<sub>50</sub> growth = 130 ± 52mg/L Cu
  - Test 3: Reference toxicity tests for Toxicant: Copper
    - 7-d LC<sub>50</sub> survival = 132 ± 48mg/L Cu,
    - 7-d IC<sub>50</sub> growth = 131 ± 51mg/L Cu

## **APPENDIX B**

### **92-h Echinoderm Fertilization Test**



## **Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)**

### **Effluent Sample**

- i. Name & location of operation generating the effluent
  - Polaris Mine, Little Cornwallis Island, Nunavut
  - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.
- ii. Date & time of sampling
  - Samples for sublethal toxicity testing were collected:
    - Test 1 - Wednesday July 7, 2004 – 1100h
    - Test 2 - Tuesday July 27, 2004 – 2130h
    - Test 3 – Tuesday Aug 24, 2004 – 1500h
- iii. Type of sample
  - Final effluent water
- iv. Brief description of sampling point
  - 20m downstream of the siphon discharge point at Garrow Lake dam
- v. Sampling method
  - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
  - Water was collected from the upstream direction
  - The pump was flushed with site water for at least one minute prior to sample collection
  - 4 x 20L sample bottles were filled
- vi. Name of person submitting samples
  - Dennis Lu (Gartner Lee) Tests 1 & 2
  - Patrick Allard (Azimuth) Test 3
- x. \*\*Labeling/coding of sample (Sample IDs)
  - Test 1 - G-Creek\_sub\_070704
  - Test 2 - G-Creek\_Sublethal\_270704
  - Test 3 – G-Creek\_081704
- xi. \*\*Date & time of sample receipt
  - Samples for sublethal toxicity testing were collected:
    - Test 1 - Saturday July 10, 2004 – 1425h
    - Test 2 - Friday July 30, 2004 – 1200h
    - Test 3 – Friday Aug 27, 2004 – 0945h
- xii. \*\*Temperature upon sample receipt at laboratory
  - Test 1 – n/a no test
  - Test 2 – 13.0 °C
  - Test 3 – 15.4 °C

### **Test Organisms**

- i. Species of test organism
  - Sandollar Echinoid (*Dendraster excentricus*)
- ii. Name and city of testing laboratory
  - EVS Environment Consultants, North Vancouver, BC
- iii. Source of test species
  - M-REP, Escondido, California
  - All adults providing gametes are from the same population and source
  - Gametes are spawned in-house at EVS
- iv. Date test species acquired on
  - Test 1: Test was not initiated due to inability of the Sandollars to spawn.
  - Test 2: July 30, 2004
  - Test 3: August 27, 2004
- v. Holding time and conditions for adults
  - Test 1: N.A.

## **Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)**

- Test 2: Adults received at the testing laboratory the day of the test.
- Test 3: Adults received at the testing laboratory the day of the test.
- vi. Indications of deviations from EC guidance on the importation of test organisms
  - Test 1: na
  - Test 2: No deviations from EC requirements
  - Test 3: No deviations from EC requirements
- vii. Weekly percent mortality of adults being held over 7d preceding test
  - Test 1: na
  - Test 2: <2% per day over the 7 days preceding the test
  - Test 3: <2% per day over the 7 days preceding the test
- viii. Age of test organisms
  - Test 1: n.a.
  - Test 2: < 4 hours after spawning
  - Test 3: < 4 hours after spawning
- ix. \*\*Unusual appearance, behaviour, or treatment of adults or gametes before test start, or anything unusual about the test
  - Test 1: Test was not initiated due to inability of the Sandollars to spawn
  - Test 2: Organisms appear healthy, in good condition, nothing unusual about test organisms or test
  - Test 3: Organisms appear healthy, in good condition, nothing unusual about test organisms or test

### **Test Facilities and Conditions**

- i. Test type & method
  - Echinoderm (*Dendraster excentricus*) Fertilization Toxicity Test
  - Static
  - Reference Method – EPS1/RM/27 with 1997 amendments
- ii. Test duration
  - Test 1: na
  - Test 2: 10:10 min (10min sperm + 10min sperm & egg)
  - Test 3: 10:10 min (10min sperm + 10min sperm & egg)
- iii. Date and time for start of definitive test
  - Test 1: na
  - Test 2: Friday July 30, 2004 – 1620h
  - Test 3: Friday August 27, 2004 – 1334h
- iv. Test vessel description
  - Test 1: na
  - Test 2: 16 x 125mm test tubes
  - Test 3: 16 x 125mm test tubes
- v. Person(s) performing the test and verifying the results
  - Test 1: na
  - Test 2: Testing by Kathryn Sentance and Ann-Marie Norris. Statistical analyses by Jenny Shao and Kathryn Sentance. QA/QC reviewed by Julianna Kalokai.
  - Test 3: Testing by Kathryn Sentance and Ann-Marie Norris. Statistical analyses by Jenny Shao and Kathryn Sentance. QA/QC reviewed by Julianna Kalokai.
- vi. Indication of rate and duration of pre-aeration of test solutions before initiation of test
  - Test 1: na
  - Test 2: No pre-aeration noted.
  - Test 3: No pre-aeration noted.
- vii. Confirmation that no adjustment of sample or solution pH occurred
  - Test 1: na

## **Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)**

- Test 2: No pH adjustment
- Test 3: No pH adjustment
- viii. Procedure for sample filtration
  - Test 1: na
  - Test 2: No sample filtration
  - Test 2: No sample filtration
- ix. \*\*Procedure for preparation of hypersaline brine (HSB) as per EC guidance document on salinity adjustment – July 1997
  - Test 1: na
  - Test 2: Hypersaline brine (HSB) was prepared from natural seawater concentrated to 90ppt (by filtering to at least 10 µm before placing it into the freezer and then freezing/refreezing to remove frozen layer and concentrate salts in the hypersaline brine). HSB was added to samples to salinity adjust them to 30ppt. For a 10mL volume the concentrations were prepared by adding 7.31mL of effluent + 2.69mL of HSB for the highest concentration. This solution was diluted using natural seawater for the lower test concentrations (i.e., 50% of the highest concentration + 50% of the dilution water, repeated for subsequent dilutions). No deviations from EC guidance document (July 1997) for salinity adjustment of sample.
  - Test 2: Hypersaline brine (HSB) was prepared from natural seawater concentrated to 90ppt (by filtering to at least 10 µm before placing it into the freezer and then freezing/refreezing to remove frozen layer and concentrate salts in the hypersaline brine). HSB was added to samples to salinity adjust them to 30ppt. For a 10mL volume the concentrations were prepared by adding 7.51mL of effluent + 2.49mL of HSB for the highest concentration. This solution was diluted using natural seawater for the lower test concentrations (i.e., 50% of the highest concentration + 50% of the dilution water, repeated for subsequent dilutions). No deviations from EC guidance document (July 1997) for salinity adjustment of sample.
- x. Procedure for salinity adjustment as per EC guidance document on salinity adjustment – July 1997
  - No deviations from EC guidance for salinity adjustment
  - Test 1: na
  - Test 2: salinity adjusted from 2.8 to 28 ppt
  - Test 3: salinity adjusted from 5 to 28 ppt
- xi. Type and source of control/dilution water
  - Test 1: na
  - Test 2: UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium
  - Test 3: UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium
- xii. Concentrations and volumes tested
  - Test 1: na
  - Test 2: Concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Control (0%) - 10mL
    - Salinity Control (0%) - 10mL
    - 4.6% - 10mL
    - 9.1% - 10mL
    - 18.3% - 10mL
    - 36.6% - 10mL
    - 73.1% - 10mL
  - Test 3: Concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Control (0%) - 10mL
    - Salinity Control (0%) - 10mL
    - 4.7% - 10mL
    - 9.4% - 10mL

## Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)

- 18.8% - 10mL
  - 37.5% - 10mL
  - 75.1% - 10mL
- xiii. Number of replicated per concentration
- Test 1: na
  - Test 2: 4 replicates per treatment concentration
  - Test 3: 4 replicates per treatment concentration
- xiv. \*\*Number of organisms per container
- Test 1: na
  - Test 2: 2000 eggs per vessel (100 counted)
  - Test 3: 2000 eggs per vessel (100 counted)
- xv. Measurements of pH and dissolved oxygen in sample water before use
- Test 1: na
  - Test 2: pH 8.1, DO 8.5
  - Test 3: pH 8.0, DO 8.5
- xvi. Measurements of pH, temperature, dissolved oxygen, and salinity during test
- Test 1: na
  - Test 2: pH – 8.0 – 8.1, T - 15.0-16.0°C, DO - 8.2-8.5mg/L, salinity - 28ppt
  - Test 3: pH – 8.2 – 8.5, T - 15.0-16.0°C, DO - 8.2-8.5mg/L, salinity - 28ppt

### Results

- i. Number and % of fertilized eggs in each test concentration
- Test 1: na
  - Test 2: (Number is equal to percent since totals were 100)
    - Control (0%): #F = 59, 62, 56, 65 #UF = 41, 38, 44, 35
    - Salinity Control: #F = 60, 57, 59, 62 #UF = 40, 43, 41, 38
    - 4.6%: #F = 60, 66, 56, 58 #UF = 40, 34, 44, 42
    - 9.1%: #F = 46, 42, 45, 42 #UF = 54, 58, 55, 58
    - 18.3%: #F = 39, 39, 37, 36 #UF = 61, 64, 63, 64
    - 36.6%: #F = 31, 34, 25, 31 #UF = 69, 66, 75, 69
    - 73.1%: #F = 19, 20, 21, 20 #UF = 81, 80, 79, 80
  - Test 3: (Number is equal to percent since totals were 100)
    - Control (0%): #F = 77, 80, 74, 77 #UF = 23, 20, 26, 23
    - Salinity Control: #F = 76, 73, 79, 77 #UF = 24, 27, 21, 23
    - 4.7%: #F = 78, 74, 76, 72 #UF = 22, 26, 24, 28
    - 9.4%: #F = 61, 62, 62, 60 #UF = 39, 38, 38, 40
    - 18.8%: #F = 56, 58, 59, 55 #UF = 44, 42, 41, 45
    - 37.5%: #F = 49, 50, 50, 48 #UF = 51, 50, 50, 52
    - 75.1%: #F = 25, 27, 24, 27 #UF = 75, 73, 76, 73
- ii. \*\*Estimate of IC<sub>25</sub> (95% CL) for fertilization success
- Test 1: na
  - Test 2: IC<sub>25</sub> concentration = 8.7 (7.6 – 9.9)% v/v effluent
  - Test 3: IC<sub>25</sub> concentration = 17.5 (11.6 – 22.6)% v/v effluent
  - Quantitative statistic used to generate IC<sub>25</sub> values was log-linear interpolation (200 resamples) calculated in ToxCalc v5.0.23 (Test 2) and log-logit interpolation (200 resamples) calculated in ToxCalc v5.0.23 (Test 3)
- iii. Current reference toxicity tests (95% CL) for IC<sub>50</sub> for fertilization
- Test 1: na
  - Test 2: Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate

## **Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)**

- Test conducted on July 30, 2004, same day as effluent test
  - Reference test conducted under same conditions
  - $IC_{50}$  for fertilization = 2.1mg/L SDS, 95% CL = (1.9 – 2.4)mg/L
  - Test 3: Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
    - Test conducted on August 27, 2004, same day as effluent test
    - Reference test conducted under same conditions
    - $IC_{50}$  for fertilization = 2.3mg/L SDS, 95% CL = (2.1 – 2.4)mg/L
- iv. Reference toxicant warning limits (+/- 2SD) for  $IC_{50}$  for fertilization
- Test 1: na
  - Test 2: 4.2 +/- 4.8 mg/L SDS
  - Test 3: 3.9 +/- 4.6 mg/L SDS

## **APPENDIX C**

### **7-d Sublethal *Champia* (Algae) Toxicity Test**

# Reporting Requirements for Reference Method EPA/600/4-91-003, Method 1009.0 (Champia)

## Effluent Sample

- i. Name & location of operation generating the effluent
  - Polaris Mine, Little Cornwallis Island, Nunavut
  - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.
- ii. Date & time of sampling
  - Samples for yearly sublethal toxicity testing were collected:
    - Test 1 - Wednesday July 7, 2004 – 1100h
    - Test 2 - Tuesday July 27, 2004 – 2130h
    - Test 3 – Tuesday Aug 24, 2004 – 1500h
- iii. Type of sample
  - Final effluent water
- iv. Brief description of sampling point
  - 20m downstream of the siphon discharge point at Garrow Lake dam
- v. Sampling method
  - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
  - Water was collected from the upstream direction
  - The pump was flushed with site water for at least one minute prior to sample collection
  - 1 x 4L sample bottles were filled
- vi. Name of person submitting samples
  - Dennis Lu (Gartner Lee) Tests 1 & 2
  - Patrick Allard (Azimuth) Test 3
- vii. Temperature of water upon receipt at lab
  - Test 1: Test was not conducted as sample was delayed by weather and person qualified to conduct the work at the lab left for vacation. This was discussed with Sandra Blenkinsopp at the time to provide direction.
  - Test 2: 8°C
  - Test 3: 17°C
- xiii. \*\*Labeling/coding of sample (Sample IDs)
  - Test 1 - G-Creek\_sub\_070704
  - Test 2 - G-Creek\_Sublethal\_270704
  - Test 3 – G-Creek\_081704
- xiv. \*\*Date & time of sample receipt
  - Samples for sublethal toxicity testing were collected:
    - Test 1 – n/a test not conducted
    - Test 2 - Friday July 30, 2004 – 0900h
    - Test 3 – Friday Aug 27, 2004 – 0900h

## Test Organisms

- i. Species of test organism
  - Algae (*Champia parvula*)
- ii. Name and city of testing laboratory
  - Saskatchewan Research Council [SRC], Saskatoon, SK
- iii. Source of test species and health of organisms
  - Test 1: na
  - Test 2 and Test 3
    - Sexually mature male and female branches
    - Obtained from USEPA, Hatfield Marine Science Center, Newport Oregon, 1995
    - Appear in excellent health, healthy red color
    - Females have trichogynes, males have sori with spermatia

## **Reporting Requirements for Reference Method EPA/600/4-91-003, Method 1009.0** **(Champia)**

- iv. \*\*Any unusual appearance, behaviour, or treatment of test organisms, before their use in test
  - Test 1: na
  - Test 2 and Test 3
    - Nothing unusual about the appearance, behaviour, or treatment of test organisms, before their use in test; everything is normal
    - Nothing unusual about the tests

### **Test Facilities and Conditions**

- i. Test type & method
  - *Champia parvula* sexual reproduction test
  - Static, non-renewal
  - 2-day exposure, followed by 5-7 day recovery period for cystocarp development
  - Reference Method - EPA/600/4-91/003, Method 1009.0
- ii. Date and time for start of definitive test
  - Test 1: na
  - Test 2: Friday July 30, 2004 – time not noted but lab notes state tests started within 72 hrs of collection
  - Test 3: Friday August 27, 2004 – time not noted but lab notes state tests started within 72 hrs of collection
- xviii. \*\*Date for test completion
  - Test 1 – n/a
  - Test 2 – August 6, 2004
  - Test 3 – September 3, 2004
- iii. Test vessel description
  - Test 1: na
  - Test 2: 270mL transparent polystyrene cups with polystyrene lids
  - Test 2: 270mL transparent polystyrene cups with polystyrene lids
- iv. Person(s) performing the test and verifying the results
  - Test 1: na
  - Tests 2 & 3 - Mary Moody
- v. Indication of pre-aeration of test solutions
  - Test 1: na
  - Tests 2 & 3 - No pre-aeration
- vi. Confirmation that no pH adjustment of sample or solution occurred
  - Test 1: na
  - Tests 2 & 3: - No pH adjustment
- vii. \*\*Indication that EC guidance document for salinity adjustment was followed
  - Test 1: na
  - Test 2:
    - No deviations from EC guidance document on preparation of hypersaline brine (May 2001)
    - HSB prepared from natural seawater at 90ppt (by filtering to at least 10 µm before placing it into the freezer and then freezing/refreezing to remove frozen layer and concentrate salts in the hypersaline brine)
    - No deviations from EC guidance document for salinity adjustment of sample
    - Salinity adjustment: 600mL effluent + 250mL HSB + 8.5mL test nutrient solution
    - Salinity of samples adjusted from 4ppt to 30ppt
  - Test 3:



**Reporting Requirements for Reference Method EPA/600/4-91-003, Method 1009.0**  
**(Champia)**

- No deviations from EC guidance document on preparation of hypersaline brine (May 2001)
  - HSB prepared from natural seawater at 90ppt (by filtering to at least 10 µm before placing it into the freezer and then freezing/refreezing to remove frozen layer and concentrate salts in the hypersaline brine)
  - No deviations from EC guidance document for salinity adjustment of sample
  - Salinity adjustment: 600mL effluent + 230mL HSB + 10 ml test nutrient solution
  - Salinity of samples adjusted from 5ppt to 30ppt
- viii. Type and source of control/dilution water
- Test 1: na
  - Tests 2 & 3
    - Natural seawater collected at the Pacific Environmental Center, Environment Canada, North Vancouver, BC
    - Filtered to 0.2µm and autoclaved prior to use
    - Salinity adjusted as per EC guidance document to 30ppt with HSB from the same source
- ix. \*\*Type and quantity of any chemicals added to the control dilution water
- Test 1: na
  - Test 2: Test nutrients as described in Test Method USEPA/600/4-91/003, Method 1009.0 were added at concentration of 10mL/L, analytical grade, 8.5mL added
  - Test 3: Test nutrients as described in Test Method USEPA/600/4-91/003, Method 1009.0 were added at concentration of 10mL/L, analytical grade, 10mL added
- x. Concentrations and volumes of test solutions
- Concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Test 1: na
    - Tests 2:
      - Control (Natural Seawater) (0%) - 100mL, 4.5cm depth
      - Salinity Control Brine (0%) - 100mL, 4.5cm depth
      - 4.38% - 100mL, 4.5cm depth
      - 8.75% - 100mL, 4.5cm depth
      - 17.5% - 100mL, 4.5cm depth
      - 35.0% - 100mL, 4.5cm depth
      - 70.0% - 100mL, 4.5cm depth
    - Tests 3:
      - Control (Natural Seawater) (0%) - 100mL, 4.5cm depth
      - Salinity Control Brine (0%) - 100mL, 4.5cm depth
      - 4.5% - 100mL, 4.5cm depth
      - 9.0% - 100mL, 4.5cm depth
      - 18.0% - 100mL, 4.5cm depth
      - 36.0% - 100mL, 4.5cm depth
      - 72.0% - 100mL, 4.5cm depth
- xi. Number of replicated per concentration
- Test 1: na
  - Tests 2 & 3: 3 replicates per concentration
- xii. Number of organisms per test chamber
- Test 1: na
  - Tests 2 & 3: 5 female branches + 2 male branches per chamber
- xiii. Measurements of pH, temperature, dissolved oxygen, and salinity of sample before use

**Reporting Requirements for Reference Method EPA/600/4-91-003, Method 1009.0**  
**(Champia)**

- Test 1: na
  - Test 2: pH - 7.78, T – 22.0 °C, DO – 7.9mg/L, salinity - 4ppt
  - Test 3: pH - 7.58, T – 23.0 °C, DO – 8.0mg/L, salinity - 5ppt
- xiv. \*\*Measurements of pH, temperature, dissolved oxygen, and salinity of test solution and controls at 0hr, 48hr, and the beginning and end of recovery period
- Test 1: na
  - Test 2:

Concentration (% v/v)	Temperature (°C)				Dissolved Oxygen (mg/L)				pH (pH units)				Salinity (ppt)			
	Exposure		Recovery		Exposure		Recovery		Exposure		Recovery		Exposure		Recovery	
	0	48	0	end	0	48	0	end	0	48	0	end	0	48	0	end
Control-NSW <sup>1</sup>	22	23	22	23	7.9	7.9	8.0	7.9	8.20	8.35	8.33	8.22	30	30	30	30
Control-brine	22	23	22	23	7.9	7.9	8.0	7.9	7.93	8.20	8.34	8.21	30	30	30	30
A 70	22	23	22	23	7.9	7.9	8.0	7.9	7.80	8.40	8.34	8.26	30	30	30	30
C 17.5	22	23	22	23	7.9	7.9	8.0	7.9	8.15	8.31	8.34	8.36	30	30	30	30
E 4.38	22	23	22	23	7.9	7.9	8.0	7.9	8.19	8.36	8.34	8.21	30	30	30	30

<sup>1</sup>NSW = natural seawater

- Test 3:

Concentration (% v/v)	Temperature (°C)				Dissolved Oxygen (mg/L)				pH (pH units)				Salinity (ppt)			
	Exposure		Recovery		Exposure		Recovery		Exposure		Recovery		Exposure		Recovery	
	0	48	0	end	0	48	0	end	0	48	0	end	0	48	0	end
Control-NSW <sup>1</sup>	23	23	23	23	7.9	7.9	8.0	7.9	8.34	8.61	8.22	8.37	30	30	30	30
Control-brine	23	23	23	23	7.9	7.9	8.0	7.9	7.92	8.52	8.22	8.42	30	30	30	30
A 70	23	23	23	23	8.0	7.9	8.0	7.9	7.83	8.52	8.22	8.44	30	30	30	30
C 17.5	23	23	23	23	7.9	7.9	8.0	7.9	8.21	8.29	8.21	8.41	30	30	30	30
E 4.38	23	23	23	23	7.9	7.9	8.0	7.9	8.32	8.42	8.22	8.39	30	30	30	30

<sup>1</sup>NSW = natural seawater

**Results**

- i. Number and % mortality of female plants after recovery in each test solution
  - Totals from all 3 replicates are presented:
  - Test 1: na
  - Test 2:
    - Control (0%): 0 (0%) mortality
    - Salinity Control (0%): 0 (0%) mortality
    - 4.38%: 0 (0%) mortality
    - 8.75%: 0 (0%) mortality
    - 17.5%: 0 (0%) mortality
    - 35.0%: 0 (0%) mortality
    - 70.0%: 0 (0%) mortality
  - Test 3:
    - Control (0%): 0 (0%) mortality
    - Salinity Control (0%): 0 (0%) mortality
    - 4.5%: 0 (0%) mortality
    - 9.0%: 0 (0%) mortality
    - 18.0%: 0 (0%) mortality
    - 36.0%: 0 (0%) mortality
    - 72.0%: 0 (0%) mortality
- ii. \*\*Mean number of cystocarps per plant in each replicate of each test concentration
  - Test 1: na
  - Test 2: (Replicates are A, B, and C)
    - Control (0%): A) 89.6, B) 89.8, C) 96.8
    - Salinity Control (0%): A) 86.2, B) 93.4, C) 98.0

## Reporting Requirements for Reference Method EPA/600/4-91-003, Method 1009.0

### (Champia)

- 4.38%: A) 114.8, B) 101.0, C) 99.6
- 8.75%: A) 108.4, B) 105.8, C) 101.0
- 17.5%: A) 81.6, B) 90.2, C) 100.2
- 35.0%: A) 54.4, B) 64.2, C) 67.0
- 70.0%: A) 9.6, B) 9.0, C) 21.4
- Test 3: (Replicates are A, B, and C)
  - Control (0%): A) 55.2, B) 62.0, C) 57.6
  - Salinity Control (0%): A) 50.8, B) 70.4, C) 55.6
  - 4.5%: A) 61.4, B) 50.8, C) 67.0
  - 9.0%: A) 63.0, B) 56.0, C) 61.0
  - 18.0%: A) 68.6, B) 53.2, C) 61.0
  - 36.0%: A) 53.8, B) 48.6, C) 51.6
  - 72.0%: A) 31.2, B) 36.4, C) 11.2
- iii. \*\*Estimate of IC<sub>25</sub> (95% CL) for cystocarp development
  - Test 1: na
  - Test 2: IC<sub>25</sub> concentration = 26.6 (20.8 – 31.5)% effluent v/v
  - Test 3: IC<sub>25</sub> concentration = 45.3 (36.3 – 58.1)% effluent v/v
    - Quantal statistic method was linear interpolation (200 resamples) determined using ToxCalc v5.0.23
- iv. Current reference toxicity tests (95% CL) for IC<sub>50</sub> for cystocarp development
  - Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
  - Test 1: na
  - Test 2: Test conducted on July 27, 2004, within 30 days of effluent test
    - Reference toxicant test was conducted under the same experimental conditions as the effluent test
    - IC<sub>50</sub> cystocarp development = 1.48mg/L SDS, 95% CL = (1.38 - 1.62) mg/L
    - Reference toxicity warning limits 1.40 (+/- 2SD) for IC<sub>50</sub> for cystocarp development
  - Test 3: Test conducted on July 27, 2004, within 30 days of effluent test
    - Reference toxicant test was conducted under the same experimental conditions as the effluent test
    - IC<sub>50</sub> cystocarp development = 1.48mg/L SDS, 95% CL = (1.38 - 1.62) mg/L
    - Reference toxicity warning limits 1.40 (+/- 2SD) for IC<sub>50</sub> for cystocarp development
- v. Reference toxicant warning limits (+/- 2SD) for IC<sub>50</sub> for cystocarp development
  - Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
  - Test 1: na
  - Test 2: 1.40 (1.6-1.70) mg/L SDS
  - Test 3: 1.40 (1.6-1.70) mg/L SDS

Note that Pages 1.1-1.4, 2.1-2.4, 3.1-3.4 are included in the hardcopy paper report only. This data can also be found in Appendix E. Note that the champia test lab reports are only included in the hardcopy paper report, not in this pdf.

**APPENDIX D**

**Acute Toxicity Testing Laboratory Reports**



Our File: 09-0302-54.00  
Work Order: 0400304/307

Cheryl Mackintosh  
Azimuth Consulting Group  
218 – 2902 West Broadway  
Vancouver, BC V6K 2G8

Dear Ms. Mackintosh:

**RE: Acute Toxicity Test Results for a sample collected July 7, 2004**


We are pleased to provide you with the results of the toxicity tests performed on the sample identified as G-Creek acute 070704 (received July 10, 2004). The sample was tested with the 96-h rainbow trout LC50 test and the 48-h *Daphnia magna* LC50 test. Testing was performed according to the Environment Canada protocols for conducting acute toxicity tests using rainbow trout (EPS 1/RM/13, Second Edition, 2000) and *D. magna* (EPS 1/RM/14, Second Edition, 2000). An independent EVS QA/QC review confirmed that all acceptability criteria specified by the protocols were met. The results of these tests are summarized from the appended data and are presented in Table 1.

**Table 1.** Toxicity Test Results.

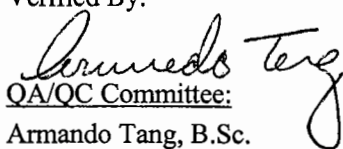
Sample ID	Sample Date (Time h)	96-h Rainbow Trout	48-h <i>Daphnia magna</i>
		LC50 (95% CL) (% v/v)	LC50 (95% CL) (% v/v)
G-Creek acute 070704	7-July-04 (2200h)	>100	>100

Should you have any questions or comments regarding this report, please do not hesitate to contact the undersigned at 604-986-4331.

Sincerely,

  
Robert Harrison, B.Sc. Hons.  
Assistant Bioassay Test Supervisor– Fish Team  
[rharrison@evsenvironment.com](mailto:rharrison@evsenvironment.com)

Verified By:

  
QA/QC Committee:  
Armando Tang, B.Sc.  
Cathy McPherson, B.Sc.  
Julianna Kalocai, M.Sc.  
John Wilcockson, M.Sc.

195 Pemberton Ave.  
North Vancouver, BC  
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Fax: 604.662.8548

[www.evsenvironment.com](http://www.evsenvironment.com)  
[info@evsenvironment.com](mailto:info@evsenvironment.com)

EVS ENVIRONMENT CONSULTANTS  
RAINBOW TROUT ACUTE TOXICITY TEST DATA SUMMARY

Client (Polaris) Azimuth EVS Analysts RGH, AWD  
EVS Project No. 09-0302-54 Test Type 96h LC50  
EVS Work Order No. 0400304 Test Initiation Date July 12/04 @ 1445

**SAMPLE**

Identification G - Creek acute 070704  
Amount Received 2 x 20L  
Date Collected July 7 /04  
Date Received July 10 /04  
Other \_\_\_\_\_

**DILUTION/CONTROL WATER** (initial water quality)

Fresh Water (dechlorinated)  \_\_\_\_\_  
Temperature (°C) 15.0  
pH 7.4  
Dissolved Oxygen (mg/L) 10.1  
Conductivity (µS/cm) 37  
Hardness (mg/L as CaCO<sub>3</sub>) 12  
Alkalinity (mg/L as CaCO<sub>3</sub>) 12  
Other \_\_\_\_\_

**TEST SPECIES INFORMATION**

Source Fraser Valley  
Collection Date/Batch 052604  
Control Fish Size (mean, SD and range measured at end of test)  
Date Measured July 16 /04  
Fork Length (mm) 34±2 (29-37)  
Wet Weight (g) 0.39±0.09 (0.22-0.54)  
Reference Toxicant SDS  
Current Reference Toxicant Result  
Reference Toxicant Test Date June 21 /04  
Duration of Acclimation (days) 26  
96-h LC50 (and 95% CL) 23 (20 and 25) µg/L SDS  
Reference Toxicant Warning Limits (mean ± 2SD) and CV  
29 ± 12 µg/L SDS CV = 21%

**TEST CONDITIONS**

Dissolved Oxygen Range (mg/L) 9.3 - 10.1  
Temperature Range (°C) 14.0 - 15.0  
pH Range 7.0 - 8.3  
Conductivity Range (µS/cm) 37 - 11843  
Aeration Provided? (give rate) 6.5 ± 1 mL/min/L  
Photoperiod (L:D h) 16:8  
No. Organisms/Volume 10 / 10L  
Loading Density (g/L) 0.39  
Acclimation Before Testing (days) 47  
Mortality In Previous Week of Acclimation (%) 0  
Other \_\_\_\_\_

**TEST RESULTS**

The 96h LC50 is estimated at > 100% (0/0)

Data Verified By

Armeda Terry

Date Verified

August 5, 2004

**EVS ENVIRONMENT CONSULTANTS  
RAINBOW TROUT ACUTE TOXICITY TEST DATA**

WHOLE SAMPLE WATER QUALITY

Temp. (°C)	Initial	pH Adjustment <sup>1</sup>	After 30-min Pre-aeration
	14		14
pH	8.1		8.1
DO (mg/L)	10.0		10.1
Cond. (µS/cm)	11730		11730

1. Document pH adjustment procedure (if used) under "Comments".

Client Ar. Muth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400304  
 Trout Batch No. and 7-d Acclimation Mortality 052604/07  
 No. Fish/Volume 10/10L  
 Sample ID C7-Creek acute 070704  
 Date/Time Collected July 7/04  
 Test Initiation Date/Time July 12/04 @ 1445

Total Pre-Aeration Time 30 min

Concentration % (w/v)	Number of Survivors (1 to 96 hours)						Temperature (°C)						pH						Conductivity (µS/cm)					
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96					
Control				10	10	10	10	10.1	9.5	9.8	9.8	10.0	15	15.0	15.0	15	15	7.4	7.3	7.0	7.2	7.1	37	43
6.25				16	10	10	10	10.1	9.5	9.6	9.7	9.8	15	15.0	15.0	15	15	7.6	7.3	7.1	7.1	7.2	1520	1540
12.5				10	10	10	10	10.1	9.7	9.8	9.6	9.9	15	14.5	15.0	15	15	7.8	7.5	7.3	7.4	7.4	2270	2100
25				10	10	10	10	10.1	9.6	9.7	9.7	9.9	15	14.5	15.0	15	15	7.9	7.6	7.5	7.6	7.7	3660	3700
50				10	10	10	10	10.1	9.6	9.7	9.7	9.9	15	14.5	15.0	15	15	8.0	7.8	7.7	7.8	7.9	6070	6020
100				10	10	10	10	10.1	9.8	9.8	9.7	9.9	15	14.0	15.0	15	15	8.1	8.3	8.2	7.9	8.1	11730	11840
Technician Initials				REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF

WQ Instruments Used: Temperature Calibrated Hg Thermometer pH II - A - 030302 DO II - A - 3 Conductivity II - A - 030306  
 Sample Description cloudy white grey  
 Comments

Test Set Up By REF Date Verified July 30, 2004  
 Data Verified By Armeda



EVS ENVIRONMENT CONSULTANTS  
48-h *Daphnia magna* TOXICITY TEST DATA SUMMARY

Client Azimuth (Polaris)  
EVS Project No. 09-0302-54  
EVS Work Order No. 0400307

EVS Analysts AKN, JRY  
Test Type 48hr - LC50  
Test Initiation Date July 11, 2004

SAMPLE INFORMATION

Identification G-Creek. 070704

Amount Received 1 x 2L subsampled from 2 x 20L @ EVS

Date Collected July 7, 2004

Date Received 10 July 2004

Temperature (°C) 22.0 → 20.0

pH 7.9 → 7.8

Dissolved Oxygen (mg/L) 11.4 → 9.1

Conductivity (µmhos/cm) 11850

Hardness (mg/L as CaCO<sub>3</sub>) 1440

Alkalinity (mg/L as CaCO<sub>3</sub>) —

Ammonia (mg/L N) —

Chlorine (mg/L Cl) —

pH adjustment details: None.

Pre-aeration rate and duration: ① aerated 8min

DILUTION/CONTROL WATER (initial water quality)

Water Type Moderately Hard H<sub>2</sub>O (July 7)

Temperature (°C) 20.0

pH 8.0

Dissolved Oxygen (mg/L) 9.1

Conductivity (µS/cm) 357

Hardness (mg/L as CaCO<sub>3</sub>) 98

Alkalinity (mg/L as CaCO<sub>3</sub>) 66

Other —

TEST SPECIES INFORMATION

Broodstock Culture ID (in-house culture) June 15A+B

Age (on Day 0) < 24h

Days to First Brood 8

Avg. Young/Brood (after 1<sup>st</sup> brood) 27.5

% Mortality in 7 d Before Test 4.8% 9.5%

Reference Toxicant Zinc

Current Reference Toxicant Result

Reference Toxicant Test Date July 6, 2004

48-h LC50 and 95% CL 483 (403-578) µg/L Zn

Reference Toxicant Warning Limits (mean ± 2SD) and CV

462 ± 315 µg/L Zn % CV = 34

TEST CONDITIONS

Temperature Range (°C) 20.0 - 21.5

pH Range REA 7.7-8 - 8.2

Dissolved Oxygen Range (mg/L) 8.6 - 9.1

Conductivity Range (µS/cm) 357 - 11850

Photoperiod (L:D h) 16:8

No. Organisms/Volume 10/200mL

Other —

TEST RESULTS

The 48h LC50 for G-Creek 070704 is > 100% (v/v).

Data Verified By Armeda Terry

Date Verified August 5, 2004

**EVS ENVIRONMENT CONSULTANTS**  
**48-h *Daphnia magna* ACUTE TOXICITY TEST DATA**

Client Azimuth - Polaris  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400307  
 Daphnid Broodstock Batch June 15A

Sample ID G-Creek. 070704  
 Date Collected July 7, 2004  
 Test Initiation Date/Time July 11<sup>th</sup>/04 @ 1400  
 No. Organisms/Volume 10/200ml

Concentration % (v/v)	Number of Survivors (1 to 48 h)					Dissolved Oxygen (mg/L)			Temperature (°C)			pH			Conductivity (µmhos/cm)	
	1	2	4	24	48	0	24	48	0	24	48	0	24	48	0	48
CONTROL				10	10	9.1	8.8	8.6	20.0	21.0	21.5	8.0	7.7	7.7	357	357
6.25				10	10	9.1	8.8	8.7	20.0	21.0	21.0	8.0	7.8	7.8	1231	1206
12.5				10	10	9.1	8.8	8.8	20.0	21.0	21.0	8.0	7.9	7.9	2020	2000
25				10	10	9.1	8.8	8.8	20.0	21.0	21.0	7.9	7.9	8.0	3630	3600
50				10	10	9.1	8.8	8.8	20.0	21.0	21.0	7.9	8.0	8.1	6370	6270
100				10	7	9.1	8.8	8.8	20.0	21.0	21.0	7.8	8.0	8.2	11850	11640
Technician Initials				am	am	AW	am	am	kw	am	am	am	am	am	am	am

Sample Description Clear colourless  
 WQ Instruments Used: Temp. Calibrated Hg Thermometer pH II-A-20502 DO II-A-011201 Cond. II-A-990901  
 Comments \_\_\_\_\_

Test Set Up By AKN Data Verified By Armeda Terry Date Verified August 5, 2004





August 9, 2004

Our File: 09-0302-54.00  
Work Order: 0400342,348

Cheryl Mackintosh  
Azimuth Consulting Group  
218 – 2902 West Broadway  
Vancouver, BC V6K 2G8

Dear Ms. Mackintosh:

**RE: Acute Toxicity Test Results for a sample collected July 27, 2004**

We are pleased to provide you with the results of the toxicity tests performed on the sample identified as G-Creek acute 270704 (received July 27, 2004). The sample was tested with the 96-h rainbow trout LC50 test and the 48-h *Daphnia magna* LC50 test. Testing was performed according to the Environment Canada protocols for conducting acute toxicity tests using rainbow trout (EPS 1/RM/13, Second Edition, 2000) and *D. magna* (EPS 1/RM/14, Second Edition, 2000). An independent EVS QA/QC review confirmed that all acceptability criteria specified by the protocols were met. The results of these tests are summarized from the appended data and are presented in Table 1.

**Table 1. Toxicity Test Results.**

Sample ID	Sample Date (Time h)	96-h Rainbow Trout	48-h <i>Daphnia magna</i>
		LC50 (95% CL) (% v/v)	LC50 (95% CL) (% v/v)
G-Creek acute 270704	27-July-04 (2130h)	>100	>100

Should you have any questions or comments regarding this report, please do not hesitate to contact the undersigned at 604-986-4331.

Sincerely,

A handwritten signature in black ink, appearing to read 'R DeWynter', is written over a horizontal line.

Rachel DeWynter, B.Sc.  
Algal Bioassay Supervisor  
[rdewynter@evsenvironment.com](mailto:rdewynter@evsenvironment.com)

Verified By:

A handwritten signature in black ink, appearing to read 'Armando Tang', is written over a horizontal line.

QA/QC Committee:

Armando Tang, B.Sc.  
Cathy McPherson, B.Sc.  
Julianna Kalocai, M.Sc.  
John Wilcockson, M.Sc.

195 Pemberton Ave.  
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[info@evsenvironment.com](mailto:info@evsenvironment.com)

**EVS ENVIRONMENT CONSULTANTS**  
**48-h *Daphnia magna* TOXICITY TEST DATA SUMMARY**

Client Azimuth - (Polaris)  
EVS Project No. 09-0302-54.01  
EVS Work Order No. 0400348

EVS Analysts JRY, AwD  
Test Type 48h LC50  
Test Initiation Date July 30, 2004

**SAMPLE INFORMATION**

Identification G-Creek 270704  
Amount Received 3F<sup>20</sup> x 20L  
Date Collected July 27, 2004  
Date Received July 30, 2004  
Temperature (°C) 22.0 - 21.5  
pH 7.8 - 8.0  
Dissolved Oxygen (mg/L) 12.1 - 8.8  
Conductivity ( $\mu$ mhos/cm) 5020  
Hardness (mg/L as CaCO<sub>3</sub>) 590  
Alkalinity (mg/L as CaCO<sub>3</sub>) -  
Ammonia (mg/L N) -  
Chlorine (mg/L Cl) -

pH adjustment details: none  
Pre-aeration rate and duration: 10 minutes gentle aeration

**DILUTION/CONTROL WATER** (initial water quality)

Water Type Moderately Hard Water (July 27)  
Temperature (°C) 20.0  
pH 7.8  
Dissolved Oxygen (mg/L) 9.1  
Conductivity ( $\mu$ S/cm) 363  
Hardness (mg/L as CaCO<sub>3</sub>) 96  
Alkalinity (mg/L as CaCO<sub>3</sub>) 56  
Other -

**TEST SPECIES INFORMATION**

Broodstock Culture ID (in-house culture) July 2B  
Age (on Day 0) < 24hrs.  
Days to First Brood 7  
Avg. Young/Brood (after 1<sup>st</sup> brood) 24  
% Mortality in 7 d Before Test 6%  
Reference Toxicant Zinc  
Current Reference Toxicant Result

Reference Toxicant Test Date 27-Jul-04  
48-h LC50 and 95% CL 683 (578-807) mg/L Zn  
Reference Toxicant Warning Limits (mean  $\pm$  2SD) and CV  
463  $\pm$  315 mg/L Zn % CV = 39

**TEST CONDITIONS**

Temperature Range (°C) 20.0 - 21.5  
pH Range 7.7 - 8.0  
Dissolved Oxygen Range (mg/L) 8.6 - 9.1  
Conductivity Range ( $\mu$ S/cm) 363 - 5020  
Photoperiod (L:D h) 16:8  
No. Organisms/Volume 10/200ml  
Other -

**TEST RESULTS**

The 48h LC50 of G-Creek 270704 is > 100% (w/r)

Data Verified By [Signature]

Date Verified Sept 10/04

**EVS ENVIRONMENT CONSULTANTS**  
**48-h *Daphnia magna* ACUTE TOXICITY TEST DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-5401  
 EVS Work Order No. 0400348  
 Daphnid Broodstock Batch July 2B

Sample ID G-Creek 270704  
 Date Collected July 27, 2004  
 Test Initiation Date/Time July 30, 2004 @ 14:00  
 No. Organisms/Volume 10/200ml

Concentration % (v/v)	Number of Survivors (1 to 48 h)					Dissolved Oxygen (mg/L)			Temperature (°C)			pH			Conductivity (µmhos/cm)	
	1	2	4	24	48	0	24	48	0	24	48	0	24	48	0	48
Control				10	10	9.1	8.9	8.7	20.0	21.0	21.0	7.8	7.9	7.9	363	374
6.25				10	10	9.0	8.9	8.6	20.5	21.0	21.0	7.8	7.8	7.8	688	680
12.5				10	10	8.9	8.8	8.7	21.0	21.0	21.0	7.9	7.7	7.7	990	984
25				10	10	8.9	8.8	8.7	21.0	21.0	21.0	7.9	7.7	7.7	1592	1586
50				10	10	8.9	8.6	8.7	21.0	21.0	21.0	7.9	7.6	7.8	2750	2690
100				10	10	8.8	8.7	8.6	21.5	21.0	21.0	8.0	7.7	7.7	5020	4940
Technician Initials				~	~	DM	~	~	DM	~	~	DM	~	~	DM	~

Sample Description clear, colourless  
 WQ Instruments Used: Temp. <sup>calibrated</sup> Hg Thermometers pH I-A-000503 DO I-A-011201 Cond. I-A-990901  
 Comments \_\_\_\_\_

Test Set Up By JRY Data Verified By [Signature] Date Verified Sept 8/04

EVS ENVIRONMENT CONSULTANTS  
RAINBOW TROUT ACUTE TOXICITY TEST DATA SUMMARY

Client Azimuth  
EVS Project No. 09-0302-54  
EVS Work Order No. 0400340 342  
RSO

EVS Analysts AWD  
Test Type 96h LC50  
Test Initiation Date Aug 1/04

**SAMPLE**

Identification G-Creek acute 270704  
Amount Received 3+20L  
Date Collected July 27/04  
Date Received July 30/04  
Other \_\_\_\_\_

**DILUTION/CONTROL WATER** (initial water quality)

Fresh Water (dechlorinated)   
Temperature (°C) 14  
pH 6.8  
Dissolved Oxygen (mg/L) 10.1  
Conductivity ( $\mu$ S/cm) 30  
Hardness (mg/L as CaCO<sub>3</sub>) 16  
Alkalinity (mg/L as CaCO<sub>3</sub>) 10  
Other \_\_\_\_\_

**TEST SPECIES INFORMATION**

Source Fraser Valley  
Collection Date/Batch 070504  
Control Fish Size (mean, SD and range measured at end of test)  
Date Measured Aug 5/04  
Fork Length (mm) 33 ± 2 (31-35)  
Wet Weight (g) 0.34 ± 0.04 (0.29-0.42)  
Reference Toxicant SDS

**Current Reference Toxicant Result**

Reference Toxicant Test Date July 23/04  
Duration of Acclimation (days) 18  
96-h LC50 (and 95% CL) 21 (17 and 26)  
Reference Toxicant Warning Limits (mean ± 2SD) and CV  
29 ± 12 mg/L SDS CV = 21%

**TEST CONDITIONS**

Dissolved Oxygen Range (mg/L) 9.6-10.1  
Temperature Range (°C) 14  
pH Range 6.8-8.3  
Conductivity Range ( $\mu$ S/cm) 30-4865 4870  
Aeration Provided? (give rate) 6.5 ± 1 mL/min/L  
Photoperiod (L:D h) 16:8  
No. Organisms/Volume 10/10L  
Loading Density (g/L) 0.34  
Acclimation Before Testing (days) 27  
Mortality In Previous Week of Acclimation (%) 0.25  
Other \_\_\_\_\_

**TEST RESULTS**

The 96-h LC50 was estimated to be > 100% (U/U)

Data Verified By Jan 17/04

Date Verified Sept. 10/04

EVS ENVIRONMENT CONSULTANTS  
RAINBOW TROUT ACUTE TOXICITY TEST DATA

WHOLE SAMPLE WATER QUALITY

Temp. (°C)	pH	Initial pH Adjustment	After 30-min Pre-aeration
14			14
7.6			7.7
10.1			10.1
4870			4870

1. Document pH adjustment procedure (if used) under "Comments".

Client: Polaris Aquatics  
 EVS Project No.: 09-0302-54  
 EVS Work Order No.: 0400-342-342  
 Trout Batch No. and 7-d Acclimation Mortality: 070504/0.25%  
 No. Fish/Volume: 10/10L  
 Sample ID: G-Greek  
 Date/Time Collected: July 27-04 @ 2130  
 Test Initiation Date/Time: Aug 1-04 @ 1030

Total Pre-Aeration Time: 30 min

Concentration % (w/v)	Number of Survivors (1 to 96 hours)						Dissolved Oxygen (mg/L)						Temperature (°C)						pH						Conductivity (µS/cm)				
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control			10	10	10	10	10	10.1	9.8	9.6	9.7	9.9	14	14	14	14	14	8.8	7.1	7.4	7.5	7.2	74	74	74	72	73	0	96
6.25			10	10	10	10	10	10.1	9.8	9.6	9.7	9.9	14	14	14	14	14	7.1	7.4	7.5	7.4	7.2	74	74	74	72	73	7300	540
12.5			10	10	10	10	10	10.1	9.6	9.6	9.7	9.6	14	14	14	14	14	7.4	7.4	7.7	7.5	7.2	74	74	74	75	72	900	940
25			10	10	10	10	10	10.1	9.7	9.7	9.6	9.6	14	14	14	14	14	7.5	7.9	8.0	7.6	7.4	76	76	76	74	74	1870	1760
50			10	10	10	10	10	10.1	9.9	9.8	9.7	9.7	14	14	14	14	14	7.6	8.0	7.9	7.8	7.9	76	80	79	78	79	5845	2110
100			10	10	10	10	10	10.1	9.7	9.7	9.7	9.7	14	14	14	14	14	7.7	8.1	8.2	8.3	8.1	77	81	82	83	81	4870	4560
Technician Initials																													

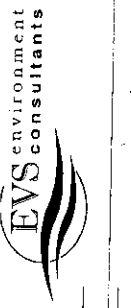
WQ Instruments Used: Temperature Calibrated 4g Thermometer pH II-A-030202 DO II-A-3 Conductivity II-A-030306  
 Sample Description: Clear

Test Set Up By: \_\_\_\_\_ Date Verified By: G. H. K. Date Verified: Sept 10/04



**CHAIN-OF-CUSTODY/TEST REQUEST FORM**

195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4  
Tel: 604-986-4331  
Fax: 604-662-8548  
www.evsenvironment.com



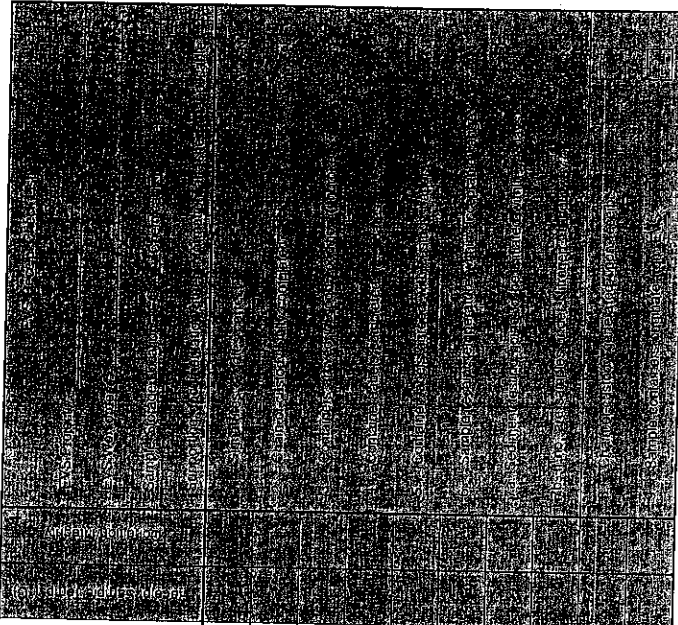
Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

Client Name: Teek Cominco (Polaris) Client Contact Name: Cheryl MacKintosh Ship to: \_\_\_\_\_  
 Address: 42 Smith Consulting Group Phone: 604 730 7220  
218-2902 West Broadway Fax: 604 739 8511  
Vancouver B.C.

Shipping Date: \_\_\_\_\_

Sampled By: Karlette Tunaley Alt: \_\_\_\_\_

Collection Date (dd/mm/yy)	Time (24-h clock)	Sample Identification	Type of Each Sample				Type by Code				Notes? (e.g. preserved, seawater, freshwater, may contain sewage)	
			Material Safety Data Sheet Attached? (✓)	Sample Collection Method (G = grab, C = composite)	Number of Sample Containers (ie, 1 x 20L)	Sample Container (ie, 1 x 20L)	Sample by Code	Test(s) Requested	Notes? (e.g. preserved, seawater, freshwater, may contain sewage)			
27/07/04	9:30 AM	G-Creek-Sublethal-zinc-E	✓		2x20L	LOPE	✓	70 TOXMET	48H RBT (CSO)	48H ECHINODERM	48H DAPHNIA	
		G-Creek-Acute-zinc-E			3x20L	LOPE	✓					POLARIS PROJ
												POLARIS PROJ



PO/Reference No.: \_\_\_\_\_

Project Title: \_\_\_\_\_

Results Needed By: \_\_\_\_\_

**A) Released By:** \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Company: EVS Date: 30 JUL 04 Time: 12:00  
 Courier name: \_\_\_\_\_  
 Shipping containers secured by: Tape Yes No N/A  
 Custody seals used? Yes No N/A

**B) Received by:** \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Company: EVS Date: 30 JUL 04 Time: 12:00  
 Courier name: \_\_\_\_\_  
 Shipping containers received secure? Yes No N/A  
 Custody seals intact? Yes No N/A

**C) Released By:** \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Company: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Courier name: \_\_\_\_\_  
 Shipping containers secured by: Tape Yes No N/A  
 Custody seals used? Yes No N/A

**D) Received by:** \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Company: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Shipping containers received secure? Yes No N/A  
 Custody seals intact? Yes No N/A

Distribution of copies: White, yellow, pink - accompany the shipment  
 Orange - retained by consignor (e.g., shipper)  
 Yellow - retained by consignee (e.g., receiver)  
 Pink - for use as needed  
 White - returned to consignor by consignee

Revision Date: Sept. 25, 2000

Photocopy of original because 3 cooler

**Golder Associates Ltd.**

195 Pemberton Avenue  
North Vancouver, British Columbia  
Canada V7P 2R4  
Telephone 604-986-4331  
Fax 604-662-8548

Our File: 09-0302-54.00  
Work Order: 0400382,383

September 2, 2004

Cheryl Mackintosh  
Azimuth Consulting Group  
218 – 2902 West Broadway  
Vancouver, BC V6K 2G8

Dear Ms. Mackintosh:

**RE: Acute Toxicity Test Results for a sample collected August 24, 2004**

We are pleased to provide you with the results of the toxicity tests performed on the sample identified as G-Creek acute 081704 (received August 24, 2004). The sample was tested with the 96-h rainbow trout LC50 test and the 48-h *Daphnia magna* LC50 test. Testing was performed according to the Environment Canada protocols for conducting acute toxicity tests using rainbow trout (EPS 1/RM/13, Second Edition, 2000) and *D. magna* (EPS 1/RM/14, Second Edition, 2000). An independent EVS QA/QC review confirmed that all acceptability criteria specified by the protocols were met. The results of these tests are summarized from the appended data and are presented in Table 1.

**Table 1.** Toxicity Test Results.

Sample ID	Sample Date (Time h)	96-h Rainbow Trout	48-h <i>Daphnia magna</i>
		LC50 (95% CL) (% v/v)	LC50 (95% CL) (% v/v)
G-Creek acute 081704	24-Aug-04 (1500h)	>100	>100

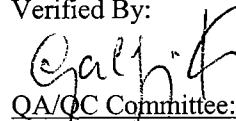
Should you have any questions or comments regarding this report, please do not hesitate to contact the undersigned at 604-986-4331.

Sincerely,



For: Robert Harrison, B.Sc. Hons.  
Assistant Bioassay Test Supervisor– Fish Team  
[rharrison@evsenvironment.com](mailto:rharrison@evsenvironment.com)

Verified By:



QA/QC Committee:

Armando Tang, B.Sc.  
Cathy McPherson, B.Sc.  
Julianna Kalocai, M.Sc.  
John Wilcockson, M.Sc.

EVS ENVIRONMENT CONSULTANTS  
48-h *Daphnia magna* TOXICITY TEST DATA SUMMARY

Client Azimuth (Polaris)  
EVS Project No. 09-1108-01.01  
EVS Work Order No. 0400383

EVS Analysts JRY, BLR AND  
Test Type 48 hr LC50  
Test Initiation Date August 27, 2004

SAMPLE INFORMATION

Identification G-Creek 081704  
Amount Received 1x2L subsampled @ EVS from 1x20L  
Date Collected August 24, 2004  
Date Received August 27, 2004  
Temperature (°C) 23.0 @ 22.0  
pH 7.8 @ 8.1  
Dissolved Oxygen (mg/L) 10.2 @ 8.7  
Conductivity (µmhos/cm) 9320  
Hardness (mg/L as CaCO<sub>3</sub>) 1220  
Alkalinity (mg/L as CaCO<sub>3</sub>) -  
Ammonia (mg/L N) -  
Chlorine (mg/L Cl) -

pH adjustment details: none  
Pre-aeration rate and duration: 30 minutes

DILUTION/CONTROL WATER (initial water quality)

Water Type Moderately Hard water (Aug 23)  
Temperature (°C) 20.5  
pH 8.0  
Dissolved Oxygen (mg/L) 9.0  
Conductivity (µS/cm) 319  
Hardness (mg/L as CaCO<sub>3</sub>) 84 @ 80  
Alkalinity (mg/L as CaCO<sub>3</sub>) 50  
Other -

TEST SPECIES INFORMATION

Broodstock Culture ID (in-house culture) Aug 6A  
Age (on Day 0) < 24 hrs  
Days to First Brood 7  
Avg. Young/Brood (after 1<sup>st</sup> brood) 21  
% Mortality in 7 d Before Test 0  
Reference Toxicant Zn  
Current Reference Toxicant Result

Reference Toxicant Test Date August 24, 2004  
48-h LC50 and 95% CL 536(438-656) µg Zn  
Reference Toxicant Warning Limits (mean ± 2SD) and CV  
481 ± 322 µg Zn % CV = 33

TEST CONDITIONS

Temperature Range (°C) 20.5 - 22.0  
pH Range 7.6 - 8.1  
Dissolved Oxygen Range (mg/L) 8.5 - 9.0  
Conductivity Range (µS/cm) 303 - 9320  
Photoperiod (L:D h) 16:8  
No. Organisms/Volume 10/200µl  
Other -

TEST RESULTS

The 48hr LC50 of G-Creek 081704  
is > 100% (V/V).

Data Verified By Qualifit

Date Verified Nov. 16/04

**EVS ENVIRONMENT CONSULTANTS**  
**48-h *Daphnia magna* ACUTE TOXICITY TEST DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-1108-01.01  
 EVS Work Order No. 0400383  
 Daphnid Broodstock Batch Aug 6A

Sample ID G-Creek 081704  
 Date Collected August 24, 2004  
 Test Initiation Date/Time August 27/04 @ 11:00  
 No. Organisms/Volume 10/200ml

Concentration %. (v/v)	Number of Survivors (1 to 48 h)					Dissolved Oxygen (mg/L)			Temperature (°C)			pH			Conductivity (µmhos/cm)	
	1	2	4	24	48	0	24	48	0	24	48	0	24	48	0	48
Control				10	10	9.0	8.8	8.7	20.5	21.0	21.5	8.0	7.6	7.7	319	353*
6.25				10	10	9.0	8.7	8.7	20.5	21.5	21.5	8.0	7.6	7.7	919	921
12.5				10	10	9.0	8.7	8.6	20.5	21.5	21.5	8.0	7.7	7.8	1514	1551
25				10	10	9.0	8.7	8.6	20.5	21.5	21.5	8.0	7.6	7.8	2720	2850
50				10	10	8.9	8.6	8.5	21.0	21.5	21.5	8.0	7.7	7.8	4960	4920
100				10	10	8.7	8.7	8.5	22.0	21.5	21.5	8.1	7.7	7.8	9320	9120
Technician Initials				^	^	pm	^	^	pm	^	^	pm	^	^	pm	^

Sample Description clear, colourless  
 WQ Instruments Used: Temp. Calibrated HS Thermometer pH II-A-020501 DO II-A-011201 Cond. II-A-990501  
 Comments \_\_\_\_\_

Test Set Up By JRY Data Verified By Quality Date Verified Nov. 16/04

**EVS ENVIRONMENT CONSULTANTS  
RAINBOW TROUT ACUTE TOXICITY TEST DATA SUMMARY**

Client Azimuth (Polaris)  
EVS Project No. 09-0302-54  
EVS Work Order No. 0400382

EVS Analysts AWD, RPH  
Test Type 96-h LC50  
Test Initiation Date August 27/04 @ 11:45

**SAMPLE**

Identification G-Creek  
Amount Received 5 x 20L  
Date Collected Aug 24/04  
Date Received Aug 27/04  
Other \_\_\_\_\_

**DILUTION/CONTROL WATER** (initial water quality)

Fresh Water (dechlorinated) ✓  
Temperature (°C) 15  
pH 7.9  
Dissolved Oxygen (mg/L) 10.1  
Conductivity (µS/cm) 46  
Hardness (mg/L as CaCO<sub>3</sub>) 16  
Alkalinity (mg/L as CaCO<sub>3</sub>) 10  
Other \_\_\_\_\_

**TEST SPECIES INFORMATION**

Source Sun Valley  
Collection Date/Batch 072804  
Control Fish Size (mean, SD and range measured at end of test)  
Date Measured Aug 31/04  
Fork Length (mm) 0.40 ± 0.02 (0.38-0.44)  
Wet Weight (g) 0.45 ± 0.10 (0.31-0.61)  
Reference Toxicant SDS  
Current Reference Toxicant Result  
Reference Toxicant Test Date Aug 27/04  
Duration of Acclimation (days) 30  
96-h LC50 (and 95% CL) 38 (33 and 44) mg/L SDS  
Reference Toxicant Warning Limits (mean ± 2SD) and CV  
29 ± 13 mg/L SDS CV: 22%

**TEST CONDITIONS**

Dissolved Oxygen Range (mg/L) 9.1-10.1  
Temperature Range (°C) 15 est  
pH Range 7.2-7.89  
Conductivity Range (µS/cm) 46-7533  
Aeration Provided? (give rate) 6.5 ± 1 mL/min  
Photoperiod (L:D h) 16:8  
No. Organisms/Volume 10 / 12L  
Loading Density (g/L) 0.38  
Acclimation Before Testing (days) 30  
Mortality In Previous Week of Acclimation (%) 0  
Other \_\_\_\_\_

**TEST RESULTS**

The 96-h LC50 was estimated to be >100% (w/o)

Data Verified By Opal J. [Signature]

Date Verified Nov 16/04

EVS ENVIRONMENT CONSULTANTS  
 RAINBOW TROUT ACUTE TOXICITY TEST DATA

WHOLE SAMPLE WATER QUALITY

	Initial	pH Adjustment <sup>1</sup>	After 30-min Pre-aeration
Temp. (°C)	15		15
pH	7.7		7.7
DO (mg/L)	9.9		10.1
Cond. (µS/cm)	7416		7416

1. Document pH adjustment procedure (if used) under "Comments".

Total Pre-Aeration Time 30 minutes

Client Azimith (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400382  
 Trout Batch No. and 7-d Acclimation Mortality 072804/096  
 No. Fish/Volume 10/12L  
 Sample ID G-Creek  
 Date/Time Collected August 24/04 @ 1500  
 Test Initiation Date/Time August 27/04 @ 1145

Concentration % (V/V)	Number of Survivors (1 to 96 hours)							Dissolved Oxygen (mg/L)					Temperature (°C)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control				10	10	10	10	10.1	9.9	9.8	10.0	9.8	15	15	15	15	15	7.4	7.4	7.5	7.2	7.4	416	58
6.25				10	10	10	10	10.1	9.7	9.8	10.0	9.9	15	15	15	15	15	7.5	7.5	7.7	7.4	7.4	556	601
12.5				10	10	10	10	10.1	9.9	9.8	9.3	9.6	15	15	15	15	15	7.6	7.5	7.8	7.5	7.6	1030	1054
25				10	10	10	10	10.1	9.9	9.9	9.1	9.5	15	15	15	15	15	7.6	7.7	7.8	7.6	7.6	1825	1881
50				10	10	10	10	10.1	9.8	9.8	9.5	9.3	15	15	15	15	15	7.7	7.8	7.8	7.6	7.7	3950	3983
100				10	10	10	10	10.1	9.8	9.9	9.6	9.5	15	15	15	15	15	7.7	7.8	7.9	7.8	7.8	7416	7533
Technician Initials				~	~	REH	REH	REH	~	REH	REH	REH	~	~	REH	REH	REH	~	~	REH	REH	REH	REH	

WQ Instruments Used: Temperature Calibrated Hg Thermo pH II-A-020601 DO II-A-3 Conductivity II-A-030306  
 Sample Description clear with slight cloudy  
 Comments

Test Set Up By REH Data Verified By Quality Date Verified Nov. 16/04

# CHAIN-OF-CUSTODY/TEST REQUEST FORM



195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4  
Tel: 604-986-4331  
Fax: 604-662-8548

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

Client Name: ATMOSPHERIC CONSULTING INC Client Contact Name: Christy MacIntosh/Billy Dwyer Ship to: EVS Environment Consultants  
 Address: 218-2100 West Broadway Phone: 604-734-1220 195 Pemberton Ave.  
North Vancouver, BC, V8P 2G8 Fax: 604-734-9070 Shipping Date: Aug 26, 2004  
 Sampled By: Christy MacIntosh Attn: Edvard Cassia

Collection Date (dd/mm/yy)	Time (24-h clock)	Sample Identification	1 Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab; C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	2 Sample Container Type by Code	Test(s) Requested					3 Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)	4 Receipt Sample Temp. (°C)	5 Condition/Integrity	EVS Receipt Check List
								RAINBOW FLAG	GLASS JAR	PLASTIC BUCKET	PLASTIC CARBOY	OTHER				
For composite sample record date & time starting and ending																
19/Aug/04	15:00	G-COPE 021704	E	✓	5x20L	✓	✓	✓	✓	✓	✓	Preserved	15.0	✓	1. Signatures & dates correct? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 2. Chain-of-custody, fully completed? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 3. Containers arrived in good condition (unbroken)? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 4. Container labels completed (i.e. dates, ID's)? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 5. Container labels agreed with custody papers? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 6. Sample receipt temperature within acceptable range? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 7a. Sediment testing going to be initiated within 14 days? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 7b. If no, are samples under Nitrogen? If not, why? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 8. Chain of custody generated upon receipt? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Sample containers originate from EVS? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

PO/Reference No.: 11-03-03 Comments/Instructions:

Project Title: Black River

Results Needed By:

A) Released By: <u>MacIntosh</u> Date: <u>12/1/04</u> Company: <u>ACI</u> Time: <u>9:00am</u> Courier name: <u>Billy Dwyer</u> Shipping containers secured by: <input checked="" type="checkbox"/> Tape <input checked="" type="checkbox"/> Straps <input type="checkbox"/> Lock <input type="checkbox"/> Other _____ Custody seals used? Yes No <input checked="" type="checkbox"/> <u>STRAPS</u>	B) Received by: <u>AXI</u> Date: <u>11/16/04</u> Company: <u>EVS</u> Time: <u>0945</u> Shipping containers received secure? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Custody seals intact? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	C) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: <input type="checkbox"/> Tape <input type="checkbox"/> Straps <input type="checkbox"/> Lock <input type="checkbox"/> Other _____ Custody seals used? Yes No <input type="checkbox"/> <u>(circle one)</u>	D) Received by: _____ Date: _____ Company: _____ Time: _____ Shipping containers received secure? Yes No Custody seals intact? Yes No <input type="checkbox"/> N/A
--	---	---	---

1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)  
 2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify)  
 3 Please note any conditions the lab should be aware of for safety and storage concerns  
 4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Distribution of copies: White, yellow, pink - accompany the shipment  
 Orange - retained by consignor (e.g., shipper)  
 Yellow - retained by consignee (e.g., receiver)  
 Pink - for use as needed  
 White - returned to consignor by consignee

Revision Date: Sept. 25, 2000

**APPENDIX E**

**Sublethal Toxicity Testing Laboratory Reports**



**Azimuth Consulting Group**  
ENVIRONMENTAL EFFECTS  
MONITORING PROGRAM

July 10, 2004

**PREPARED FOR:**

**PREPARED BY:**

---

**Azimuth Consulting Group**  
*Vancouver, BC*



*North Vancouver, BC*

# AZIMUTH CONSULTING GROUP

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## **POLARIS MINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM**

**July 10, 2004**

### **LABORATORY REPORT**

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**Prepared for**

**Azimuth Consulting Group**  
218-2902 W. Broadway  
Vancouver, BC  
V6K 2G8

---

**Prepared by**

**EVS Environment Consultants**  
195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4

---

**EVS Project No.**

09-0302-54

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**September 2004**

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## ACKNOWLEDGEMENTS

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Toxicity testing was conducted by Andy Diewald, Anja Fouche, Keven Goodearle, Ann-Marie Norris and Jenny Shao. Statistical analyses were performed by Jenny Shao. The report was written by Kathryn Sentance and reviewed by Edmund Canaria. Quality Assurance/Quality Control (QA/QC) review was conducted by Julianna Kalokai.

# 1. INTRODUCTION

---

EVS Environment Consultants conducted sublethal Metal Mining Effluent Regulations (MMER) toxicity testing for Azimuth Consulting Group as part of the Environmental Effects Monitoring (EEM) program for Polaris Mine.

A sample, identified as G Creek, was collected from the Polaris Mine Site on July 07, 2004 in 20-L collapsible polyethylene containers. It was received at the EVS laboratory on July 10, 2004 and was stored in the dark at 4°C prior to test initiation. The sample was evaluated for toxicity using the 7-d topsmelt (*Atherinops affinis*) survival and growth toxicity test. The 7-d topsmelt toxicity testing was initiated on the day of initial sample receipt.

This report describes the methods and results of the 7-d topsmelt (*Atherinops affinis*) toxicity test. The raw data and statistical analyses are provided in Appendix A and the chain-of-custody form is provided in Appendix B.

The sample was also intended for toxicity evaluation using the echinoderm (*Dendraster excentricus*) fertilization toxicity test as part of the EEM program requirements. The test was not initiated successfully due to inability of the sand dollars to spawn.

## 2. METHODS

---

### 2.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

A static-renewal 7-d toxicity test and reference toxicant test using topsmelt (*A. affinis*) was conducted in accordance with EVS Environment Consultants Standard Operating Procedures (SOP) 1100-4 (EVS, 2002) with modifications based on U.S. Environmental Protection Agency (USEPA, 1995). Test conditions and methods are summarized in Table 1.

This 7-day test exposes topsmelt larvae to different concentrations of a given sample. Fish are fed on a daily basis and both survival and growth endpoints are measured at test termination. These observations are assessed in comparison to the pooled negative and brine controls.

### 2.2 STATISTICAL ANALYSIS

Statistical analyses for all tests were conducted using the computer software program TOXCALC (version 5.0.23; Tidepool Scientific Software, 1994). The Power Standards were calculated as outlined by the Washington Department of Ecology (WDOE, 2001).

### 2.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This study followed a comprehensive QA/QC Program to ensure full documentation and minimize possible errors in computation and reporting of results. The following general QA/QC guidelines were applied in this test: use of negative controls, use of positive controls, use of brine controls, replication, instrument calibration, water quality maintenance and record-keeping, and use of standard operating procedures (SOPs). To ensure the highest quality of data and reporting, all data and statistical analyses were reviewed by a member of our QA/QC Committee prior to reporting the results.

**Table 1.** 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static-renewal
Test duration	7 d
Test chamber	600-mL beaker
Test solution volume	200 mL
Number of replicate chambers per treatment	5
Number of organisms per test chamber	5
Age of test organisms at test initiation	11d
Food	Newly hatched <i>Artemia</i> nauplii (<24 hours old)
Feeding Regime	Fed 0.5 mL/ beaker twice daily of concentrated nauplii suspension (prepared to provide 200 nauplii in 0.5 mL); no feeding at test termination
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity-adjusted
Control/dilution water	UV-sterilized and 0.45µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.5, 9.1, 18.2, 36.3, 72.6% (v/v)
Renewal of dilutions	Daily
Aeration	None
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and salinity daily
Temperature	20 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Overhead full-spectrum fluorescent lights; 538 – 1076 lux; 16:8 light:dark photoperiod
Reference toxicant	Initiated concurrently with sample using copper to generate LC50 and IC50 values; results compared to lab mean ± 2 SD
Endpoints	Survival and growth (dry weight)
Test validity	≥ 80% mean control survival; ≥ 0.85 mg/fish mean dry weight for surviving control fish
Reference protocol	US EPA (1995), EPA/600/R-95/136



### 3. RESULTS

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#### 3.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

The highest concentration tested was 72.6‰ due to salinity adjustment. The test results are summarized in Table 2 and the raw statistical analyses are provided in Appendix A.

The *A. affinis* survival and growth toxicity test showed no adverse effects on survival or growth in all tested concentrations relative to the pooled controls ( $p \leq 0.05$ ). The mean survival in both the negative and brine controls was 96%.

#### 3.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The tests met all passing criteria for test validity as outlined in the respective protocols. Water quality parameters during the test were all within the acceptable range of values. Point estimates for the reference toxicant tests were all within the laboratory mean  $\pm 2$  standard deviations, indicating that the tests were within acceptable limits of variability.

An attempt was made to initiate the echinoderm (*Dendraster excentricus*) fertilization toxicity test as part of the sample evaluation requirements. The sand dollars purchased from Westwind Sealab Supplies, did not spawn, and consequently, the test was not initiated. The inability of the sand dollars to spawn may have resulted from various reasons such as handling of organisms during transport, seasonal conditions, holding and culturing conditions and poor quality of organisms.

**Table 2.** Summary of results for the 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test

<b>TEST CONCENTRATION (% v/v)</b>	<b>SURVIVAL (%) (MEAN ± SD)</b>	<b>GROWTH (DRY WEIGHT MG) (MEAN ± SD)</b>
D-Control	96.0 ± 8.9	0.93 ± 0.18
Brine Control	96.0 ± 8.9	1.08 ± 0.17
Pooled Controls	96.0 ± 8.4	1.00 ± 0.18
4.5	100 ± 0.0	1.00 ± 0.08
9.1	100 ± 0.0	1.04 ± 0.09
18.2	100 ± 0.0	0.96 ± 0.09
36.3	96.0 ± 8.9	1.10 ± 0.15
72.6	92.0 ± 11.0	0.99 ± 0.22
<b>TEST ENDPOINT</b>	<b>SURVIVAL (% v/v)</b>	<b>GROWTH (% v/v)</b>
NOEC	72.6	72.6
LOEC	>72.6	>72.6
LC50	>72.6	na
IC50	na	>72.6
IC25	na	>72.6

\*Indicates significant difference ( $p \leq 0.05$ ) relative to the pooled controls.  
SD – Standard Deviation; na – not applicable.

## 4. REFERENCES

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- EVS (EVS Environment Consultants). 2002. Topsmelt (*Atherinops affinis*) 7-d larval survival and growth test. EVS SOP 1100-4. In: EVS Consultants Laboratory Standard Operating Procedures (SOP) Manual. Volume II: Water Toxicity Tests. EVS Environment Consultants, North Vancouver, BC.
- US EPA (U.S. Environmental Protection Agency). 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 3<sup>rd</sup> edition. US Environmental Protection Agency, Office of Water (4303T). US Environmental Protection Agency, Washington, DC. EPA/821/R-02/014. 464 pp.
- US EPA. 1995. Short term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 2<sup>nd</sup> edition. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Washington, DC. EPA/600/R-95/136. 563 pp.
- Tidepool Scientific Software. 1994. TOXCALC: Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.23. Tidepool Scientific Software, McKinleyville, CA. 80 pp.

## **APPENDIX A**

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Raw Data and Statistical Analyses:

*Atherinops affinis*

**EVS ENVIRONMENT CONSULTANTS**

**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client PRAZIMUTH (POLARIS MINE)

EVS Analysts KMG, AKW, AWD, AXF, JS

EVS Project No. 09-0302-54

EVS Work Order No. 0400303

Test Initiation Date 10 Jul-04

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	G-CREEK 070707	-	-
Amount Received		-	-
Date Collected		-	-
Date Received	10 Jul-04	-	-
Temperature (°C)	19.5 → 19.0	-	-
pH	8.1 → 8.0	-	-
DO (mg/L)	9.3 → 7.9	-	-
Conductivity (µmhos/cm)	11600	-	-
Salinity (ppt)	7 → 28	-	-
Ammonia (mg/L N)	-	-	-
Chlorine (mg/L Cl)	-	-	-
Other	-	-	-

**DILUTION/CONTROL WATER (initial water quality)**

Water Type UN STERILIZED FILTERED SEA H<sub>2</sub>O

Temperature (°C) 20.0

pH 8.0

Dissolved Oxygen (mg/L) 7.6

Salinity 28

**TEST CONDITIONS**

Temperature Range (°C) 19.0 - 21.0

pH Range 7.8 - 8.3

Dissolved Oxygen Range (mg/L) 6.1 - 7.9

Salinity (ppt) 28 - 31

Photoperiod (L:D h) 16:8

Aeration Provided? NO

Other -

**TEST SPECIES INFORMATION**

Source AQUATIC BIO SYSTEMS (ABS)

Date Received 08 Jul-04

Age (on Day 0) 11d

Reference Toxicant Cu

Current Reference Toxicant Result (incl. 95% CL)

Reference Toxicant Test Date 10 Jul-04

7-d survival LC50 ~~143~~ 161 µg/L Cu + 95% CI (139-138)

7-d growth IC50 147 µg/L Cu (119-169)

Reference Toxicant Warning Limits (mean ± 2SD) and CV

7-d survival LC50 137 µg/L Cu ± 28% CV=21%

7-d growth IC50 135 µg/L Cu ± 26% CV=19%

① SAL. ADJ. TO 30 ± 2 ppt.

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	% (v/v)	72.6	> 72.6	> 72.6		
Growth		72.6	> 72.6		72.6	> 72.6

Other -

Data Verified By Galfin

Date Verified August 18/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimuth (Peters Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303

Sample ID G-CREEK 70704  
 Test Initiation Date/Time 10-JUN-04 / 1730H  
 Source/Date Received ABS / 08-JUL-04

Concentration (% v/v)	Temperature (°C)													
	0	1	New 2 old		3	New 4 old		New 5 old		New 6 old		7		
Nitri. Con	20.0	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
Bene. Con	20.0	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
4.5	20.0	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
9.1	20.0	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
18.2	20.0	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
36.3	19.5	20.0	19.5	20.0	20.5	20.0	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
72.6	19.0	20.0	19.5	20.0	20.5	20.5	21.0	20.0	21.0	20.0	20.5	20.0	21.0	20.5
Tech. Initials	AK	A	A	A	A	A	JL	JL	JL	A	A	JL	JL	A

Concentration (% v/v)	pH													
	0	1	2		3	New 4		5		6		7		
Nitri. Con	8.0	8.0	7.9	7.9	7.8	7.9	7.8	8.0	7.8	8.0	7.9	8.0	7.9	7.9
Bene. Con	8.1	8.0	7.9	7.9	7.8	7.9	7.8	8.0	7.8	8.0	7.9	8.0	7.9	7.9
4.5	8.0	8.0	7.9	7.9	7.8	7.9	7.8	8.0	7.9	7.6	7.9	8.0	7.9	7.9
9.1	8.0	8.0	7.9	7.9	7.8	7.9	7.8	8.0	7.9	8.1	8.0	8.0	8.0	7.9
18.2	8.0	8.0	7.9	7.9	7.8	7.9	7.9	8.1	8.0	8.2	8.1	8.1	8.0	7.9
36.3	8.0	8.0	7.9	7.9	7.9	7.9	7.9	8.1	8.0	8.3	8.1	8.1	8.1	8.0
72.6	8.0	8.0	7.9	8.0	7.9	8.1	8.0	8.2	8.1	8.3	8.2	8.2	8.1	8.1
Tech. Initials	AK	A	A	A	AXF	A	JL	JL	JL	A	A	JL	JL	A

WQ Instruments Used: Temp. Cal. Hy. THERM. pH II-A-030301  
 Comments \_\_\_\_\_

Test Set Up By AK Data Verified By Qualifit Date Verified August 17/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client AZIMUTH (POLARIS MINE)  
 EVS Project No. 09-0302-S4  
 EVS Work Order No. 0406303

Sample ID G-CREEK-070704  
 Test Initiation Date/Time 10-JUL-04 / 1730h  
 Source/Date Received ABS / 08-JUL-04

Concentration (% v/v)	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Net. Ctrl	28	30	28	28	28	28	28	29
Beine Ctrl	29	30	30	29	29	30	30	30
4.5	28	30	28	28	28	28	28	29
9.1	28	31	28	28	28	28	28	29
18.2	28	30	28	28	28	28	28	29
36.3	28	31	28	28	28	28	28	29
72.6	29	30	28	28	28	28	28	29
Tech. Initials	vmb	AL	~	~	JL	~	JL	~

Concentration (% v/v)	Dissolved Oxygen (mg/L)													
	0	1	2	3	4	5	6	7						
Net. Ctrl	7.6	7.6	7.4	7.5	6.1	7.4	6.2	7.6	6.6	7.5	6.9	7.6	6.6	6.7
Beine Ctrl	7.6	7.6	7.5	7.5	6.2	7.5	6.2	7.5	6.6	7.5	6.9	7.5	6.6	6.6
4.5	7.4	7.6	7.3	7.4	6.1	7.4	6.2	7.6	6.4	7.4	6.8	7.6	6.7	6.8
9.1	7.4	7.6	7.3	7.4	6.1	7.4	6.2	7.6	6.5	7.4	6.8	7.6	6.6	6.7
18.2	7.6	7.4	7.3	7.5	6.3	7.4	6.2	7.6	6.6	7.4	6.9	7.6	6.6	6.7
36.3	7.6	7.6	7.4	7.5	6.3	7.5	6.2	7.6	6.6	7.4	6.8	7.6	6.5	6.7
72.6	7.9	7.6	7.2	7.5	6.4	7.6	6.2	7.6	6.5	7.4	6.8	7.6	6.6	6.7
Tech. Initials	vmb	AL	AL	AL	AXE/AL	~	JL	JL	JL	~	~	JL	JL	~

WQ Instruments Used: Salinity II-A-030306 DO II-A-3 / II-A-011202  
 Comments \_\_\_\_\_

Test Set Up By vmb Data Verified By Qualifly Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (POLARS MINE)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 040303

Sample ID 6<sup>th</sup> 67-0222-07070f  
 Test Species/Batch A. AFFINIS / 6-29-04  
 Test Initiation Date/Time 10-22-04 / 17:30h  
 No. of Organisms/Volume 5 / 200 ml

Concentration (% v/v)	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Neg. Ctl.	A	T1	5	5	5	5	5	5	5	
	B	T2	5	5	5	5	5	5	5	
	C	T3	5	5	5	5	4	4	4	
	D	T4	5	5	5	5	5	5	5	
	E	T5	5	5	5	5	5	5	5	
Positive Ctl.	A	T6	5	5	5	5	5	5	5	
	B	T7	5	5	5	5	5	5	5	
	C	T8	5	5	5	5	5	5	5	
	D	T9	5	5	5	5	5	5	5	
	E	T10	5	5	5	5	5	5	5	
4.5	A	T11	5	5	5	5	5	5	5	
	B	T12	5	5	5	5	5	5	5	
	C	T13	5	5	5	5	5	5	5	
	D	T14	5	5	5	5	5	5	5	
	E	T15	5	5	5	5	5	5	5	
9.1	A	T16	5	5	5	5	5	5	5	
	B	T17	5	5	5	5	5	5	5	
	C	T18	5	5	5	5	5	5	5	
	D	T19	5	5	5	5	5	5	5	
	E	T20	5	5	5	5	5	5	5	
Technician Initials		JCS	AM	AK	JCS	JCS	JCS	JCS	M	

Sample Description LIGHT GREY TRANSPARENT, NO ODOUR.  
 Data Verified By Galpik Date Verified August 17/04



**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Powers Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303

Sample ID GT-CREEK-070704  
 Test Species/Batch A. AFFINIS / 6.04.04  
 Test Initiation Date/Time 10-30-07 / 1730h  
 No. of Organisms/Volume 5 / 200ml

Concentration (% $\text{D}_{10}$ )	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
18.2	A	T21	5	5	5	5	5	5	5	
	B	T22	5	5	5	5	5	5	5	
	C	T23	5	5	5	5	5	5	5	
	D	T24	5	5	5	5	5	5	5	
	E	T25	5	5	5	5	5	5	5	
36.3	A	T26	5	5	5	5	5	5	5	
	B	T27	5	5	5	5	5	5	5	
	C	T28	4	4	4	4	4	4	4	
	D	T29	5	5	5	5	5	5	5	
	E	T30	5	5	5	5	5	5	5	
72.6	A	T31	5	5	5	5	5	5	5	
	B	T32	5	5	5	5	5	5	5	
	C	T33	5	5	5	5	5	5	4	
	D	T34	5	5	5	5	5	5	5	
	E	T35	5	5	5	5	5	5	4	
	A									
	B									
	C									
	D									
	E									
Technician Initials		Taj	A	ML/m	J-S	JL	JL	JLS	~	

Sample Description LIGHT GREEN, TRANSPARENT, NO COLOUR.  
 Data Verified By Qualifit Date Verified August 17/07

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS - DRY WEIGHT DATA**

Client Azimuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type 7.d Survival and Growth  
 Test Species Atherinops affinis (Topsmelt)  
 Start Date (Day 0) July 10, 04  
 Sample ID G-1 Creek-070404

Sample ID % (J/J)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Ctl	A	T 1	1265.92	1271.98	5	5		↓
	B	2	1267.67	1272.69	5	5		
	C	3	1264.20	1269.67	4	4		
	D	4	1265.68	1268.14	5	5		
	E	V 5	1265.14	1269.37	5	5		
Brine Ctl	A	T 6	1275.52	1281.17	5	5		↓
	B	7	1262.43	1266.70	4	4		
	C	8	1261.98	1268.48	5	5		
	D	9	1264.82	1270.38	5	5		
	E	V 10	1262.05	1267.02	5	5	confirmed: 1270.27 mg ✓	

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galpin

Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client Azimuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type 7.d Survival and Growth  
 Test Species Atherinops affinis (Topsmelt)  
 Start Date (Day 0) July 10, 04  
 Sample ID G Creek - 070704

Sample ID % (S/D)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
4.5 ↓ ✓	A	T 11	1266.53	1271.28	5	5		JCS ↓
	B	12	1271.92	1276.64	5	5		
	C	13	1270.40	1275.21	5	5		
	D	14	1276.78	1282.46	5	5		
	E	15	1248.70	1253.83	5	5		
9.1 ↓ ✓	A	T 16	1273.13	1278.39	5	5		JCS ↓
	B	17	1259.26	1264.29	5	5		
	C	18	1270.13	1274.65	5	5		
	D	19	1258.37	1263.78	5	5		
	E	20	1256.17	1261.85	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Gaeliff

Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client Azinuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type 7.d Survival and Growth  
 Test Species Atherinops affinis (Top smelt)  
 Start Date (Day 0) July 10, 04  
 Sample ID G-Creek-070704

Sample ID % (S/D)	Rep.	Pan No.	Pan Weight (mg)	Final Weight (mg) (pan + biomass)	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
18.2 ↓ ✓	A	T 21	1257.35	1262.90	5	5		JCS ↓
	B	22	1273.94	1278.48	5	5	confirmed: 1278.26. ✓	
	C	23	1277.53	1282.20	5	5		
	D	24	1274.93	1279.50	5	5		
	E	25	1268.36	1272.94	5	5		
36.3 ↓ ✓	A	T 26	1269.83	1275.11	5	5	confirmed 1274.99 mg ✓	JCS ↓
	B	27	1269.98	1276.47	5	5		
	C	28	1276.05	1280.68	4	4		
	D	29	1249.27	1254.33	5	5		
	E	30	1265.87	1271.96	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Gaigh

Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client Azimuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type F.d Survival and Growth  
 Test Species Ammatops affinis (Topsmelt)  
 Start Date (Day 0) July 10-04  
 Sample ID G-Creat-070704

Sample ID 90 (90)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
72.6	A	T 31	1251.66	1256.44	5	5	confirmed: 1256.42 mg	JCS
↓	B	32	1263.20	1269.86	5	5		↓
	C	33	1278.57	1282.63	4	4		
	D	34	1281.29	1285.32	5	5		
	E	✓ 35	1253.46	1258.69	4	4		
	A	T 6						
	B	7						
	C	8						
	D	9						
	E	✓ 0						

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galkin

Date Verified August 17/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: 0400303

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: G-Creek-070704

Sample Type: EFF2-Industrial

Start Date: 7/10/2004

End Date: 7/17/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
1	1	1	Neg Control	5							5	5	1271.98	1265.92
2	2	2	Neg Control	5							5	5	1272.69	1267.67
3	3	3	Neg Control	5							4	4	1269.67	1265.68
4	4	4	Neg Control	5							5	5	1268.14	1264.2
5	5	5	Neg Control	5							5	5	1269.37	1265.14
6	1		Brine Control	5							5	5	1281.17	1275.52
7	2		Brine Control	5							4	4	1266.7	1262.43
8	3		Brine Control	5							5	5	1268.48	1261.98
9	4		Brine Control	5							5	5	1270.38	1264.82
10	5		Brine Control	5							5	5	1267.02	1262.05
11	1		4.500	5							5	5	1271.28	1266.53
12	2		4.500	5							5	5	1276.64	1271.92
13	3		4.500	5							5	5	1275.21	1270.46
14	4		4.500	5							5	5	1282.46	1276.78
15	5		4.500	5							5	5	1253.83	1248.7
16	1		9.100	5							5	5	1278.39	1273.13
17	2		9.100	5							5	5	1264.29	1259.26
18	3		9.100	5							5	5	1274.65	1270.13
19	4		9.100	5							5	5	1263.78	1258.37
20	5		9.100	5							5	5	1261.85	1256.17
21	1		18.200	5							5	5	1262.9	1257.35
22	2		18.200	5							5	5	1278.48	1273.94
23	3		18.200	5							5	5	1282.2	1277.53
24	4		18.200	5							5	5	1279.5	1274.93
25	5		18.200	5							5	5	1272.94	1268.36
26	1		36.300	5							5	5	1275.11	1269.83
27	2		36.300	5							5	5	1276.47	1269.98
28	3		36.300	5							4	4	1280.68	1276.05
29	4		36.300	5							5	5	1254.33	1249.27
30	5		36.300	5							5	5	1271.98	1265.87
31	1		72.600	5							5	5	1256.44	1251.66
32	2		72.600	5							5	5	1269.86	1263.2
33	3		72.600	5							4	4	1282.63	1278.57
34	4		72.600	5							5	5	1285.32	1281.29
35	5		72.600	5							4	4	1258.69	1253.46

Comments: Azimuth(Polaris Mine)09-0302-54; 0400303

**Larval Fish Growth and Survival Test-7 Day Survival**

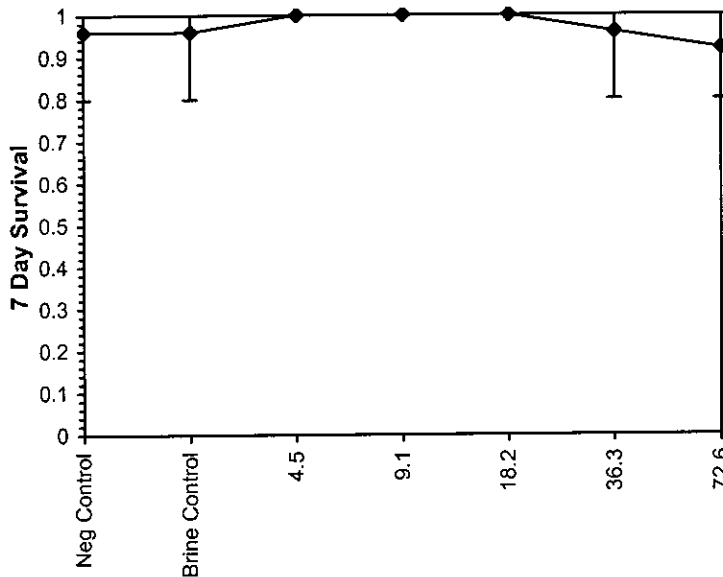
Start Date: 7/10/2004	Test ID: 400303	Sample ID: G-Creek-070704
End Date: 7/17/2004	Lab ID: BCEVS-EVS Environment Cc	Sample Type: EFF2-Industrial
Sample Date:	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: Azimuth(Polaris Mine)09-0302-54; 0400303		

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	0.8000	1.0000	1.0000
Brine Control	1.0000	0.8000	1.0000	1.0000	1.0000
4.5	1.0000	1.0000	1.0000	1.0000	1.0000
9.1	1.0000	1.0000	1.0000	1.0000	1.0000
18.2	1.0000	1.0000	1.0000	1.0000	1.0000
36.3	1.0000	1.0000	0.8000	1.0000	1.0000
72.6	1.0000	1.0000	0.8000	1.0000	0.8000

Conc-%	Mean	SD	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%	N		
Neg Control	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5		
Brine Control	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5		
4.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	30.00	16.00
9.1	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	30.00	16.00
18.2	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	30.00	16.00
36.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	27.50	16.00
72.6	0.9200	0.1095	1.2500	1.1071	1.3453	10.434	5	25.00	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.76012	0.9	-1.4778	1.97749
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	72.6	>72.6		1.37741

**Dose-Response Plot**



Statistical comparisons were against the Neg Control only

**Larval Fish Growth and Survival Test-7 Day Survival**

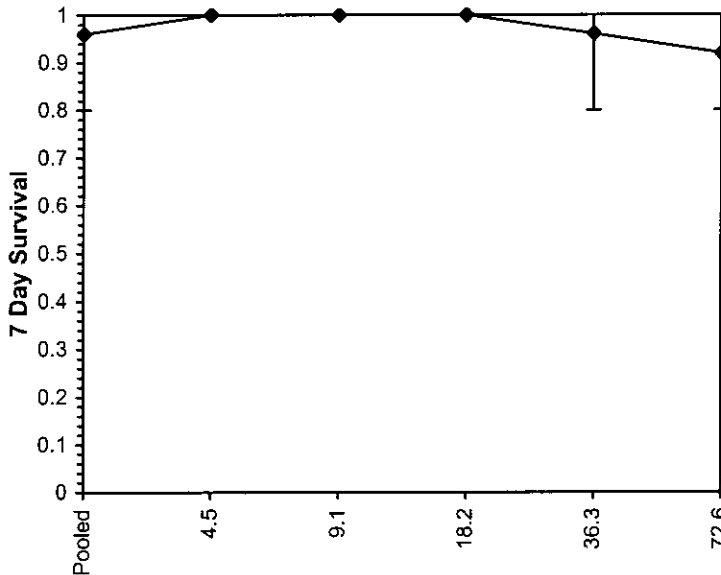
Start Date: 7/10/2004      Test ID: 400303      Sample ID: G-Creek-070704  
 End Date: 7/17/2004      Lab ID: BCEVS-EVS Environment Cc      Sample Type: EFF2-Industrial  
 Sample Date:      Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: Azimuth(Polaris Mine)09-0302-54; 0400303

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	0.8000	1.0000	1.0000
Brine Control	1.0000	0.8000	1.0000	1.0000	1.0000
4.5	1.0000	1.0000	1.0000	1.0000	1.0000
9.1	1.0000	1.0000	1.0000	1.0000	1.0000
18.2	1.0000	1.0000	1.0000	1.0000	1.0000
36.3	1.0000	1.0000	0.8000	1.0000	1.0000
72.6	1.0000	1.0000	0.8000	1.0000	0.8000

Conc-%	Mean	SD	Transform: Arcsin Square Root				N	Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%			
Pooled	0.9600	0.0843	1.2977	1.1071	1.3453	7.738	10		
4.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	45.00	21.00
9.1	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	45.00	21.00
18.2	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	45.00	21.00
36.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	40.00	21.00
72.6	0.9200	0.1095	1.2500	1.1071	1.3453	10.434	5	35.00	21.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.74527	0.91	-1.5211	1.67424
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	72.6	>72.6		1.37741

**Dose-Response Plot**



Statistical comparisons were against the Pooled Controls



**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 7/10/2004      Test ID: 400303      Sample ID: G-Creek-070704  
 End Date: 7/17/2004      Lab ID: BCEVS-EVS Environment Cc Sample Type: EFF2-Industrial  
 Sample Date:              Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: Azimuth(Polaris Mine)09-0302-54; 0400303

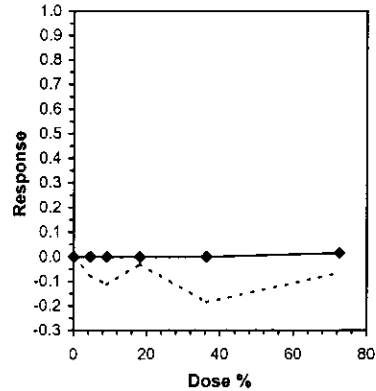
Conc-%	1	2	3	4	5
Neg Control	1.2120	1.0040	0.7980	0.7880	0.8460
Brine Control	1.1300	0.8540	1.3000	1.1120	0.9940
4.5	0.9500	0.9440	0.9500	1.1360	1.0260
9.1	1.0520	1.0060	0.9040	1.0820	1.1360
18.2	1.1100	0.9080	0.9340	0.9140	0.9160
36.3	1.0560	1.2980	0.9260	1.0120	1.2220
72.6	0.9560	1.3320	0.8120	0.8060	1.0460

Conc-%	Transform: Untransformed						N	t-Stat	1-Tailed Critical	MSD	Isotonic	
	Mean	SD	Mean	Min	Max	CV%					Mean	N-Mean
Neg Control	0.9296	0.1800	0.9296	0.7880	1.2120	19.366	5				1.0052	1.0000
Brine Control	1.0780	0.1661	1.0780	0.8540	1.3000	15.410	5					
4.5	1.0012	0.0826	1.0012	0.9440	1.1360	8.252	5	-0.786	2.360	0.2151	1.0052	1.0000
9.1	1.0360	0.0876	1.0360	0.9040	1.1360	8.456	5	-1.168	2.360	0.2151	1.0052	1.0000
18.2	0.9564	0.0864	0.9564	0.9080	1.1100	9.035	5	-0.294	2.360	0.2151	1.0052	1.0000
36.3	1.1028	0.1533	1.1028	0.9260	1.2980	13.901	5	-1.901	2.360	0.2151	1.0052	1.0000
72.6	0.9904	0.2161	0.9904	0.8060	1.3320	21.819	5	-0.667	2.360	0.2151	0.9904	0.9853

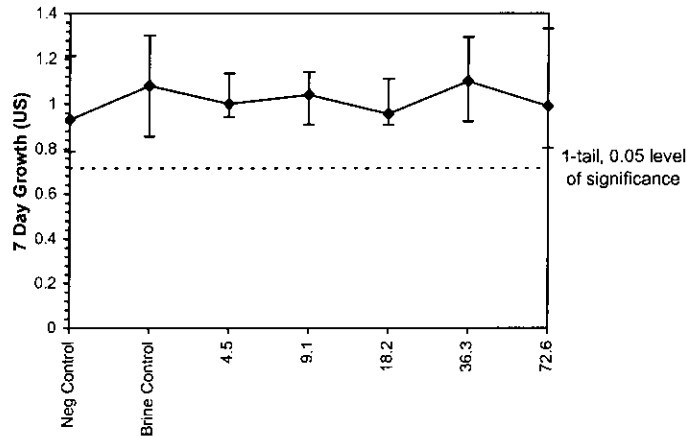
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93465	0.9	0.85573	0.53805
Bartlett's Test indicates equal variances (p = 0.27)	6.38263	15.0863		
The control means are not significantly different (p = 0.21)	1.35465	2.30601		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	72.6	>72.6		1.37741	0.21507	0.23136	0.01877	0.02076	0.49467	5, 24

Linear Interpolation (200 Resamples)				
Point	%	SD	95% CL(Exp)	Skew
IC05	>72.6			
IC10	>72.6			
IC15	>72.6			
IC20	>72.6			
IC25	>72.6			
IC40	>72.6			
IC50	>72.6			



Dose-Response Plot



Statistical comparisons were against the Neg Control only

*Qualifit*  
August 18/04

**Larval Fish Growth and Survival Test-7 Day Growth (US)**

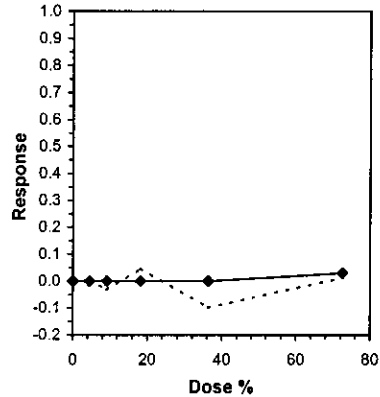
Start Date: 7/10/2004      Test ID: 400303      Sample ID: G-Creek-070704  
 End Date: 7/17/2004      Lab ID: BCEVS-EVS Environment Ct Sample Type: EFF2-Industrial  
 Sample Date:      Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: Azimuth(Polaris Mine)09-0302-54; 0400303

Conc-%	1	2	3	4	5
Neg Control	1.2120	1.0040	0.7980	0.7880	0.8460
Brine Control	1.1300	0.8540	1.3000	1.1120	0.9940
4.5	0.9500	0.9440	0.9500	1.1360	1.0260
9.1	1.0520	1.0060	0.9040	1.0820	1.1360
18.2	1.1100	0.9080	0.9340	0.9140	0.9160
36.3	1.0560	1.2980	0.9260	1.0120	1.2220
72.6	0.9560	1.3320	0.8120	0.8060	1.0460

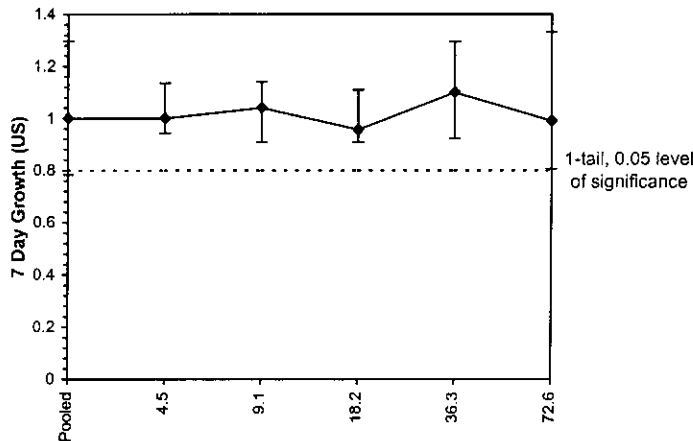
Conc-%	Mean	SD	Transform: Untransformed				N	1-Tailed			Isotonic	
			Mean	Min	Max	CV%		t-Stat	Critical	MSD	Mean	N-Mean
Pooled	1.0038	0.1811	1.0038	0.7880	1.3000	18.038	10				1.0200	1.0000
4.5	1.0012	0.0826	1.0012	0.9440	1.1360	8.252	5	0.031	2.462	0.2040	1.0200	1.0000
9.1	1.0360	0.0876	1.0360	0.9040	1.1360	8.456	5	-0.389	2.462	0.2040	1.0200	1.0000
18.2	0.9564	0.0864	0.9564	0.9080	1.1100	9.035	5	0.572	2.462	0.2040	1.0200	1.0000
36.3	1.1028	0.1533	1.1028	0.9260	1.2980	13.901	5	-1.195	2.462	0.2040	1.0200	1.0000
72.6	0.9904	0.2161	0.9904	0.8060	1.3320	21.819	5	0.162	2.462	0.2040	0.9904	0.9709

Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95473	0.91	0.53946	-0.0716						
Bartlett's Test indicates equal variances (p = 0.23)	6.8891	15.0863								
The control means are not significantly different (p = 0.21)	1.35465	2.30601								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	72.6	>72.6		1.37741	0.20401	0.20324	0.01261	0.02289	0.73615	5, 29

Point	%	SD	Linear Interpolation (200 Resamples)		
			95% CL(Exp)	Skew	
IC05	>72.6				
IC10	>72.6				
IC15	>72.6				
IC20	>72.6				
IC25	>72.6				
IC40	>72.6				
IC50	>72.6				(v/v)



Dose-Response Plot



Statistical comparisons were against the Pooled controls

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client AZIMUTH (POLARIS MINE)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303

EVS Analysts KMLG, AKN, AWD, AVF, JXS  
 Test Initiation Date 10-JUN-04

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	<u>Cu REFLEX (04-Cu-001)</u>	-	-
Amount <del>Received</del> <sup>PREPARED</sup>	<u>1 x 1L</u>	-	-
Date <del>Collected</del> <sup>PREPARED</sup>	<u>15-MAR-04</u>	-	-
Date Received	-	-	-
Temperature (°C)	-	-	-
pH	-	-	-
DO (mg/L)	-	-	-
Conductivity (µmhos/cm)	-	-	-
Salinity (ppt)	-	-	-
Ammonia (mg/L N)	-	-	-
Chlorine (mg/L Cl)	-	-	-
Other	-	-	-

**DILUTION/CONTROL WATER** (initial water quality)  
 Water Type UNSTERILIZED FILTERED SEA H<sub>2</sub>O  
 Temperature (°C) 20.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 7.6  
 Salinity 28

**TEST SPECIES INFORMATION**  
 Source AQUATIC BIO SYSTEMS (ABS)  
 Date Received 08-JUL-04  
 Age (on Day 0) 11d  
 Reference Toxicant Cu  
 Current Reference Toxicant Result (incl. 95% CL)

**TEST CONDITIONS**  
 Temperature Range (°C) 19.5 - 20.5  
 pH Range 7.8 - 8.0  
 Dissolved Oxygen Range (mg/L) 6.4 - 7.6  
 Salinity (ppt) 23 - 30  
 Photoperiod (L:D h) 16:8  
 Aeration Provided? NO  
 Other -

Reference Toxicant Test Date 15-JUL-04  
 7-d survival LC50 143 µg/L Cu (95-248)<sup>161</sup> (139-133)  
 7-d growth IC50 147 µg/L Cu (119-169)  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
 7-d survival LC50 137 µg/L Cu ± 28<sup>30</sup> (CV=21%)  
 7-d growth IC50 135 µg/L Cu ± 26<sup>31</sup> (CV=19%)

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	<u>µg/L Cu</u>	<u>100</u>	<u>180</u>	<u>161 (139-133)</u>		
Growth		<u>100</u>	<u>180</u>		<u>147 (119-169)</u>	<u>101 (63-133)</u>
Other						

Data Verified By Opal K Date Verified August 17/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimutti (Polaris Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303

Sample ID Cu Restox  
 Test Initiation Date/Time 10-Jul-04 / 1715h  
 Source/Date Received ABS / 08-Jul-04

Concentration (µg/L Cu)	Temperature (°C)													
	0	1	New <sup>2</sup> old	New <sup>3</sup> old	New <sup>4</sup> old	5	6	7						
CTL	20.0	20.0	20.0	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
32	20.0	20.0	19.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
56	20.0	20.0	19.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
100	20.0	20.0	19.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
180	20.0	20.0	19.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
320	20.0	20.0	19.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0	20.5	20.0	20.0	20.0
Tech. Initials	AKW	AKW	A	A	A	A	A	A	A	A	A	A	A	A

Concentration (µg/L Cu)	pH													
	0	1	New <sup>2</sup> old	New <sup>3</sup> old	New <sup>4</sup>	5	6	7						
CTL	8.0	8.0	7.9	7.9	7.8	7.9	7.8	7.9	7.9	7.9	8.0	7.9	8.0	7.9
32	8.0	8.0	7.9	7.9	7.8	7.9	7.8	7.9	7.9	7.9	8.0	7.9	8.0	7.9
56	8.0	8.0	7.8	7.9	7.8	7.9	7.9	7.9	7.9	7.9	8.0	7.9	8.0	7.9
100	8.0	8.0	7.8	7.9	7.8	7.9	7.9	7.9	7.9	7.9	8.0	7.9	8.0	7.9
180	8.0	8.0	7.8	7.9	7.8	7.9	7.9	7.9	7.9	7.9	8.0	7.9	8.0	7.9
320	8.0	8.0	7.8	7.9	7.8	7.9	7.9	7.9	7.9	7.9	8.0	7.9	8.0	7.9
Tech. Initials	AKW	AKW	A	A	AKW	A	A	A	A	A	A	A	A	A

WQ Instruments Used: Temp. Cal. Hg THERM. pH I-A-030301  
 Comments \_\_\_\_\_

Test Set Up By AKW Data Verified By Qualifit Date Verified August 17/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client AZIMUTH (POLARIS MINE)

Sample ID Cu REFLEX

EVS Project No. 09-0302-54

Test Initiation Date/Time 10-Jul-04 / 1715h

EVS Work Order No. 0400303

Source/Date Received ABS / 08-Jul-04

Concentration (µg/L Cu)	Salinity (ppt)							
	0	1	2	3	4	5	6	7
CTL	28	30	28	28	28	28	28	29
32	28	30	28	28	28	28	28	29
56	28	30	28	28	28	28	28	29
100	28	30	28	28	28	28	28	29
180	28	30	28	28	28	28	28	29
320	28	30	28	28	28	28	28	29
Tech. Initials	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>

Concentration (µg/L Cu)	Dissolved Oxygen (mg/L)												
	0	1	2	3	4	5	6	7					
CTL	7.6	7.6	7.5	7.5	7.4	6.4	7.6	6.6	7.5	7.0	7.6	6.6	7.0
32	7.6	7.6	7.5	7.5	6.4	7.4	6.6	7.6	6.6	7.5	7.0	7.6	6.7
56	7.6	7.6	7.4	7.5	6.7	7.4	6.5	7.6	6.6	7.5	7.0	7.6	6.9
100	7.6	7.6	7.4	7.5	6.6	7.4	6.6	7.6	6.6	7.5	7.0	7.6	6.9
180	7.6	7.6	7.4	7.5	6.8	7.4	6.4	7.6	6.6	7.5	7.0	7.6	6.7
320	7.6	7.6	7.0	7.5	6.9	7.4	6.7	7.6	6.6	7.5	6.9	7.6	6.6
Tech. Initials	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>	<u>AW</u>

WQ Instruments Used: Salinity II-A-030306

DO II-A-3 / II-A-011202

Comments \_\_\_\_\_

Test Set Up By AW Data Verified By Qualifit Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST - DAILY SURVIVAL DATA**

Client Azimut (Peters Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303

Sample ID Cu LEFTX  
 Test Species/Batch A. AFFINIS / 6.29.04  
 Test Initiation Date/Time 10-JUL-04 / 175h  
 No. of Organisms/Volume 5 / 200 ml

Concentration (µg/L Cu)	Rep.	Pan No.	Number of Survivors - Day of Test							Comments
			1	2	3	4	5	6	7	
0	A	T36	5	5	5	5	5	5	5	
	B	T37	5	5	5	5	5	5	5	
	C	T38	5	5	5	5	5	5	5	
	D	T39	5	5	5	5	5	5	5	
	E	T40	5	5	5	5	5	4	4	
32	A	T41	5	5	5	5	5	5	5	
	B	T42	5	5	5	5	5	5	5	
	C	T43	5	5	5	5	5	5	5	
	D	T44	5	5	5	5	5	5	5	
	E	T45	5	5	5	5	5	5	5	
56	A	T46	5	5	5	5	5	5	5	
	B	T47	5	5	5	5	5	5	5	
	C	T48	5	5	5	5	5	5	5	
	D	T49	5	5	5	5	5	5	5	
	E	T50	5	5	5	5	5	5	5	
100	A	T51	5	5	5	4	4	3	3	
	B	T52	5	5	5	5	5	5	5	
	C	T53	5	5	5	5	5	5	5	
	D	T54	5	5	4	4	4	3	3	
	E	T55	5	5	5	5	5	5	5	
Technician Initials		JCS	AW			JCS	JCS	JCS	~	

Sample Description CLEAR, COLOURLESS, OPAQUESS.  
 Data Verified By Qualifit Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimoth (Polaris Mine)  
 EVS Project No. C9-0302-54  
 EVS Work Order No. 0400303

Sample ID Cu Deftox  
 Test Species/Batch A. AFFINIS / 6.29.04  
 Test Initiation Date/Time 10-Jul-04 / 1715h  
 No. of Organisms/Volume 5 / 200ml

Concentration (ppm Cu)	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
180	A	T56	5	5	4	4	3	3	3	
	B	T57	5	3	1	1	1	1	1	
	C	T58	5	4	2	2	2	2	2	
	D	T59	5	3	2	1	1	1	1	
	E	T60	4	3	3	2	2	2	2	
320	A	T61	1	0						
	B	T62	3	3	3	2	2	2	2	
	C	T63	2	2	1	0				
	D	T64	1	1	0					
	E	T65	3	3	1	0				
	A									
	B									
	C									
	D									
	E									
	A									
	B									
	C									
	D									
	E									
Technician Initials		TJS	AW	ADD	N	TJS	TJS	TJS	N	

Sample Description clear, colorless, odorless  
 Data Verified By Qualifly Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client Azimuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type 7.d Survival and Growth  
 Test Species Aetideus affinis (Topsmelt)  
 Start Date (Day 0) July 10-04  
 Sample ID Cu Ref tot

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
320 ↓	A	T61	1255.61	—	0	0		723
	B	62	1256.09	1257.79	2	2		↓
	C	63	1268.85	—	0	0		↓
	D	64	1252.87	—	0	0		↓
	E	65	1270.02	—	0	0		↓
180 ↓	A	T56	1252.98	1255.06	3	3		723
	B	57	1247.43	1248.02	1	1		↓
	C	58	1270.37	1272.49	2	2	confirmed 1272.56 mg ✓	↓
	D	59	1280.94	1281.59	1	1		↓
	E	60	1280.02	1282.95	2	2		↓

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galpin

Date Verified August 17/04



**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client Azimuth (Polaris Mines)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400303  
 Balance Type/Serial Number Sartorius BP2111

Test Type 7.d Survival and Growth  
 Test Species Acheilops affinis (Topsmelt)  
 Start Date (Day 0) July 10, 04  
 Sample ID Cu Reflot

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
49/L Cu 100	A	T51	1272.54	1275.53	3	3		JCS
	B	52	1242.48	1247.54	5	5		
	C	53	1265.30	1269.67	5	5		
	D	54	1240.38	1243.48	4	4		
	E	55	1264.67	1269.25	5	5		
56	A	T46	1286.39	1291.02	5	5	confirmation 1287095 mg ✓	JCS
	B	47	1271.46	1276.05	5	5		
	C	48	1238.91	1243.78	5	5		
	D	49	1262.66	1267.58	5	5		
	E	50	1256.18	1261.80	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Qualifit

Date Verified August 17/04

**EVS ENVIRONMENT CONSULTANTS  
LARVAL FISH TOXICITY TESTS – DRY WEIGHT DATA**

Client                     Azimuth (Polaris Mireo)                      
 EVS Project No.                     09-0302-54                      
 EVS Work Order No.                     0400303                      
 Balance Type/Serial Number                     Sartorius BP211D                    

Test Type                     7.d Survival and Growth                      
 Test Species                     Atherinops affinis (Topsmelt)                      
 Start Date (Day 0)                     July 10-04                      
 Sample ID                     Ls Reflot                    

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
49/4 Ca 32	A	T41	1280.70	1283.71	5	5		JCS
↓	B	42	1256.85	1261.03	5	5		↓
	C	43	1272.55	1276.95	5	5		
	D	44	1278.22	1284.04	5	5		
	E	45	1273.94	1280.06	5	5		
ctl	A	T36	1272.84	1277.49	5	5		JCS
↓	B	37	1275.33	1280.65	5	5	confirmed: 1230.57 mg ✓	↓
	C	38	1269.27	1274.85	5	5		
	D	39	1236.88	1241.99	5	5		
	E	40	1264.45	1269.15	4	4		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By                     Gal JCS                    

Date Verified                     August 17/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: RTAACu36

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: REF-Ref Toxicant

Sample Type: CU-Copper

Start Date: 7/10/2004

End Date: 7/17/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	D-Control	5							5	5	1277.49	1272.84
	2	2	D-Control	5							5	5	1280.65	1275.33
	3	3	D-Control	5							5	5	1274.85	1269.27
	4	4	D-Control	5							5	5	1241.99	1236.88
	5	5	D-Control	5							4	4	1269.15	1264.45
	6	1	32.000	5							5	5	1283.71	1280.7
	7	2	32.000	5							5	5	1261.03	1256.85
	8	3	32.000	5							5	5	1276.95	1272.95
	9	4	32.000	5							5	5	1284.04	1278.22
	10	5	32.000	5							5	5	1280.06	1273.94
	11	1	56.000	5							5	5	1291.02	1286.39
	12	2	56.000	5							5	5	1276.05	1271.46
	13	3	56.000	5							5	5	1243.78	1238.91
	14	4	56.000	5							5	5	1267.58	1262.66
	15	5	56.000	5							5	5	1261.8	1256.18
	16	1	100.000	5							3	3	1275.53	1272.54
	17	2	100.000	5							5	5	1247.54	1242.48
	18	3	100.000	5							5	5	1269.68	1265.3
	19	4	100.000	5							4	4	1243.48	1240.38
	20	5	100.000	5							5	5	1269.25	1264.67
	21	1	180.000	5							3	3	1255.06	1252.98
	22	2	180.000	5							1	1	1248.02	1247.43
	23	3	180.000	5							2	2	1272.49	1270.37
	24	4	180.000	5							1	1	1281.59	1280.94
	25	5	180.000	5							2	2	1282.05	1280.02
	26	1	320.000	5							0	0	0	1255.61
	27	2	320.000	5							2	2	1257.79	1256.09
	28	3	320.000	5							0	0	0	1268.85
	29	4	320.000	5							0	0	0	1252.87
	30	5	320.000	5							0	0	0	1270.02

Comments: 09-0302-54, 0400303

**Larval Fish Growth and Survival Test-7 Day Survival**

Start Date: 7/10/2004	Test ID: RTAACu36	Sample ID: REF-Ref Toxicant
End Date: 7/17/2004	Lab ID: BCEVS-EVS Environment Ct	Sample Type: CU-Copper
Sample Date:	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: 09-0302-54, 0400303		

Conc-ug/L	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	0.8000
32	1.0000	1.0000	1.0000	1.0000	1.0000
56	1.0000	1.0000	1.0000	1.0000	1.0000
100	0.6000	1.0000	1.0000	0.8000	1.0000
180	0.6000	0.2000	0.4000	0.2000	0.4000
320	0.0000	0.4000	0.0000	0.0000	0.0000

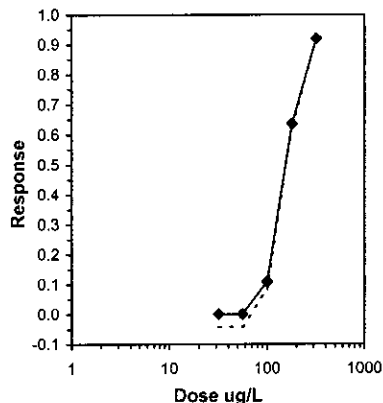
Conc-ug/L	Mean	SD	Transform: Arcsin Square Root				N	Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%					
D-Control	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5			1	25
32	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	30.00	16.00	0	25
56	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	30.00	16.00	0	25
100	0.8800	0.1789	1.2058	0.8861	1.3453	17.113	5	24.50	16.00	3	25
*180	0.3600	0.1673	0.6366	0.4636	0.8861	27.958	5	15.00	16.00	16	25
*320	0.0800	0.1789	0.3174	0.2255	0.6847	64.711	5	15.00	16.00	23	25

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93876	0.9	0.31435	1.7423

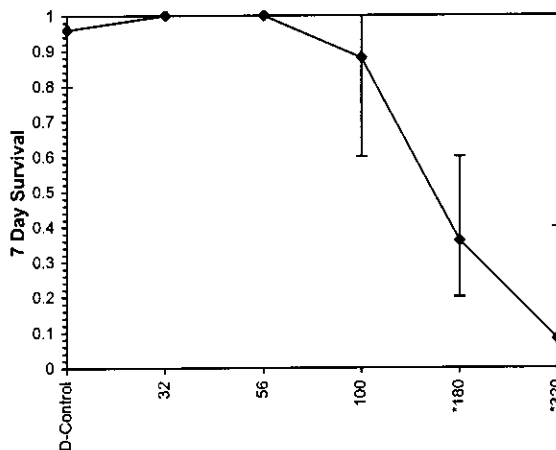
Equality of variance cannot be confirmed

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	180	134.164	

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%	161.11	138.26	187.73
20.0%	158.05	132.14	189.04
Auto-8.1%	161.46	138.66	188.00 ug/L Cu



Dose-Response Plot



**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 7/10/2004	Test ID: RTAACu36	Sample ID: REF-Ref Toxicant
End Date: 7/17/2004	Lab ID: BCEVS-EVS Environment Cr	Sample Type: CU-Copper
Sample Date:	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: 09-0302-54, 0400303		

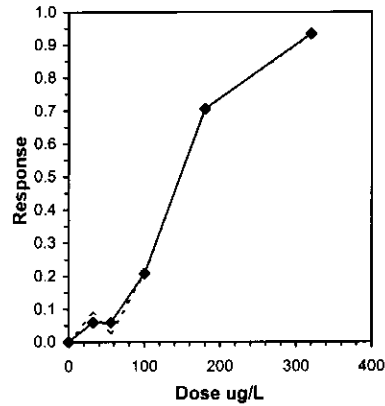
Conc-ug/L	1	2	3	4	5
D-Control	0.9300	1.0640	1.1160	1.0220	0.9400*
32	0.6020	0.8360	0.8000	1.1640	1.2240
56	0.9260	0.9180	0.9740	0.9840	1.1240
100	0.5980	1.0120	0.8760	0.6200	0.9160
180	0.4160	0.1180	0.4240	0.1300	0.4060
320	0.0000	0.3400	0.0000	0.0000	0.0000

Conc-ug/L	Mean	SD	Transform: Untransformed					N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	Mean					N-Mean	
D-Control	1.0144	0.0798	1.0144	0.9300	1.1160	7.871	5				1.0144	1.0000	
32	0.9252	0.2619	0.9252	0.6020	1.2240	28.309	5	0.851	2.360	0.2474	0.9552	0.9416	
56	0.9852	0.0828	0.9852	0.9180	1.1240	8.403	5	0.279	2.360	0.2474	0.9552	0.9416	
100	0.8044	0.1853	0.8044	0.5980	1.0120	23.031	5	2.004	2.360	0.2474	0.8044	0.7930	
*180	0.2988	0.1598	0.2988	0.1180	0.4240	53.465	5	6.827	2.360	0.2474	0.2988	0.2946	
*320	0.0680	0.1521	0.0680	0.0000	0.3400	223.607	5	9.029	2.360	0.2474	0.0680	0.0670	

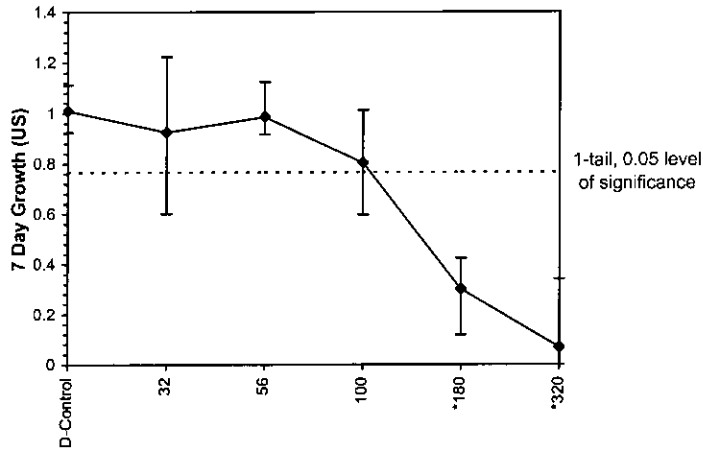
Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97039	0.9	0.15928	-0.3767						
Bartlett's Test indicates equal variances (p = 0.21)	7.13123	15.0863								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	100	180	134.164		0.24736	0.24385	0.80038	0.02746	1.9E-09	5, 24

Linear Interpolation (200 Resamples)					
Point	ug/L	SD	95% CI(Exp)		Skew
IC05*	27.42	22.74	0.00	93.30	0.4541
IC10	68.32	24.38	0.00	122.43	-0.2058
IC15	83.12	21.17	0.00	125.48	-0.8306
IC20	97.92	15.93	48.64	127.61	-0.9650
IC25	106.90	12.35	63.02	133.27	-0.3411
IC40	130.97	9.49	95.73	153.51	-0.4555
IC50	147.03	8.36	119.23	169.15	-0.1133

\* indicates IC estimate less than the lowest concentration



Dose-Response Plot



## **APPENDIX B**

---

### Chain-of-Custody Form

# AZIMUTH (POLARIS)

## CHAIN-OF-CUSTODY/TEST REQUEST FORM



195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4

Tel: (604) 986-4331  
Fax: (604) 662-8548  
www.evsenvironment.com

Client Name: Tech Comenco Client Contact: Bruce Donald Ship to: \_\_\_\_\_  
Address: Bag 2000 Phone: 250 427-8405  
Knutberley, BC Fax: 250 427-8451  
VIA 3EP Sampled by: Dennis Lu Attn: \_\_\_\_\_

Shipping Date: \_\_\_\_\_

1 Collection Date (DD/MM/YYYY)	1 Time (24-h clock)	Sample Identification	2				3 Sample Container Type by Code	Test(s) Requested				4 Sample Notes (e.g. preserved, saltwater, freshwater, may contain sewage)
			Type of Each Sample	Material Safety Data Sheet Attached? (V)	Sample Collection Method G = grab; C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)		48h LC50 Rainbow Trout	Toxicity / Fishes	D. magna	48h LC50	
<del>07/jul/2004</del>	<del>22:00</del>	<del>G-Creek - site - 070704</del>										
07/jul/2004	22:00	G-Creek - site - 070704	E		G	2x20L	X		X			
07/jul/2004	22:00	G-Creek - site - 070704	E		G	3x20L		X				

PO/Reference No.: \_\_\_\_\_ Comments/Instructions: \_\_\_\_\_  
Project Title: \_\_\_\_\_  
Results Needed By: \_\_\_\_\_

1) Released by: _____ Date: _____ Company: _____ Time: _____ Courier name: _____	2) Released by: _____ Date: _____ Company: _____ Time: _____ Courier name: _____	<b>Shaded area to be completed by EVS Laboratory upon sample receipt.</b> EVS Project No. <u>09-0302-54</u> EVS Work Order (WO) No. <u>0400302/303/304/307</u> Condition Upon Receipt <u>GOOD</u> <u>EOH TOXIN. RBT DAPH.</u> Receipt Sample Temp. (C) <u>11.6°</u>
1) Received: <u>JGK</u> Date: <u>10 JUL 04</u> Company: <u>EVS</u> Time: <u>1425</u>	2) Received by: _____ Date: _____ Company: _____ Time: _____	

1 For composite effluent or water samples, the sample collection date/time is the **end** of the compositing period.  
 2 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)  
 3 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Other (Please Specify)  
 4 Please note any conditions the lab should be aware of for safety and storage concerns

Distribution of copies: White, yellow - accompany the shipment  
 Pink - kept by signor (e.g., shipper)  
 Yellow - kept by consignee (e.g., receiver)  
 White - returned to signor by consignee

September 2004

LABORATORY REPORT

**Azimuth Consulting Group**  
POLARIS MINE  
ENVIRONMENTAL EFFECTS  
MONITORING PROGRAM  
July 30, 2004

**PREPARED FOR:**

**PREPARED BY:**

---

**Azimuth Consulting Group**  
*Vancouver, BC*

 **EVS** environment  
consultants  
A Member of the Golder Group of Companies  
*North Vancouver, BC*



**AZIMUTH CONSULTING GROUP**

---

**POLARIS MINE  
ENVIRONMENTAL EFFECTS  
MONITORING PROGRAM**

**July 30, 2004**

**LABORATORY REPORT**

---

**Prepared for**

**Azimuth Consulting Group**  
218-2902 W. Broadway  
Vancouver, BC  
V6K 2G8

---

**Prepared by**

**EVS Environment Consultants - A Member of the  
Golder Group of Companies**  
195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4

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**EVS Project No.**

09-0302-54

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**September 2004**

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## ACKNOWLEDGEMENTS

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The *A. affinis* toxicity test was conducted by Andy Diewald, Ann-Marie Norris and Jenny Shao. Kathryn Sentance and Armando Tang performed the *D. excentricus* fertilization toxicity test. Statistical analyses were performed by Jenny Shao and Kathryn Sentance. The report was written by Kathryn Sentance and reviewed by Edmund Canaria. Quality Assurance/Quality Control (QA/QC) review on the *D. excentricus* test was conducted by Julianna Kalokai and Armando Tang reviewed the *A. affinis* toxicity test.

## 1. INTRODUCTION

---

EVS Environment Consultants conducted sublethal Metal Mining Effluent Regulations (MMER) toxicity testing for Azimuth Consulting Group as part of the Environmental Effects Monitoring (EEM) program for Polaris Mine.

A sample, identified as G Creek, was collected from the Polaris Mine Site on July 27, 2004 in 20-L collapsible polyethylene containers. It was received at the EVS laboratory on July 30, 2004 and was stored in the dark at 4°C prior to test initiation. The sample was evaluated for toxicity using the 7-d topsmelt (*Atherinops affinis*) survival and growth toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. Toxicity testing was initiated on the day of initial sample receipt.

This report describes the methods and results of the 7-d topsmelt (*Atherinops affinis*) toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. The raw data and statistical analyses are provided in Appendix A and B respectively, and the chain-of-custody form is provided in Appendix C.

## 2. METHODS

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### 2.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

A static-renewal 7-d toxicity test and reference toxicant test using topsmelt (*A. affinis*) was conducted in accordance with EVS Environment Consultants Standard Operating Procedures (SOP) 1100-4 (EVS, 2002) with modifications based on U.S. Environmental Protection Agency (USEPA, 1995). Test conditions and methods are summarized in Table 1.

This 7-day test exposes topsmelt larvae to different concentrations of a given sample. Fish are fed on a daily basis and both survival and growth endpoints are measured at test termination. These observations are assessed in comparison to the pooled negative and brine controls.

### 2.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The echinoderm (*Dendraster excentricus*) fertilization toxicity test was conducted in accordance with Environment Canada (1992 with 1997 amendments). Test conditions and methods summarized in Table 2.

This fertilization test involves exposing echinoderm sperm to a series of test concentrations for ten minutes, echinoderm eggs are then added allowing fertilization to occur for ten minutes. Following the ten minutes exposure time the eggs are preserved and the number of fertilized and unfertilized eggs in each replicate are counted. These observations are assessed in comparison to the pooled negative and brine controls.

### 2.3 STATISTICAL ANALYSIS

Statistical analyses for all tests were conducted using the computer software program TOXCALC (version 5.0.23; Tidepool Scientific Software, 1994).

### 2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This study followed a comprehensive QA/QC Program to ensure full documentation and minimize possible errors in computation and reporting of results. The following general

QA/QC guidelines were applied in this test: use of negative controls, use of positive controls, use of brine controls, replication, instrument calibration, water quality maintenance and record-keeping, and use of standard operating procedures (SOPs). To ensure the highest quality of data and reporting, all data and statistical analyses were reviewed by a member of our QA/QC Committee prior to reporting the results.

**Table 1.** 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static-renewal
Test duration	7 d
Test chamber	600-mL beaker
Test solution volume	200 mL
Number of replicate chambers per treatment	5
Number of organisms per test chamber	5
Age of test organisms at test initiation	10d
Food	Newly hatched <i>Artemia</i> nauplii (<24 hours old)
Feeding Regime	Fed 0.5 mL/ beaker twice daily of concentrated nauplii suspension (prepared to provide 200 nauplii in 0.5 mL); no feeding at test termination
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity-adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.3, 8.6, 17.3, 34.5, 69.0% (v/v)
Renewal of dilutions	Daily
Aeration	None
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and salinity daily
Temperature	20 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Overhead full-spectrum fluorescent lights; 538 – 1076 lux; 16:8 light:dark photoperiod
Reference toxicant	Initiated concurrently with sample using copper to generate LC50 and IC50 values; results compared to lab mean ± 2 SD
Endpoints	Survival and growth (dry weight)
Test validity	≥ 80% mean control survival; ≥ 0.85 mg/fish mean dry weight for surviving control fish
Reference protocol	US EPA (1995), EPA/600/R-95/136



**Table 2.** Echinoderm (*Dendraster excentricus*) fertilization toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static
Test duration	10:10 min
Test chamber	16 X 125 mm test tubes
Test solution volume	10 mL
Number of replicate chambers per treatment	4
Number of eggs per test chamber	2000
Age of test organisms	< 4 hours after spawning
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.6, 9.1, 18.3, 36.6, 73.1% (v/v)
Renewal of dilutions	None
Aeration	None during testing
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and conductivity daily; hardness and alkalinity at test initiation
Temperature	15 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Ambient laboratory illumination (moderate intensity)
Reference toxicant	Initiated concurrently with test; same test methods as above using SDS to generate an EC50 value; results compared to lab mean ± 2 SD
Endpoint	Fertilization of eggs
Test validity	≥ 50% and ≤ 100% mean control fertilization
Reference protocols	Environment Canada (1992), (EPS/1/RM/27 with 1997 amendments)

## 3. RESULTS

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### 3.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

The test results are summarized in Table 1 and the raw statistical analyses are provided in Appendix A.

The highest concentration tested was 69.0% due to salinity adjustment. The mean survival in both the negative and brine controls was 100%. The negative and brine controls were not significantly different for the growth and survival endpoints ( $p = 1.00$  and  $p = 0.93$ , respectively).

The *A. affinis* survival and growth toxicity test showed no adverse effects on survival in all tested concentrations relative to the pooled controls ( $p \leq 0.05$ ). Adverse effects for growth were observed in the 17.3 and 69.0% (v/v) concentrations. For the survival and growth endpoints the NOEC was 69.0 and 8.6, and the LOEC was  $>69.0$  and 17.3% (v/v), respectively. The LC50 for survival was  $>69.0\%$  (v/v). The IC50 and IC25 for growth were both  $>69.0\%$  (v/v).

### 3.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The test results are summarized in Table 2 and the raw statistical analyses are provided in Appendix B.

The highest concentration tested was 73.1% due to salinity adjustment. Mean fertilization in the pooled controls was 59.9%. The negative and brine controls were not significantly different ( $p = 0.72$ ).

The *D. excentricus* fertilization toxicity test exhibited adverse effects on egg fertilization in all except the lowest (4.6%(v/v)) test concentrations relative to the pooled controls ( $p \leq 0.05$ ). The NOEC was 4.6 and LOEC was 9.1 %(v/v). The IC50 and IC25 (95% confidence limits) values were 37.3 (24.4 – 46.0) and 8.7 (7.6 – 9.9) %(v/v), respectively.

### 3.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The tests met all passing criteria for test validity as outlined in the respective protocols. Water quality parameters during the test were all within the acceptable range of values. Point

estimates for the reference toxicant tests were all within the laboratory mean  $\pm$  2 standard deviations, indicating that the tests were within acceptable limits of variability.

**Table 3.** Summary of results for the 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test

<b>TEST CONCENTRATION (% V/V)</b>	<b>SURVIVAL (%) (MEAN ± SD)</b>	<b>GROWTH (DRY WEIGHT MG) (MEAN ± SD)</b>
D-Control	100.0 ± 0.0	0.98 ± 0.09
Brine Control	100.0 ± 0.0	0.99 ± 0.14
Pooled Controls	100.0 ± 0.0	0.98 ± 0.11
4.3	96.0 ± 8.9	0.91 ± 0.15
8.6	96.0 ± 8.9	0.87 ± 0.14
17.3	100.0 ± 0.0	0.78 ± 0.14*
34.5	100.0 ± 0.0	0.90 ± 0.03
69.0	96.0 ± 8.9	0.77 ± 0.19*

<b>TEST ENDPOINT</b>	<b>SURVIVAL (% V/V)</b>	<b>GROWTH (% V/V)</b>
NOEC	69.0	8.6
LOEC	>69.0	17.3
LC50	>69.0	na
IC50	na	>69.0
IC25	na	>69.0

\*Indicates significant difference ( $p \leq 0.05$ ) relative to the pooled controls.  
SD – Standard Deviation; na – not applicable.

**Table 4.** Summary of results for the Echinoderm (*Dendraster excentricus*) fertilization toxicity test

<b>TEST CONCENTRATION (% v/v)</b>	<b>PROPORTION FERTILIZED (%) (MEAN ± SD)</b>
Negative Control	60.0 ± 4.1
Brine Control	60.0 ± 2.1
Pooled Control	60.0 ± 3.0
4.6	60.0 ± 4.3
9.1	43.8 ± 2.1*
18.3	37.0 ± 1.4*
36.6	30.2 ± 3.8*
73.1	20.0 ± 0.8*

<b>TEST ENDPOINT</b>	<b>PROPORTION FERTILIZED % (v/v)</b>
NOEC	4.6
LOEC	9.1
IC50 (95% CL)	37.3 (24.4 – 46.0)
IC25 (95% CL)	8.7 (7.6 – 9.9)

\*Indicates significant difference ( $p \leq 0.05$ ) relative to the pooled controls.  
SD – Standard Deviation; CL – Confidence Limits.

## 4. REFERENCES

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- Environment Canada. 1992. Biological test method: fertilization of echinoids (sea urchins and sand dollars). Environmental Protection Series, Report EPS 1/RM/27, December 1992. Environment Canada, Conservation and Protection, Ottawa, ON. 68 pp + appendices. Amended November 1997.
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- US EPA (U.S. Environmental Protection Agency). 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 3<sup>rd</sup> edition. US Environmental Protection Agency, Office of Water (4303T). US Environmental Protection Agency, Washington, DC. EPA/821/R-02/014. 464 pp.
- US EPA. 1995. Short term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 2<sup>nd</sup> edition. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Washington, DC. EPA/600/R-95/136. 563 pp.
- Tidepool Scientific Software. 1994. TOXCALC: Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.23. Tidepool Scientific Software, McKinleyville, CA. 80 pp.

## **APPENDIX A**

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Raw Data and Statistical Analyses:

*Atherinops affinis*

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

EVS Analysts A.W.D., J.S., A.K.V.  
 Test Initiation Date July 30, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	<u>G-Creek - sublethal - 270704</u>		
Amount Received	<u>20 L</u>		
Date Collected	<u>July 27, 2004</u>		
Date Received	<u>July 30, 2004</u>		
Temperature (°C)	<u>20.0 <sup>D</sup> → 20.0</u>		
pH	<u>7.8 <sup>D</sup> → 8.3</u>		
DO (mg/L)	<u>10.7 <sup>D</sup> → 7.4</u>		
Conductivity (µmhos/cm)	<u>4880</u>		
Salinity (ppt)	<u>2.6 <sup>D</sup> → 28</u>		
Ammonia (mg/L N)	<u>-</u>		
Chlorine (mg/L Cl)	<u>-</u>		
Other	<u>0 Brine adjusted to 30±2 ppt with 90 ppt HSB</u>		

**DILUTION/CONTROL WATER** (initial water quality)

Water Type filtered, UV sterilized sea H<sub>2</sub>O  
 Temperature (°C) 20.0  
 pH 8.1  
 Dissolved Oxygen (mg/L) 7.4  
 Salinity 28 ppt

**TEST SPECIES INFORMATION**

Source Aquatic Biosystems (ABS)  
 Date Received July 29, 2004  
 Age (on Day 0) 10-d  
 Reference Toxicant Cu  
 Current Reference Toxicant Result (incl. 95% CL)

Reference Toxicant Test Date July 30, 2004  
 7-d survival LC50 130 (115-147) mg/L Cu  
 7-d growth IC50 124 (87-144) mg/L Cu

Reference Toxicant Warning Limits (mean ± 2SD) and CV  
 7-d survival LC50 129 ± 48 mg/L Cu, CV=19%  
 7-d growth IC50 130 ± 52 mg/L Cu, CV=20%

**TEST CONDITIONS**

Temperature Range (°C) 20.0-20.5  
 pH Range 7.8-8.1  
 Dissolved Oxygen Range (mg/L) 6.4-7.7  
 Salinity (ppt) 28  
 Photoperiod (L:D h) 16:8  
 Aeration Provided? NA  
 Other -

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	% (1/1)	<u>69</u>	<u>&gt;69</u>	<u>&gt;69</u>		
Growth		<u>8.6 34.5<sup>ms</sup></u>	<u>17.3 69<sup>ms</sup></u>		<u>&gt;69</u>	<u>&gt;69</u>

Other \_\_\_\_\_

Data Verified By *Qualifly* Date Verified Sept. 16/04



EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimuth (Polaris)

Sample ID G-Creek - Route 270704

EVS Project No. 09-0302-54

Test Initiation Date/Time July 30/1500 h

EVS Work Order No. 0400339

Source/Date Received ABS/July 29/04

Concentration (% V/V)	Temperature (°C)													
	0	old 1 new		2		3		4		5		6		7
Neg. CTL	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
B-CTL	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
4.3	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
8.6	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
17.3	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
34.5	20.0	20.5	20.0	20.5	20.0	20.6	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
69	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
Tech. Initials	JW													

Concentration (% V/V)	pH													
	0	1	2		3		4		5		6		7	
Neg. CTL	8.1	8.1	7.9	7.9	8.0	8.0	7.9	8.0	7.8	8.0	7.8	7.9	8.0	7.9
B-CTL	8.1	8.1	7.9	7.9	8.0	7.9	7.9	8.0	7.8	8.0	7.8	7.9	8.0	7.9
4.3	8.2	8.0	8.1	8.1	8.1	7.9	8.1	7.9	8.1	7.9	8.1	8.0	8.1	8.0
8.6	8.2	8.1	8.2	8.2	8.1	8.1	8.2	8.1	8.1	8.0	8.2	8.1	8.1	8.1
17.3	8.2	8.1	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.1
34.5	8.2	8.1	8.3	8.3	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.3	8.2
69	8.3	8.2	8.4	8.4	8.4	8.3	8.3	8.3	8.4	8.3	8.7	8.4	8.3	8.2
Tech. Initials	JW													

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51

Comments \_\_\_\_\_

Test Set Up By AWD, JES, AKN Data Verified By Opal Date Verified Sept. 13/04

**EVS ENVIRONMENT CONSULTANTS**

**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA**

Client Azimuth (Polaris)

Sample ID G-Creek - Acute - 270704

EVS Project No. 09-0302-54

Test Initiation Date/Time July 30 / 15:00 L

EVS Work Order No. 0400339

Source/Date Received ABS / July 29/04

Concentration % (v/v)	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Neg-CTL	28	28	28	28	28	28	28	28
B-CTL	28	28	28	28	28	28	28	28
4.3	28	28	28	28	28	28	28	28
8.6	28	28	28	28	28	28	28	28
17.3	28	28	28	28	28	28	28	28
34.5	28	28	28	28	28	28	28	28
69	28	28	28	28	28	28	28	28
Tech. Initials	JCS	~	~	~	~	~	~	~

Concentration % (v/v)	Dissolved Oxygen (mg/L)													
	0	1	new 2 old		3	4	5	6	7					
Neg. CTL	7.4	6.6	7.4	7.5	6.8	7.4	7.0	7.5	7.0	7.6	6.8	6.7	7.2	6.8
B-CTL	7.4	6.8	7.4	7.5	6.7	7.4	6.9	7.5	6.9	7.6	6.7	6.6	7.2	6.9
4.3	7.4	6.7	7.4	7.5	6.8	7.4	6.8	7.5	6.8	7.6	6.7	6.6	7.6	6.9
8.6	7.4	6.8	7.4	7.5	6.9	7.4	6.8	7.5	6.8	7.6	6.7	6.5	7.7	6.8
17.3	7.4	6.8	7.4	7.5	6.8	7.4	6.6	7.5	6.5	7.6	6.8	6.6	7.7	6.7
34.5	7.4	6.7	7.4	7.5	6.7	7.4	6.7	7.5	6.4	7.6	6.8	6.7	7.7	6.7
69	7.4	6.7	7.4	7.4	6.7	7.4	6.7	7.5	6.4	7.6	6.8	6.7	7.7	6.7
Tech. Initials	JCS	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Salinity II-A-030304

DO II-A-011202

Comments \_\_\_\_\_

Test Set Up By AWD, JCS, AKN Data Verified By Qualifly Date Verified Sept 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST - DRY WEIGHT DATA

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Start Date (Day 0) July 30/04  
 Sample ID G-Creek - Acute - 270704  
 Balance Type/Serial Number Sartorius BP211 D

Sample ID % %	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Neg. CTL	A	A1	1239.31	1244.31	5	5		Tech. Init. 2/3/04
	B	A2	1249.28	1254.89	5	5		
	C	A3	1245.80	1250.56	5	5		
	D	A4	1249.65	1254.46	5	5		
	E	A5	1272.31	1276.64	5	5		
Brine CTL	A	A6	1247.06	1252.91	5	5		
	B	A7	1253.79	1257.85	5	5	confirmed 1257.85 ✓	
	C	A8	1281.77	1286.98	5	5		
	D	A9	1251.58	1255.98	5	5		
	E	A10	1259.93	1265.08	5	5		
4.3	A	A11	1257.42	1261.19	4	4		
	B	A12	1236.86	1242.25	5	5	confirmed 1242.19 ✓	
	C	A13	1239.81	1248.13	5	5		
	D	A14	1242.85	1246.92	5	5		
	E	A15	1235.71	1239.91	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galjit

Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST - DRY WEIGHT DATA

Client Azimuth (polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Start Date (Day 0) July 30, 2004  
 Sample ID G-Creek - Acute - 270709  
 Balance Type/Serial Number Ser. Torus BP 211D

Sample ID % $\frac{1}{N}$	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
8.6	A	A16	1227.02	1232.51	5	5		PS/KJS
	B	A17	1239.24	1243.57	5	5		
	C	A18	1229.02	1233.44	4	4		
	D	A19	1233.84	1237.47	5	5		
	E	A20	1228.86	1232.75	5	5	confirmed 1232.80 ✓	
17.3	A	A21	1231.20	1234.75	5	5		
	B	A22	1233.22	1237.19	5	5		
	C	A23	1222.38	1227.10	5	5		
	D	A24	1222.20	1225.18	5	5		
	E	A25	1226.00	1230.36	5	5		
34.5	A	A26	1225.11	1229.67	5	5		
	B	A27	1233.99	1238.36	5	5		
	C	A28	1237.10	1241.69	5	5	confirmed 1241.64 ✓	
	D	A29	1222.42 <sup>38</sup>	1226.65	5	5		
	E	A30	1233.63	1238.25	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be  $\leq 10\%$  of organism weight.

Data Verified By Gal K

Date Verified Sept. 13/04

**EVS ENVIRONMENT CONSULTANTS**

**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Start Date (Day 0) July 30/04  
 Sample ID G-Creek - Acute - 270704  
 Balance Type/Serial Number Sartorius 3P211D

Sample ID % $\frac{y}{v}$	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
69	A	A31	1239.64	1242.07	4	4		<del>AS</del>
	B	A32	1237.11	1241.20	5	5		↓
	C	A33	1231.11	1234.89	5	5		
	D	A34	1239.84	1243.88	5	5		
	E	A35	1233.50	1238.50	5	5	condensed 1238.46 ✓	

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By

Date Verified Sept. 13/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Polaris Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Sample ID G-creek - Azim - 270704  
 Test Species/Batch A. affinis  
 Test Initiation Date/Time July 30 / 15:00 2004  
 No. of Organisms/Volume 5/200ml

Concentration <i>1/2 1/4</i>	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Neg. CTL	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
B-CTL	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
4.3	A		5	5	5	5	5	5	4	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
8.6	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	4	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
Technician Initials			m	m	m	m	m	m	m	

Sample Description clear, colorless  
 Data Verified By Galhich Date Verified Sept. 15/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Polaris Mine)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Sample ID G-Creek - Arute - 270704  
 Test Species/Batch *A. affinis* / July 29, 04  
 Test Initiation Date/Time July 30 / 15:00  
 No. of Organisms/Volume 5/200ml

Concentration <i>1/4</i>	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
17.3	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
34.5	A		5	5	5	5	5	5	5	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
69	A		5	5	5	5	4	4	4	
	B		5	5	5	5	5	5	5	
	C		5	5	5	5	5	5	5	
	D		5	5	5	5	5	5	5	
	E		5	5	5	5	5	5	5	
	A									
	B									
	C									
	D									
	E									
Technician Initials			~	~	~	~	~	~	~	

Sample Description clear, colorless  
 Data Verified By Oralick Date Verified Sept 15/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: 0400339

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: G-Creek-sublethal-270704

Sample Type: EFF2-Industrial

Start Date: 7/30/2004

End Date: 8/6/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	Neg Control	5							5	5	1244.31	1239.31
	2	2	Neg Control	5							5	5	1254.89	1249.28
	3	3	Neg Control	5							5	5	1250.56	1245.8
	4	4	Neg Control	5							5	5	1254.46	1249.65
	5	5	Neg Control	5							5	5	1276.64	1272.31
	6	1	Brine Control	5							5	5	1252.91	1247.06
	7	2	Brine Control	5							5	5	1257.85	1253.79
	8	3	Brine Control	5							5	5	1286.98	1281.77
	9	4	Brine Control	5							5	5	1255.98	1251.58
	10	5	Brine Control	5							5	5	1265.08	1259.93
	11	1	4.300	5							4	4	1261.19	1257.42
	12	2	4.300	5							5	5	1242.25	1236.86
	13	3	4.300	5							5	5	1245.13	1239.81
	14	4	4.300	5							5	5	1246.92	1242.85
	15	5	4.300	5							5	5	1239.91	1235.71
	16	1	8.600	5							5	5	1232.51	1227.02
	17	2	8.600	5							5	5	1243.57	1239.24
	18	3	8.600	5							4	4	1233.44	1229.02
	19	4	8.600	5							5	5	1237.47	1233.84
	20	5	8.600	5							5	5	1232.75	1228.86
	21	1	17.300	5							5	5	1234.75	1231.2
	22	2	17.300	5							5	5	1237.19	1233.22
	23	3	17.300	5							5	5	1227.1	1222.38
	24	4	17.300	5							5	5	1225.18	1222.2
	25	5	17.300	5							5	5	1230.36	1226
	26	1	34.500	5							5	5	1229.67	1225.11
	27	2	34.500	5							5	5	1238.36	1233.99
	28	3	34.500	5							5	5	1241.69	1237.1
	29	4	34.500	5							5	5	1226.65	1222.38
	30	5	34.500	5							5	5	1238.25	1233.63
	31	1	69.000	5							4	4	1242.07	1239.64
	32	2	69.000	5							5	5	1241.2	1237.11
	33	3	69.000	5							5	5	1234.89	1231.11
	34	4	69.000	5							5	5	1243.88	1239.84
	35	5	69.000	5							5	5	1238.5	1233.5

Comments: Azimuth(Polaris Mine)09-0302-54



**Larval Fish Growth and Survival Test-7 Day Survival**

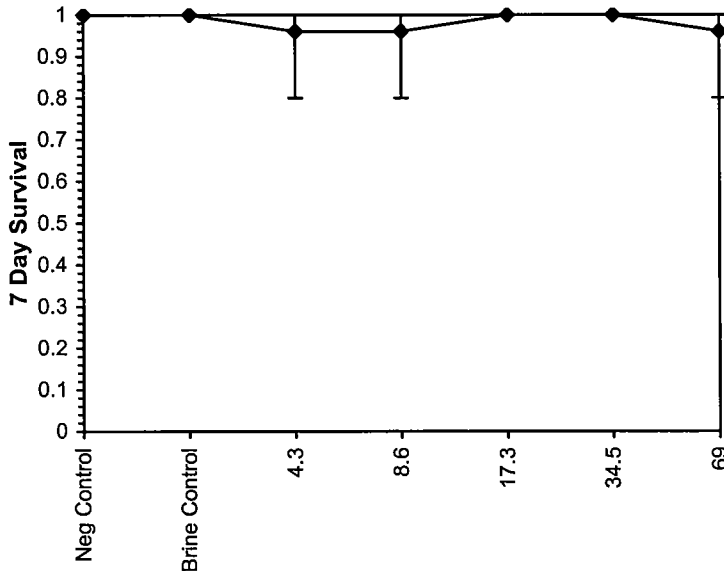
Start Date: 7/30/2004	Test ID: 400339	Sample ID: G-Creek-sublethal-270704
End Date: 8/6/2004	Lab ID: BCEVS-EVS Environment Cc	Sample Type: EFF2-Industrial
Sample Date: 7/27/2004	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: Azimuth(Polaris Mine)09-0302-54		

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.3	0.8000	1.0000	1.0000	1.0000	1.0000
8.6	1.0000	1.0000	0.8000	1.0000	1.0000
17.3	1.0000	1.0000	1.0000	1.0000	1.0000
34.5	1.0000	1.0000	1.0000	1.0000	1.0000
69	0.8000	1.0000	1.0000	1.0000	1.0000

Conc-%	Mean	SD	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%	N		
Neg Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
Brine Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
4.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00
8.6	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00
17.3	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
34.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
69	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.59678	0.9	-2.2346	4.3922
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	69	>69		1.44928

**Dose-Response Plot**



Statistical comparisons were against the D-Control only

**Larval Fish Growth and Survival Test-7 Day Survival**

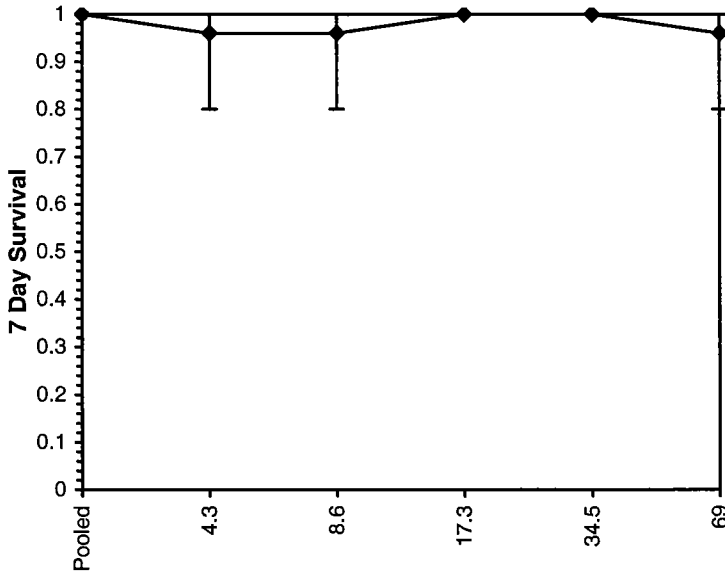
Start Date: 7/30/2004	Test ID: 400339	Sample ID: G-Creek-sublethal-270704
End Date: 8/6/2004	Lab ID: BCEVS-EVS Environment Cc	Sample Type: EFF2-Industrial
Sample Date: 7/27/2004	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: Azimuth(Polaris Mine)09-0302-54		

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.3	0.8000	1.0000	1.0000	1.0000	1.0000
8.6	1.0000	1.0000	0.8000	1.0000	1.0000
17.3	1.0000	1.0000	1.0000	1.0000	1.0000
34.5	1.0000	1.0000	1.0000	1.0000	1.0000
69	0.8000	1.0000	1.0000	1.0000	1.0000

Conc-%	Mean	SD	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%	N		
Pooled	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	10		
4.3	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00
8.6	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00
17.3	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	40.00	21.00
34.5	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	40.00	21.00
69	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	35.00	21.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.58129	0.91	-2.3952	5.50568
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	69	>69		1.44928

**Dose-Response Plot**



Statistical comparisons were against the Pooled control.

**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 7/30/2004      Test ID: 400339      Sample ID: G-Creek-sublethal-270704  
 End Date: 8/6/2004      Lab ID: BCEVS-EVS Environment Cc Sample Type: EFF2-Industrial  
 Sample Date: 7/27/2004      Protocol: EPAW 95-EPA West Coast Test Species: AA-Atherinops affinis  
 Comments: Azimuth(Polaris Mine)09-0302-54

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.1220	0.9520	0.9620	0.8660
Brine Control	1.1700	0.8120	1.0420	0.8800	1.0300
4.3	0.7540	1.0780	1.0640	0.8140	0.8400
8.6	1.0980	0.8660	0.8840	0.7260	0.7780
17.3	0.7100	0.7940	0.9440	0.5960	0.8720
34.5	0.9120	0.8740	0.9180	0.8540	0.9240
69	0.4860	0.8180	0.7560	0.8080	1.0000

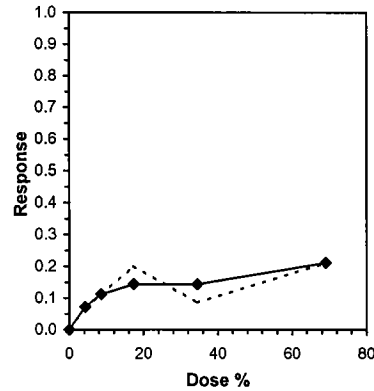
Conc-%	Mean	SD	Transform: Untransformed				N	t-Stat	1-Tailed			Isotonic	
			Mean	Min	Max	CV%			Critical	MSD	Mean	N-Mean	
Neg Control	0.9804	0.0931	0.9804	0.8660	1.1220	9.496	5				0.9804	1.0000	
Brine Control	0.9868	0.1418	0.9868	0.8120	1.1700	14.370	5						
4.3	0.9100	0.1503	0.9100	0.7540	1.0780	16.519	5	0.840	2.360	0.1979	0.9100	0.9282	
8.6	0.8704	0.1426	0.8704	0.7260	1.0980	16.389	5	1.312	2.360	0.1979	0.8704	0.8878	
17.3	0.7832	0.1363	0.7832	0.5960	0.9440	17.397	5	2.352	2.360	0.1979	0.8398	0.8566	
34.5	0.8964	0.0307	0.8964	0.8540	0.9240	3.425	5	1.002	2.360	0.1979	0.8398	0.8566	
*69	0.7736	0.1854	0.7736	0.4860	1.0000	23.961	5	2.466	2.360	0.1979	0.7736	0.7891	

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97283	0.9	-0.0321	0.12793
Bartlett's Test indicates equal variances (p = 0.10)	9.1539	15.0863		
The control means are not significantly different (p = 0.93)	0.08436	2.30601		

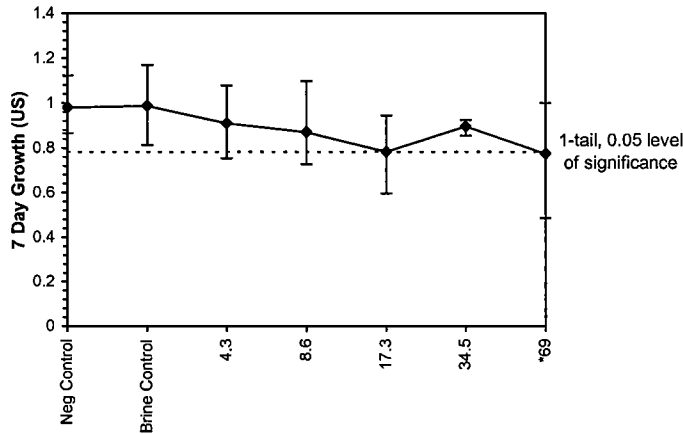
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	34.5	69	48.7904	2.89855	0.1979	0.20186	0.03131	0.01758	0.15497	5, 24

Linear Interpolation (200 Resamples)				
Point	%	SD	95% CL(Exp)	Skew
IC05*	2.994	3.701	0.790	14.903
IC10	7.301			
IC15	37.867			
IC20	63.413			
IC25	>69			
IC40	>69			
IC50	>69			

\* indicates IC estimate less than the lowest concentration



Dose-Response Plot



Statistical comparisons were against the D-Control only

**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 7/30/2004 Test ID: 400339 Sample ID: G-Creek-sublethal-270704  
 End Date: 8/6/2004 Lab ID: BCEVS-EVS Environment Cc Sample Type: EFF2-Industrial  
 Sample Date: 7/27/2004 Protocol: EPAW 95-EPA West Coast Test Species: AA-Atherinops affinis  
 Comments: Azimuth(Polaris Mine)09-0302-54

Conc-%	1	2	3	4	5
Neg Control	1.0000	1.1220	0.9520	0.9620	0.8660
Brine Control	1.1700	0.8120	1.0420	0.8800	1.0300
4.3	0.7540	1.0780	1.0640	0.8140	0.8400
8.6	1.0980	0.8660	0.8840	0.7260	0.7780
17.3	0.7100	0.7940	0.9440	0.5960	0.8720
34.5	0.9120	0.8740	0.9180	0.8540	0.9240
69	0.4860	0.8180	0.7560	0.8080	1.0000

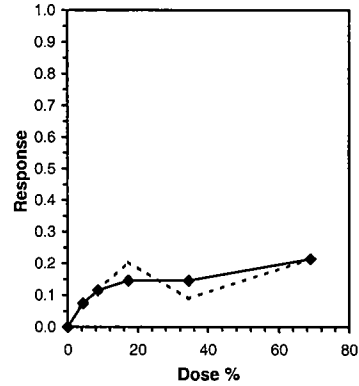
Conc-%	Mean	SD	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
Pooled	0.9836	0.1131	0.9836	0.8120	1.1700	11.503	10				0.9836	1.0000
4.3	0.9100	0.1503	0.9100	0.7540	1.0780	16.519	5	1.021	2.462	0.1775	0.9100	0.9252
8.6	0.8704	0.1426	0.8704	0.7260	1.0980	16.389	5	1.570	2.462	0.1775	0.8704	0.8649
*17.3	0.7832	0.1363	0.7832	0.5960	0.9440	17.397	5	2.780	2.462	0.1775	0.8398	0.8538
34.5	0.8964	0.0307	0.8964	0.8540	0.9240	3.425	5	1.209	2.462	0.1775	0.8398	0.8538
*69	0.7736	0.1854	0.7736	0.4860	1.0000	23.961	5	2.913	2.462	0.1775	0.7736	0.7865

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97705	0.91	-0.0216	-0.1535
Bartlett's Test indicates equal variances (p = 0.11)	8.86442	15.0863		
The control means are not significantly different (p = 0.93)	0.08436	2.30601		

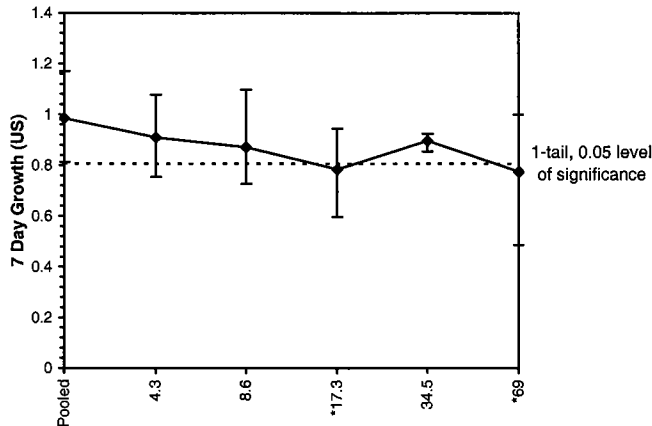
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	8.6	17.3	12.1975	11.6279	0.1775	0.18046	0.04318	0.01733	0.05389	5, 29

Point	%	SD	95% CL(Exp)		Skew
IC05*	2.873	2.982	0.771	15.235	1.2072
IC10	6.989				
IC15	36.449				
IC20	62.079				
IC25	>69				
IC40	>69				
IC50	>69				

\* indicates IC estimate less than the lowest concentration



**Dose-Response Plot**



Statistic comparisons were against the pooled control.

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

EVS Analysts JLS, AWD  
 Test Initiation Date July 30, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	04-Cu-001		
Amount Received	1 L		
Date Collected <sup>Prepared</sup>	March-15, 04		
Date Received			
Temperature (°C)			
pH			
DO (mg/L)			
Conductivity (µmhos/cm)			
Salinity (ppt)			
Ammonia (mg/L N)			
Chlorine (mg/L Cl)			
Other			

**DILUTION/CONTROL WATER** (initial water quality)  
 Water Type UV sterilized, filtered SW  
 Temperature (°C) 20.0  
 pH 8.1  
 Dissolved Oxygen (mg/L) 7.4  
 Salinity 28 ppt

**TEST SPECIES INFORMATION**  
 Source Aquatic Biosystems (ABS)  
 Date Received July 29, 2004  
 Age (on Day 0) 10-d  
 Reference Toxicant Cu  
 Current Reference Toxicant Result (incl. 95% CL)

**TEST CONDITIONS**  
 Temperature Range (°C) 20.0 - 20.5  
 pH Range 7.8 - 8.1  
 Dissolved Oxygen Range (mg/L) 6.4 - 7.6  
 Salinity (ppt) 28  
 Photoperiod (L:D h) 16:8  
 Aeration Provided? NA  
 Other -

Reference Toxicant Test Date July 30, 04  
 7-d survival LC50 130 (115-147) mg/L Cu  
 7-d growth IC50 119 (89-138) mg/L Cu  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
 7-d survival LC50 129 ± 48 mg/L Cu. CV = 19%  
 7-d growth IC50 130 ± 52 mg/L Cu. CV = 20%

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	mg/L	100	180	130 (115-147)		
Growth	Cu	56	100		119 (89-138) 124 (87-144)	85 (3.6-124) 82 (0.4-124)

Other \_\_\_\_\_

Data Verified By Galpin Date Verified Sept. 13/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimuth (Polaris)

Sample ID Cu refax

EVS Project No. 09-0302-54

Test Initiation Date/Time July 30/04 / 1430 h

EVS Work Order No. 0400339

Source/Date Received ABS / July 29, 2004

Concentration Cu mg/L	Temperature (°C)													
	0	old	1	new	2	3	4	5	6	7	8	9	10	11
Neg. CTL	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
32	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
56	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
100	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
180	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5
320	20.0	20.5	20.0	20.5	20.0	_____								
Tech. Initials	WD	~	~	~	~	~	~	~	~	~	~	~	~	~

Concentration Cu mg/L	pH													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Neg. CTL	8.1	8.0	7.9	7.9	8.0	7.9	8.0	7.8	8.0	7.8	8.0	8.0	7.9	7.8
32	8.1	8.0	7.9	7.9	8.0	7.9	8.1	7.8	8.0	7.8	8.1	8.0	7.9	7.8
56	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	8.0	7.8	8.1	8.0	7.9	7.9
100	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	7.9	7.8	8.0	8.0	7.8	7.9
180	8.1	7.9	7.9	7.9	8.0	7.9	8.1	7.8	7.9	7.8	8.1	8.0	7.9	7.9
320	8.1	7.9	7.9	7.9	8.0	_____								
Tech. Initials	WD	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51

Comments \_\_\_\_\_

Test Set Up By JR/AM Data Verified By Qualifit Date Verified Sept-10/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimuth

Sample ID Cu. reftox

EVS Project No. 09-0302-54

Test Initiation Date/Time July 30, 2004 / 1430 h

EVS Work Order No. 0400339

Source/Date Received ABS / July 29, 04

Concentration Cu mg/L	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Neg. CTL	28	28	28	28	28	28	28	28
32	28	28	28	28	28	28	28	28
56	28	28	28	28	28	28	28	28
100	28	28	28	28	28	28	28	28
180	28	28	28	28	28	28	28	28
320	28	28	28	—	—	—	—	—
Tech. Initials	JMS	~	~	~	~	~	~	

Concentration Cu mg/L	Dissolved Oxygen (mg/L)													
	0	1	2 <sub>old</sub>		3	4	5	6	7					
Neg. CTL	7.4	7.0	7.4	7.5	6.7	7.0	7.4	7.0	7.5	6.8	7.6	6.4	7.6	6.7
32	7.4	6.9	7.4	7.5	6.7	6.8	7.4	6.9	7.5	6.9	7.6	6.6	7.6	6.8
56	7.4	6.9	7.4	7.5	6.8	6.8	7.4	6.7	7.5	7.0	7.6	6.7	7.6	6.7
100	7.4	6.8	7.4	7.5	6.8	6.7	7.4	6.5	7.5	6.9	7.6	6.4	7.6	6.8
180	7.4	6.8	7.4	7.5	6.7	6.7	7.4	6.4	7.5	6.8	7.6	6.6	7.6	6.8
320	7.4	6.8	7.4	7.5	6.7	6.8	7.4	—	—	—	—	—	—	—
Tech. Initials	JMS	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Salinity II-A030304

DO II-A-011202

Comments \_\_\_\_\_

Test Set Up By JMS/AMB Data Verified By Gulick Date Verified Sept. 10/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST - DAILY SURVIVAL DATA**

Client Azimuth (Polaris Mine)

Sample ID Cu (Reflux)

EVS Project No. 09-0302-54

Test Species/Batch *A. affinis* / July 29, 2004

EVS Work Order No. 0400339

Test Initiation Date/Time July 30, 2004 / 14:30 L

No. of Organisms/Volume 5/200ml

Cu $\mu$ g/L Concentration	Rep.	Pan No.	Number of Survivors - Day of Test							Comments
			1	2	3	4	5	6	7	
Neg. CTL	A	A 36	5	5	5	5	5	5	5	
	B	37	5	5	5	5	5	5	5	
	C	38	5	5	5	5	5	5	5	
	D	39	5	5	5	5	5	5	5	
	E	40	5	5	5	5	5	5	5	
32	A	41	5	5	5	5	5	5	5	
	B	42	5	5	5	5	5	5	5	
	C	43	5	5	5	4	4	4	4	
	D	44	5	5	5	5	5	5	5	
	E	45	5	5	5	5	5	5	5	
56	A	46	5	5	5	5	5	5	5	
	B	47	5	5	5	5	5	4	4	
	C	49	5	5	5	5	5	5	5	
	D	50	5	5	5	5	5	5	5	
	E	51	5	5	5	5	5	5	5	
100	A	52	4	3	3	3	3	3	3	
	B	53	4	4	4	4	4	4	4	
	C	54	5	5	5	5	5	5	5	
	D	55	5	5	5	5	5	5	5	
	E	56	5	5	6	4	4	4	4	
Technician Initials			r	r	r	r	-	r	m	

Sample Description clear, colorless

Data Verified By Qualifit

Date Verified Sept. 13/04



**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST - DAILY SURVIVAL DATA**

Client Azimuth (Polaris Mine)

Sample ID Cu reflex

EVS Project No. 09-0302-54

Test Species/Batch *A. affinis* / July 29, 2004

EVS Work Order No. 0400339

Test Initiation Date/Time July 30, 04 / 1430 h

No. of Organisms/Volume 5/200ml

Cu mg/L Concentration	Rep.	Pan No.	Number of Survivors - Day of Test							Comments
			1	2	3	4	5	6	7	
180	A	<del>A5</del>	2	1	0	—	—	—	—	
	B	—	2	2	1	1	0	—	—	
	C	A58	4	4	2	2	2	2	2	
	D	A59	2	1	1	1	1	1	1	
	E	—	2	2	2	1	0	—	—	
320	A	—	1	0	—	—	—	—	—	
	B	—	0	—	—	—	—	—	—	
	C	—	0	—	—	—	—	—	—	
	D	—	0	—	—	—	—	—	—	
	E	—	0	—	—	—	—	—	—	
	A									
	B									
	C									
	D									
	E									
	A									
	B									
	C									
	D									
	E									
Technician Initials			r	r	r	r	r	r	r	

Sample Description \_\_\_\_\_

Data Verified By Quah Date Verified Sept 13/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST - DRY WEIGHT DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Start Date (Day 0) July 30, 2004  
 Sample ID Cu-reflex  
 Balance Type/Serial Number Sartorius BP211D

Sample ID <i>Cu mg/L</i>	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Neg. CTL	A	A36	1225.46	1231.37	5	5		Jds/12
	B	A37	1223.00	1227.74	5	5		
	C	A38	1227.28	1232.01	5	5		
	D	A39	1225.60	1232.35	5	5		
	E	A40	1231.561	1238.39	5	5	confirmed 1238.42 ✓	
32	A	A41	1223.15	1228.32	5	5		↓
	B	A42	1232.24	1238.17	5	5		
	C	A43	1228.20 <sup>15</sup>	1232.39	4	4		
	D	A44	1228.67	1233.67	5	5		
	E	A45	1223.92	1228.14	5	5	Confirmed 1228.16 ✓	
56	A	A46	1224.29	1229.51	5	5		↓
	B	A47	1219.34	1223.14	4	4		
	C	A48	1223.19	12				
	C	A49	1224.29	1229.03	5	5		
	C	A50	1228.49	1234.94	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Qualifit Date Verified Sept. 13/04

Concentration 56mg/L E Pan # A51 pan wt 1228.55 Final pan wt 1233.48 # Survival 5 # Weighed 5

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA**

Client Arimath  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400339

Start Date (Day 0) July 30-04  
 Sample ID Cu Effort  
 Balance Type/Serial Number Sartorius BP 211D

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
100	A	A52	1229.80	1231.98	3	3		JRS
	B	A53	1230.92	1234.72	4	4		
	C	A54	1226.04	1230.33	5	5		
	D	A55	1228.91	1234.05	5	5	confirm 1234.07 ✓	
	E	A56	1226.61	1231.21	4	4		
180	C	<del>A58</del> A57	<del>1214.44</del> 1215.23	1215.67	2	2		
	D	<del>A59</del> A57	<del>1229.90</del> 1225.71	1230.26	1	1		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Gail H

Date Verified Sept - 13/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: RTAACu37

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: REF-Ref Toxicant

Sample Type: CU-Copper

Start Date: 7/30/2004

End Date: 8/6/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
1	1	1	D-Control	5							5	5	1231.37	1225.46
2	2	2	D-Control	5							5	5	1227.74	1223
3	3	3	D-Control	5							5	5	1232.01	1227.28
4	4	4	D-Control	5							5	5	1232.35	1225.6
5	5	5	D-Control	5							5	5	1238.39	1231.61
6	1		32.000	5							5	5	1228.32	1223.15
7	2		32.000	5							5	5	1238.17	1232.24
8	3		32.000	5							4	4	1232.39	1228.15
9	4		32.000	5							5	5	1233.67	1228.67
10	5		32.000	5							5	5	1228.14	1223.92
11	1		56.000	5							5	5	1229.51	1224.29
12	2		56.000	5							4	4	1223.14	1219.34
13	3		56.000	5							5	5	1229.03	1224.29
14	4		56.000	5							5	5	1234.94	1228.49
15	5		56.000	5							5	5	1233.48	1228.55
16	1		100.000	5							3	3	1231.98	1229.8
17	2		100.000	5							4	4	1234.72	1230.92
18	3		100.000	5							5	5	1230.33	1226.04
19	4		100.000	5							5	5	1234.05	1228.91
20	5		100.000	5							4	4	1231.21	1226.61
21	1		180.000	5							0	0	0	0
22	2		180.000	5							0	0	0	0
23	3		180.000	5							2	2	1215.67	1214.44
24	4		180.000	5							1	1	1230.26	1229.9
25	5		180.000	5							0	0	0	0
26	1		320.000	5							0	0	0	0
27	2		320.000	5							0	0	0	0
28	3		320.000	5							0	0	0	0
29	4		320.000	5							0	0	0	0
30	5		320.000	5							0	0	0	0

Comments: 09-0302-54, 0400339

**Larval Fish Growth and Survival Test-7 Day Survival**

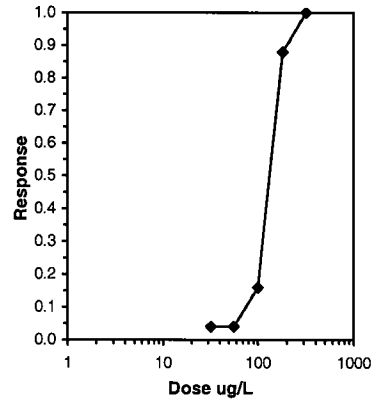
Start Date: 7/30/2004	Test ID: RTAACu37	Sample ID: REF-Ref Toxicant
End Date: 8/6/2004	Lab ID: BCEVS-EVS Environment Cc	Sample Type: CU-Copper
Sample Date: 8/6/2004	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: 09-0302-54, 0400339		

Conc-ug/L	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	1.0000
32	1.0000	1.0000	0.8000	1.0000	1.0000
56	1.0000	0.8000	1.0000	1.0000	1.0000
100	0.6000	0.8000	1.0000	1.0000	0.8000
180	0.0000	0.0000	0.4000	0.2000	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

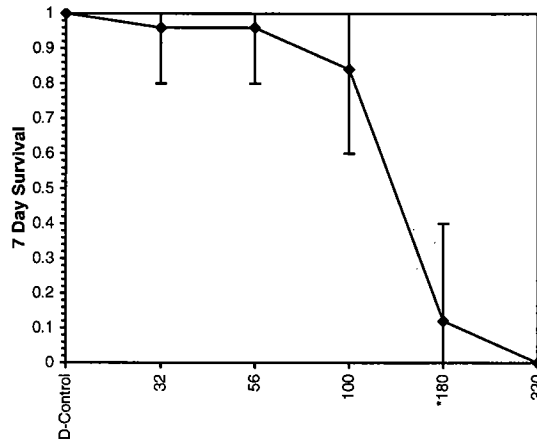
Conc-ug/L	Mean	SD	Transform: Arcsin Square Root				N	Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%					
D-Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5			0	25
32	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	17.00	1	25
56	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	17.00	1	25
100	0.8400	0.1673	1.1582	0.8861	1.3453	16.679	5	20.00	17.00	4	25
*180	0.1200	0.1789	0.3650	0.2255	0.6847	56.537	5	15.00	17.00	22	25
320	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	5			25	25

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94287	0.888	0.10595	0.6692
Equality of variance cannot be confirmed				
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	180	134.164	

Trim Level	EC50	95% CL	
0.0%			
5.0%	129.88	114.75	146.99
10.0%	130.93	116.99	146.54
20.0%	131.99	121.77	143.08
Auto-4.0%	129.69	114.60	146.77 ug/L Cu



Dose-Response Plot



**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 7/30/2004      Test ID: RTAACu37      Sample ID: REF-Ref Toxicant  
 End Date: 8/6/2004      Lab ID: BCEVS-EVS Environment Ct      Sample Type: CU-Copper  
 Sample Date:      Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: 09-0302-54, 0400339

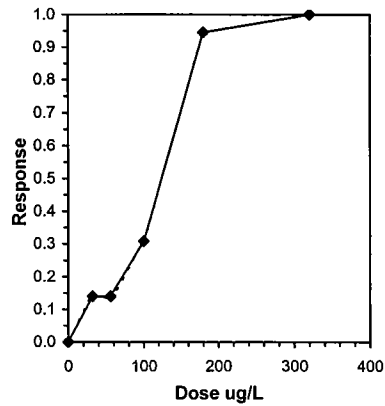
Conc-ug/L	1	2	3	4	5
D-Control	1.1820	0.9480	0.9460	1.3500	1.3560
32	1.0340	1.1860	0.8480	1.0000	0.8440
56	1.0440	0.7600	0.9480	1.2900	0.9860
100	0.4360	0.7600	0.8580	1.0280	0.9200
180	0.0000	0.0000	0.2460	0.0720	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Mean	SD	Transform: Untransformed					N	1-Tailed			Isotonic	
			Mean	Min	Max	CV%	t-Stat		Critical	MSD	Mean	N-Mean	
D-Control	1.1564	0.2035	1.1564	0.9460	1.3560	17.599	5				1.1564	1.0000	
32	0.9824	0.1429	0.9824	0.8440	1.1860	14.543	5	1.534	2.300	0.2608	0.9940	0.8596	
56	1.0056	0.1913	1.0056	0.7600	1.2900	19.023	5	1.330	2.300	0.2608	0.9940	0.8596	
*100	0.8004	0.2257	0.8004	0.4360	1.0280	28.204	5	3.139	2.300	0.2608	0.8004	0.6921	
*180	0.0636	0.1066	0.0636	0.0000	0.2460	167.649	5	9.636	2.300	0.2608	0.0636	0.0550	
320	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	5				0.0000	0.0000	

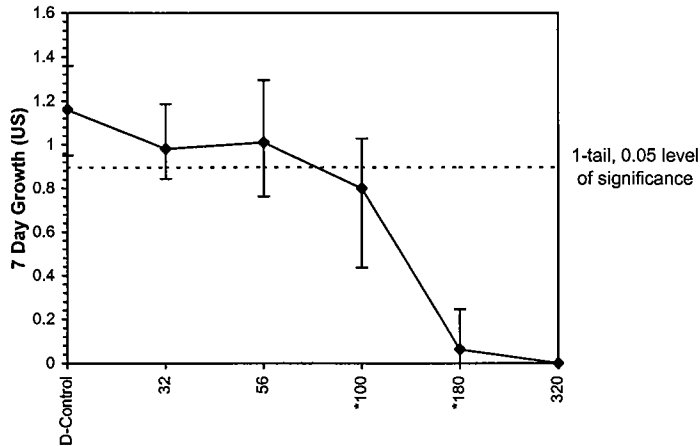
Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97311	0.888	-0.2174	-0.3474						
Bartlett's Test indicates equal variances (p = 0.67)	2.36564	13.2767								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	56	100	74.8331		0.26083	0.22555	0.93104	0.03215	4.6E-08	4, 20

Linear Interpolation (200 Resamples)					
Point	ug/L	SD	95% CL(Exp)		Skew
IC05*	11.39	19.61	3.51	97.01	1.6113
IC10*	22.79	23.89	7.01	129.04	1.0634
IC15	58.51	26.81	0.00	126.48	0.4512
IC20	71.65	25.04	0.99	127.04	-0.1836
IC25	84.80	21.56	3.62	127.36	-0.5667
IC40	111.57	11.06	71.01	135.64	-0.6491
IC50	124.13	9.44	86.97	143.83	-0.7596

\* indicates IC estimate less than the lowest concentration



Dose-Response Plot



## **APPENDIX B**

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Raw Data and Statistical Analyses:

*Dendraster excentricus*

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY**

Client AZIMOTH CONSULTING GROUP  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400340

EVS Analysts KES ART  
 Test Initiation Date 30 JULY 2004

**SAMPLE**

Identification G-Creek Sublethal-270704  
 Amount Received 5 X 20L  
 Date Collected 27 JULY 2004  
 Date Received 30 JULY 2004  
 Temperature (°C) 16.0 @ → 15.0  
 pH 7.7 @ → 8.1  
 Dissolved Oxygen (mg/L) 9.6 @ → 8.5  
 Conductivity (µmhos/cm) 4940  
 Salinity (ppt) 2.6 @ → 28  
 Ammonia (mg/L N) -  
 Chlorine (mg/L Cl) -  
 Other -

**TEST SPECIES**

Organism Dendroaster ~~sp~~ eccentricus  
 Source Westwind Sealab Supplies  
 Date Received 30 July 2004  
 Reference Toxicant SDS  
 Current Reference Toxicant Result  
 Reference Toxicant Test Date 30 July 2004  
 IC50 (and 95% CL) ~~2.1~~ (1.9-2.4) mg/L SDS  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
4.2 ± 4.8 mg/L SDS, CV% = 57

① Brie adjustment

**DILUTION/CONTROL WATER** (initial water quality)

Water Type UV Steralized, 0.45µm filtered SW  
 Temperature (°C) 16.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 8.2  
 Salinity (ppt) 28  
 Other -

**TEST CONDITIONS**

Temperature Range (°C) 15.0 - 16.0  
 pH Range 8.0 - 8.1  
 Dissolved Oxygen Range (mg/L) 8.2 - 8.5  
 Salinity Range (ppt) 28  
 Sperm:Egg Ratio 1600:1  
 Test Duration 10:10  
 Other -

**TEST RESULTS**

IC 50: 37.3 (24.4 - 46.0) % V/V  
IC 25: 8.7 (7.6 - 9.9) % V/V  
NOEC: 4.6 % V/V  
LOEC: 9.1 % V/V

Data Verified By Qualifit

Date Verified Sept. 10/04



**EVS ENVIRONMENT CONSULTANTS**  
**ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY**

Client ~~09-0302-54~~ <sup>Kef</sup> AZIMUTH CONSULTING GROUP Test Initiation Date/Time 30 July 2004  
 EVS Project No. 09-0302-54 Test Species Dendrosteira eccentricus  
 EVS Work Order No. 0400340 Source/Date Received 30 July 2004 / Westwind Seelab  
 Logbook #13 Pages 50-53 Test Duration 10:10 Supplies

Sample ID	Conc/Rep % V/V	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
CONTROL		16.0	8.0	28	8.2	
BRINE CONTROL		15.0	8.1	28	8.4	
G. CREEK #	4.6	15.5	8.0	28	8.2	
	9.1	15.5	8.0	28	8.3	
	18.3	15.0	8.0	28	8.3	
	36.6	15.0	8.1	28	8.4	
	73.1	15.0	8.1	28	8.5	
Tech. Init.	Kef	Kef	Kef	Kef	Kef	

WQ Instruments Used: Temp. Calibrated Hg pH II-A-51 Salinity II-A-030303 DO II-A-011202  
 Data Verified By Qualif Date Verified Sept. 8, 2004

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNT (SAMPLES)**

Client AZIMUTH CONSULTING GROUP

Test Initiation Date/Time 30 JULY 2004 @ 16:20

EVS Project No. 09-0302-54

Test Species Dendroaster ~~sp~~ excentricus

EVS Work Order No. 0400340

Source/Date Received Westwind Sealab Supplies/30 July 2004

Logbook Echinoid #13 Pages 50-53

Test Duration 10:10

Sperm:Egg Ratio 1600:1

Sample ID % (v/v)	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
CONTROL	A	59	41		ket
	B	62	38		↓
	C	56	44		↓
	D	65	35		↓
4.6	A	60	40		ket
	B	66	34		↓
	C	56	44		↓
	D	58	42		↓
9.1	A	46	54		ket
	B	42	58		↓
	C	45	55		↓
	D	42	58		↓
18.3	A	39	61		ket
	B	36	64		↓
	C	37	63		↓
	D	36	64		↓
36.6	A	31	69		ket
	B	34	66		↓
	C	25	75		↓
	D	31	69		↓
73.1	A	19	81		ket
	B	20	80		↓
	C	21	79		↓
	D	20	80		↓

Data Verified By *Wally H*

Date Verified Sept. 8/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNT (SAMPLES)**

Client AZIMUTH CONSULTING GROUP

Test Initiation Date/Time 30 JULY 2004 @ 16:20

EVS Project No. 09-0302-54

Test Species Dendroaster ~~sp~~ excentricus

EVS Work Order No. 0400340

Source/Date Received Westwind Sealab Supplies/30 July 2004

Logbook Echinoid #13 Pages 50-53

Test Duration 10:10

Sperm:Egg Ratio 1600:1

Sample ID	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
BRINE CONTROL	A	60	40		KST ↓
	B	57	43		
	C	59	41		
	D	62	38		
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Data Verified By Galt J

Date Verified Sept. 8/04

Test: SC-Sperm Cell Fertilization test      Test ID: 0400340  
 Species: DE-Dendroaster excentricus      Protocol: EPS1/RM/27-EC 92 (Sperm Cell)  
 Sample ID: G CREEK 270704E      Sample Type: EFF2-Industrial  
 Start Date: 7/30/2004 16:20 (10:00)      End Date: 7/30/2004      Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	59	41	
	2	2	D-Control	100	62	38	
	3	3	D-Control	101	56	44	
	4	4	D-Control	100	65	35	
	5	1	B-Control	100	60	40	
	6	2	B-Control	100	57	43	
	7	3	B-Control	100	59	41	
	8	4	B-Control	100	62	38	
	9	1	4.6	100	60	40	
	10	2	4.6	100	66	34	
	11	3	4.6	100	56	44	
	12	4	4.6	100	58	42	
	13	1	9.1	100	46	54	
	14	2	9.1	100	42	58	
	15	3	9.1	100	45	55	
	16	4	9.1	100	42	58	
	17	1	18.3	100	39	61	
	18	2	18.3	100	36	64	
	19	3	18.3	100	37	63	
	20	4	18.3	100	36	64	
	21	1	36.6	100	31	69	
	22	2	36.6	100	34	66	
	23	3	36.6	100	25	75	
	24	4	36.6	100	31	69	
	25	1	73.1	100	19	81	
	26	2	73.1	100	20	80	
	27	3	73.1	100	21	79	
	28	4	73.1	100	20	80	

Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)

**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 7/30/2004 10:10 Test ID: 400340 Sample ID: G CREEK 270704E  
 End Date: 7/30/2004 Lab ID: BCEVS-EVS Environment Cr Sample Type: EFF2-Industrial  
 Sample Date: 7/27/2004 Protocol: EPS1/RM/27-EC 92 (Sperm Test Species: DE-Dendraater excentricus  
 Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)

Conc-%	1	2	3	4
D-Control	0.5900	0.6200	0.5545	0.6500
B-Control	0.6000	0.5700	0.5900	0.6200
4.6	0.6000	0.6600	0.5600	0.5800
9.1	0.4600	0.4200	0.4500	0.4200
18.3	0.3900	0.3600	0.3700	0.3600
36.6	0.3100	0.3400	0.2500	0.3100
73.1	0.1900	0.2000	0.2100	0.2000

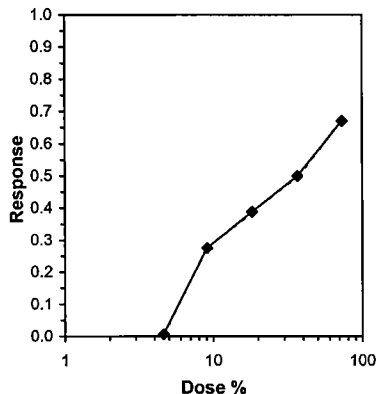
Conc-%	Mean	SD	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
D-Control	0.6036	0.0409	0.6036	0.5545	0.6500	6.778	4				0.6035	1.0000
B-Control	0.5950	0.0208	0.5950	0.5700	0.6200	3.499	4					
4.6	0.6000	0.0432	0.6000	0.5600	0.6600	7.201	4	0.166	2.410	0.0523	0.6000	0.9942
*9.1	0.4375	0.0206	0.4375	0.4200	0.4600	4.712	4	7.650	2.410	0.0523	0.4375	0.7249
*18.3	0.3700	0.0141	0.3700	0.3600	0.3900	3.822	4	10.759	2.410	0.0523	0.3700	0.6131
*36.6	0.3025	0.0377	0.3025	0.2500	0.3400	12.479	4	13.868	2.410	0.0523	0.3025	0.5013
*73.1	0.2000	0.0082	0.2000	0.1900	0.2100	4.082	4	18.589	2.410	0.0523	0.2000	0.3314

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97262	0.884	0.10504	0.3504
Bartlett's Test indicates equal variances (p = 0.12)	8.83506	15.0863		
The control means are not significantly different (p = 0.72)	0.37528	2.44691		

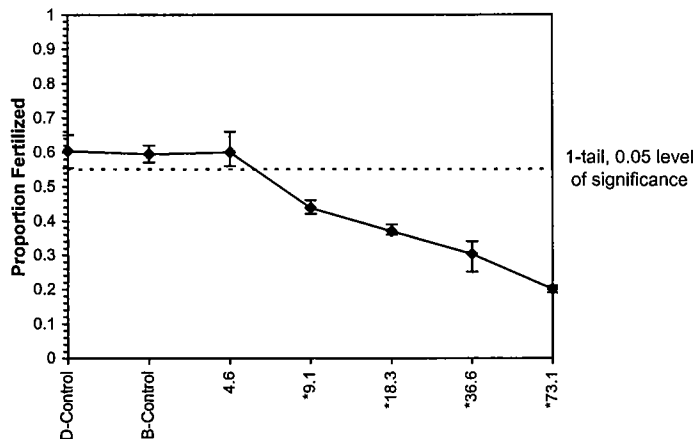
  

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4.6	9.1	6.46993	21.7391	0.05233	0.08669	0.1049	0.00094	6.9E-13	5, 18

Log-Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)	Skew	
IC05	5.169	1.017	0.000	5.397	-2.0092
IC10	5.883	0.366	4.155	6.252	-1.2685
IC15	6.680	0.367	5.002	7.221	-0.7933
IC20	7.569	0.396	5.813	8.353	-0.2936
IC25	8.561	0.492	6.881	9.883	0.8154
IC40	19.868	2.019	13.185	25.832	0.4117
IC50	36.788	4.538	22.468	46.940	-0.2718



Dose-Response Plot



Statistical comparisons were against the D-control

**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 7/30/2004 10:10 Test ID: 400340 Sample ID: G CREEK 270704E  
 End Date: 7/30/2004 Lab ID: BCEVS-EVS Environment Cr Sample Type: EFF2-Industrial  
 Sample Date: 7/27/2004 Protocol: EPS1/RM/27-EC 92 (Sperm + Test Species: DE-Dendroaster excentricus  
 Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400340)

Conc-%	1	2	3	4
D-Control	0.5900	0.6200	0.5545	0.6500
B-Control	0.6000	0.5700	0.5900	0.6200
4.6	0.6000	0.6600	0.5600	0.5800
9.1	0.4600	0.4200	0.4500	0.4200
18.3	0.3900	0.3600	0.3700	0.3600
36.6	0.3100	0.3400	0.2500	0.3100
73.1	0.1900	0.2000	0.2100	0.2000

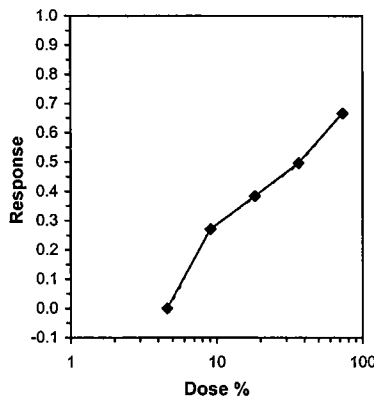
Conc-%	Mean	SD	Transform: Untransformed					N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	Mean					N-Mean	
Pooled	0.5993	0.0304	0.5993	0.5545	0.6500	5.073	8				0.5996	1.0000	
4.6	0.6000	0.0432	0.6000	0.5600	0.6600	7.201	4	-0.039	2.508	0.0444	0.5996	1.0000	
*9.1	0.4375	0.0206	0.4375	0.4200	0.4600	4.712	4	9.132	2.508	0.0444	0.4375	0.7296	
*18.3	0.3700	0.0141	0.3700	0.3600	0.3900	3.822	4	12.941	2.508	0.0444	0.3700	0.6171	
*36.6	0.3025	0.0377	0.3025	0.2500	0.3400	12.479	4	16.750	2.508	0.0444	0.3025	0.5045	
*73.1	0.2000	0.0082	0.2000	0.1900	0.2100	4.082	4	22.535	2.508	0.0444	0.2000	0.3335	

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97514	0.896	0.207	0.38283
Bartlett's Test indicates equal variances (p = 0.14)	8.25726	15.0863		
The control means are not significantly different (p = 0.72)	0.37528	2.44691		

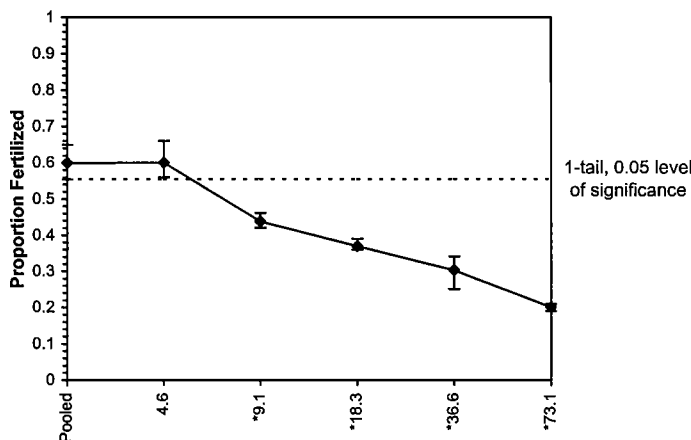
  

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	4.6	9.1	6.46993	21.7391	0.04445	0.07416	0.12612	0.00084	3.0E-16	5, 22

Log-Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)	Skew	
IC05	5.245	0.437	3.010	5.322	-4.5891
IC10	5.965	0.211	4.856	6.144	-1.3490
IC15	6.768	0.218	5.712	7.144	-0.5439
IC20	7.663	0.265	6.670	8.281	0.2881
IC25	8.661	0.385	7.566	9.896	1.1053
IC40	20.352	1.691	14.803	25.784	0.6254
IC50	37.275	3.916	24.371	46.032	-0.2591 %v/v



Dose-Response Plot



Statistical comparisons were against the pooled controls

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY**

Client AZIMOTH CONSULTING GROUP  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400340

EVS Analysts KES, ART  
 Test Initiation Date 30 JULY 2004

**SAMPLE**

**TEST SPECIES**

Identification Prep'd SDS Ref Tox Stock Sol<sup>n</sup> #04-5-005  
 Amount Received 1 X 1 L  
 Date Collected Prep'd 26 April 2004  
 Date Received n/a  
 Temperature (°C) \_\_\_\_\_  
 pH \_\_\_\_\_  
 Dissolved Oxygen (mg/L) \_\_\_\_\_  
 Conductivity (µmhos/cm) \_\_\_\_\_  
 Salinity (ppt) \_\_\_\_\_  
 Ammonia (mg/L N) \_\_\_\_\_  
 Chlorine (mg/L Cl) \_\_\_\_\_  
 Other \_\_\_\_\_

Organism Dendroaster eccentricus  
 Source Westwind Sealab Supply  
 Date Received 30 July 2004  
 Reference Toxicant SDS

Current Reference Toxicant Result  
 Reference Toxicant Test Date 30 July 2004  
 IC50 (and 95% CL) 2.1 (1.9-2.4) mg/L SDS  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
4.2 ± 4.8 mg/L SDS, CV% = 57

**DILUTION/CONTROL WATER** (initial water quality)

**TEST CONDITIONS**

Water Type UV Sterilized, 0.45µm filtered SW  
 Temperature (°C) 16.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 8.2  
 Salinity (ppt) 28  
 Other -

Temperature Range (°C) 16.0  
 pH Range 8.0  
 Dissolved Oxygen Range (mg/L) 8.2  
 Salinity Range (ppt) 28  
 Sperm:Egg Ratio 1600:1  
 Test Duration 10:10  
 Other -

**TEST RESULTS**

IC 50 : 2.1 (1.9-2.4) mg/L SDS  
 IC 25 : 1.0 (0.9-1.5) mg/L SDS  
 NOEC : < 1 mg/L SDS  
 LOEC : 1 mg/L SDS

Data Verified By [Signature]

Date Verified Sept - 10/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY**

Client AZIMUTH CONSULTING GROUP  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400340  
 Logbook ECHINOID #13 Pages 50-53

Test Initiation Date/Time 30 July 2004 @ 16:20  
 Test Species Dendroaster ~~sp~~ eccentricus  
 Source/Date Received 30 July  
 Test Duration 10:10

Sample ID	Conc/Rep mg/L	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
SDS	Control	16.0	8.0	28	8.2	
↓	1.0	16.0	8.0	28	<del>8.4</del> 8.2	
	1.8	16.0	8.0	28	8.2	
	3.2	16.0	8.0	28	8.2	
	5.6	16.0	8.0	28	8.2	
	10.0	16.0	8.0	28	8.2	
Tech. Init.	Kef	Kef	Kef	Kef	Kef	

WQ Instruments Used: Temp. Calibrated by thermometer pH II-A-51 Salinity II-A-03-030 DO II-A-011202  
 Data Verified By [Signature] Date Verified Sept 8/04



**EVS ENVIRONMENT CONSULTANTS**  
**ECHINOID FERTILIZATION TOXICITY TEST - EGG COUNTS (CONTROLS)**

Client AZIMUTH CONSULTING GROUP  
 EVS Project No. 09 0302-54  
 EVS Work Order No. 0400340  
 Logbook ECHINOID #13 Pages 50-53

Test Initiation Date/Time 30 JULY 2004 @ 16:20  
 Test Species Dendrosteris<sup>#</sup> excentricus  
 Test Duration 10:10  
 Sperm:Egg Ratio ~~1:1600~~ 1600:1  
*Kef*

Concentration SDS mg/L	Replicate	No. Fertilized Eggs	No. Unfertilized Eggs	Comments	Tech. Initials
<b>Reference Toxicant</b>					
1.0	A	47	53		<i>Kef</i>
	B	55	45		↓
	C	50	50		↓
	D	48	52		↓
1.8	A	33	67		<i>Kef</i>
	B	36	64		↓
	C	39	61		↓
	D	35	65		↓
3.2	A	14	86		<i>Kef</i>
	B	11	89		↓
	C	<del>13</del> 15	85		↓
	D	18	82		↓
5.6	A	5	<del>89</del> 95		<i>Kef</i>
	B	8	92		↓
	C	7	93		↓
	D	5	<del>82</del> 95		↓
10.0	A	2	98		<i>Kef</i>
	B	3	97		↓
	C	2	98		↓
	D	2	98		↓
<b>Control Seawater</b>					
	A	59	41		<i>Kef</i>
	B	62	38		↓
	C	56	44		↓
	D	65	35		↓

Data Verified By *Jalpith*

Date Verified Sept. 10/04

Test: SC-Sperm Cell Fertilization test

Test ID: rtscsds8

Species: DE-Dendraster excentricus

Protocol: EPS1/RM/27-EC 92 (Sperm Cell)

Sample ID: REF-Ref Toxicant

Sample Type: SDS-Sodium dodecyl sulfate

Start Date: 7/30/2003 10:10

End Date: 7/30/2003

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	59	41	
	2	2	D-Control	100	62	38	
	3	3	D-Control	100	56	44	
	4	4	D-Control	100	65	35	
	5	1	1.0	100	47	53	
	6	2	1.0	100	55	45	
	7	3	1.0	100	50	50	
	8	4	1.0	100	48	52	
	9	1	1.8	100	33	67	
	10	2	1.8	100	36	64	
	11	3	1.8	100	39	61	
	12	4	1.8	100	35	65	
	13	1	3.2	100	14	86	
	14	2	3.2	100	11	89	
	15	3	3.2	100	15	85	
	16	4	3.2	100	18	82	
	17	1	5.6	100	5	95	
	18	2	5.6	100	8	92	
	19	3	5.6	100	7	93	
	20	4	5.6	100	5	95	
	21	1	10.0	100	2	98	
	22	2	10.0	100	3	97	
	23	3	10.0	100	2	98	
	24	4	10.0	100	2	98	

Comments: Azimuth Consulting Group 09-0302-54 (0400340)

**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 7/30/2003 10:10 Test ID: rtscds8 Sample ID: REF-Ref Toxicant  
 End Date: 7/30/2003 Lab ID: BCEVS-EVS Environment Cr Sample Type: SDS-Sodium dodecyl sulfate  
 Sample Date: Protocol: EPS1/RM/27-EC 92 (Sperm) Test Species: DE-Dendroaster excentricus  
 Comments: Azimuth Consulting Group 09-0302-54 (0400340)

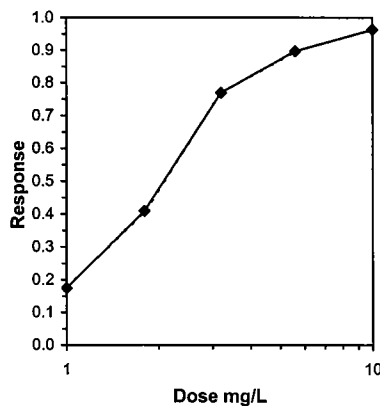
Conc-mg/L	1	2	3	4
D-Control	0.5900	0.6200	0.5600	0.6500
1	0.4700	0.5500	0.5000	0.4800
1.8	0.3300	0.3600	0.3900	0.3500
3.2	0.1400	0.1100	0.1300	0.1800
5.6	0.0500	0.0800	0.0700	0.0500
10	0.0200	0.0300	0.0200	0.0200

Conc-mg/L	Mean	SD	Transform: Untransformed					N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	Mean					N-Mean	
D-Control	0.6050	0.0387	0.6050	0.5600	0.6500	6.402	4				0.6050	1.0000	
*1	0.5000	0.0356	0.5000	0.4700	0.5500	7.118	4	5.417	2.410	0.0467	0.5000	0.8264	
*1.8	0.3575	0.0250	0.3575	0.3300	0.3900	6.993	4	12.769	2.410	0.0467	0.3575	0.5909	
*3.2	0.1400	0.0294	0.1400	0.1100	0.1800	21.028	4	23.990	2.410	0.0467	0.1400	0.2314	
*5.6	0.0625	0.0150	0.0625	0.0500	0.0800	24.000	4	27.989	2.410	0.0467	0.0625	0.1033	
*10	0.0225	0.0050	0.0225	0.0200	0.0300	22.222	4	30.052	2.410	0.0467	0.0225	0.0372	

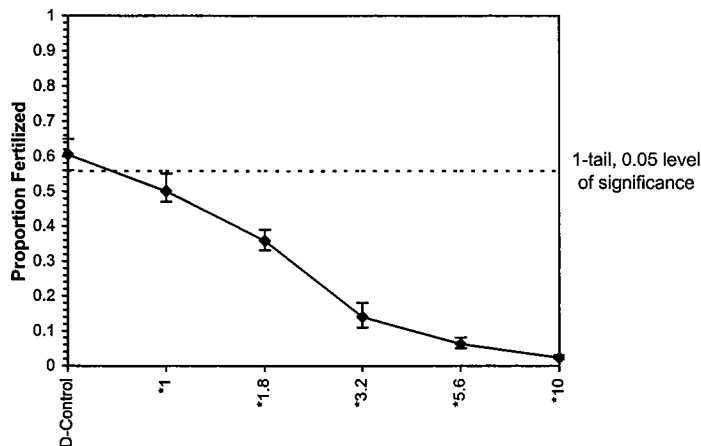
Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95924	0.884	0.47024	-0.048						
Bartlett's Test indicates equal variances (p = 0.10)	9.12722	15.0863								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	<1	1			0.04671	0.07721	0.23459	0.00075	7.9E-17	5, 18

Log-Linear Interpolation (200 Resamples)					
Point	mg/L	SD	95% CL(Exp)	Skew	
IC05*	0.2210	0.0598	0.1215	0.4427	1.9998
IC10*	0.4909	0.1376	0.2541	1.0631	1.4199
IC15*	0.8204	0.1664	0.3977	1.2636	0.1322
IC20	1.0770	0.1112	0.6393	1.3408	-0.5478
IC25	1.2308	0.0881	0.9462	1.4744	0.0167
IC40	1.7639	0.0892	1.4812	2.0222	0.0823
IC50	2.1023	0.0768	1.8738	2.3581	0.1963

\* indicates IC estimate less than the lowest concentration



Dose-Response Plot



## **APPENDIX C**

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### Chain-of-Custody Form

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

Client Name: Teek Cominco (Polaris) Client Contact Name: Cheryl Mackintosh Ship to: \_\_\_\_\_  
 Address: Azimuth Consulting Group Phone: 604 730 1220  
218-2902 West Broadway Fax: 604 739 8511  
Vancouver B.C. Sampled By: Kardette Tunaley Attn: \_\_\_\_\_

Shipping Date: \_\_\_\_\_ Toprock

Collection Date (dd/mmm/yy)	Time (24-h clock)	Sample Identification	1 Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab, C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	2 Sample Container Type by Code	Test(s) Requested				3 Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)
For composite sample record date & time starting and ending												
<u>27/07/04</u>	<u>9:30AM</u>	<u>G-Creek-Sublethal-270704 E</u>				<u>2x20LOPE</u>						<u>POLARIS PROJ</u>
		<u>G-Creek-Acute-270704 E</u>				<u>3x20LOPE</u>						<u>POLARIS PROJ</u>

Photocopy of original because 3 cooler.

PO/Reference No.: \_\_\_\_\_ Comments/Instructions: \_\_\_\_\_  
 Project Title: \_\_\_\_\_  
 Results Needed By: \_\_\_\_\_

A) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: Tape Straps Lock Other _____ Custody seals used? Yes No (circle one)	B) Received by: <u>AW</u> Date: <u>July 30 - 04</u> Company: <u>EVS</u> Time: <u>1200</u> Shipping containers received secure? Yes No Custody seals intact? Yes No <u>N/A</u>	C) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: Tape Straps Lock Other _____ Custody seals used? Yes No (circle one)	D) Received by: _____ Date: _____ Company: _____ Time: _____ Shipping containers received secure? Yes No Custody seals intact? Yes No <u>N/A</u>
---	--	---	---

1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)  
 2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify) HDPE plastic  
 3 Please note any conditions the lab should be aware of for safety and storage concerns  
 4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Distribution of copies: White, yellow, pink - accompany the shipment  
 Orange - retained by consignor (e.g., shipper)  
 Yellow - retained by consignee (e.g., receiver)  
 Pink - for use as needed  
 White - returned to consignor by consignee

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

Client Name: Teck Cominco (Polaris) Client Contact Name: Cheryl Mackintosh Ship to: \_\_\_\_\_  
 Address: Azimuth Consulting Group Phone: 604 730 1220  
218-2902 West Broadway Fax: 604 739 8511  
Vancouver B.C. Sampled By: Kardette Tunaley Attn: \_\_\_\_\_

Shipping Date: \_\_\_\_\_ Kathyra

Photo copy of original because 3 coolers

Collection Date (dd/mm/yy)	Time (24-h clock)	Sample Identification	1			2				3			
			Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab; C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	Sample Container Type by Code	Test(s) Requested				Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)	
For composite sample record date & time starting and ending													
<u>27/07/04</u>	<u>9:30AM</u>	<u>G-Creek-Sublethal-270704/E</u>				<u>2x20L</u>	<u>LOPE</u>						<u>POLARIS PROJ</u>
		<u>G-Creek-Acute-270704/E</u>				<u>3x20L</u>	<u>LOPE</u>						<u>POLARIS PROJ</u>

PO/Reference No.: \_\_\_\_\_ Comments/Instructions: \_\_\_\_\_  
 Project Title: \_\_\_\_\_  
 Results Needed By: \_\_\_\_\_

A) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: Tape Straps Lock Other _____ Custody seals used? Yes No (circle one)	B) Received by: <u>AWD</u> Date: <u>30 JULY 2004</u> Company: <u>EVS</u> Time: <u>12:00</u> Shipping containers received secure? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Custody seals intact? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	C) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: Tape Straps Lock Other _____ Custody seals used? Yes No (circle one)	D) Received by: _____ Date: _____ Company: _____ Time: _____ Shipping containers received secure? <input type="checkbox"/> Yes <input type="checkbox"/> No Custody seals intact? Yes No N/A
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1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)  
 2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify) HDPE Plastic  
 3 Please note any conditions the lab should be aware of for safety and storage concerns  
 4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Revision Date: Sept. 25, 2000

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October 2004

LABORATORY REPORT

**Azimuth Consulting Group**  
POLARIS MINE  
ENVIRONMENTAL EFFECTS  
MONITORING PROGRAM  
August 24, 2004

**PREPARED FOR:**

**PREPARED BY:**

**Azimuth Consulting Group**  
*Vancouver, BC*

 **EVS** environment  
consultants  
A Member of the Golder Group of Companies  
*North Vancouver, BC*

**AZIMUTH CONSULTING GROUP**

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**POLARIS MINE  
ENVIRONMENTAL EFFECTS  
MONITORING PROGRAM**

**August 24, 2004**

**LABORATORY REPORT**

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**Prepared for**

**Azimuth Consulting Group**  
218-2902 W. Broadway  
Vancouver, BC  
V6K 2G8

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**Prepared by**

**EVS Environment Consultants - A Member of the  
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195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4

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**EVS Project No.**

09-0302-54

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**October 2004**



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## ACKNOWLEDGEMENTS

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The *A. affinis* toxicity test was conducted by Andy Diewald, Anja Fouche and Jenny Shao. Kathryn Sentance and Ann-Marie Norris performed the *D. excentricus* fertilization toxicity test. Statistical analyses were performed by Jenny Shao and Kathryn Sentance. The report was written by Kathryn Sentance and reviewed by Edmund Canaria. Quality Assurance/Quality Control (QA/QC) review was conducted by Julianna Kalokai.

# 1. INTRODUCTION

---

EVS Environment Consultants conducted sublethal Metal Mining Effluent Regulations (MMER) toxicity testing for Azimuth Consulting Group as part of the Environmental Effects Monitoring (EEM) program for Polaris Mine.

A sample, identified as G Creek-082404, was collected from the Polaris Mine Site on August 24, 2004 in 20-L collapsible polyethylene containers. It was received at the EVS laboratory on August 27, 2004 and was stored in the dark at 4°C prior to test initiation. The sample was evaluated for toxicity using the 7-d topsmelt (*Atherinops affinis*) survival and growth toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. Toxicity testing was initiated on the day of initial sample receipt.

This report describes the methods and results of the 7-d topsmelt (*Atherinops affinis*) toxicity test and the echinoderm (*Dendraster excentricus*) fertilization toxicity test. The raw data and statistical analyses are provided in Appendix A and B respectively, and the chain-of-custody form is provided in Appendix C.

## 2. METHODS

---

### 2.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

A static-renewal 7-d toxicity test and reference toxicant test using topsmelt (*A. affinis*) was conducted in accordance with EVS Environment Consultants Standard Operating Procedures (SOP) 1100-5 (EVS, 2004) with modifications based on U.S. Environmental Protection Agency (USEPA, 1995). Test conditions and methods are summarized in Table 1.

This 7-day test exposes topsmelt larvae to different concentrations of a given sample. Fish are fed on a daily basis and both survival and growth endpoints are measured at test termination. These observations are assessed in comparison to the pooled negative and brine controls.

### 2.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The echinoderm (*Dendraster excentricus*) fertilization toxicity test was conducted in accordance with Environment Canada (1992 with 1997 amendments). Test conditions and methods summarized in Table 2.

This fertilization test involves exposing echinoderm sperm to a series of test concentrations for ten minutes, echinoderm eggs are then added allowing fertilization to occur for ten minutes. Following the ten minutes exposure time the eggs are preserved and the number of fertilized and unfertilized eggs in each replicate are counted. These observations are assessed in comparison to the pooled negative and brine controls.

### 2.3 STATISTICAL ANALYSIS

Statistical analyses for all tests were conducted using the computer software program TOXCALC (version 5.0.23; Tidepool Scientific Software, 1994).

### 2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This study followed a comprehensive QA/QC Program to ensure full documentation and minimize possible errors in computation and reporting of results. The following general

QA/QC guidelines were applied in this test: use of negative controls, use of positive controls, use of brine controls, replication, instrument calibration, water quality maintenance and record-keeping, and use of standard operating procedures (SOPs). To ensure the highest quality of data and reporting, all data and statistical analyses were reviewed by a member of our QA/QC Committee prior to reporting the results.

**Table 1.** 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static-renewal
Test duration	7 d
Test chamber	600-mL beaker
Test solution volume	200 mL
Number of replicate chambers per treatment	5
Number of organisms per test chamber	5
Age of test organisms at test initiation	10 d
Food	Newly hatched <i>Artemia</i> nauplii (<24 hours old)
Feeding Regime	Fed 0.5 mL/ beaker twice daily of concentrated nauplii suspension (prepared to provide 200 nauplii in 0.5 mL); no feeding at test termination
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity-adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.4, 9.0, 18.0, 36.0, 71.0% (v/v)
Renewal of dilutions	Daily
Aeration	None
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and salinity daily
Temperature	20 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Overhead full-spectrum fluorescent lights; 538 – 1076 lux; 16:8 light:dark photoperiod
Reference toxicant	Initiated concurrently with sample using copper to generate LC50 and IC50 values; results compared to lab mean ± 2 SD
Endpoints	Survival and growth (dry weight)
Test validity	≥ 80% mean control survival; ≥ 0.85 mg/fish mean dry weight for surviving control fish
Reference protocol	US EPA (1995), EPA/600/R-95/136

**Table 2.** Echinoderm (*Dendraster excentricus*) fertilization toxicity test methods

TEST PARAMETER	TEST CONDITION
Test type	Static
Test duration	10:10 min
Test chamber	16 X 125 mm test tubes
Test solution volume	10 mL
Number of replicate chambers per treatment	4
Number of eggs per test chamber	2000
Age of test organisms	< 4 hours after spawning
Sample manipulations (e.g. pre-aeration, pH adjustment, filtration)	Salinity adjusted
Control/dilution water	UV-sterilized and 0.5µm-filtered natural sea water from Vancouver Aquarium, BC
Dilutions	4.7, 9.4, 18.8, 37.5, 75.1% (v/v)
Renewal of dilutions	None
Aeration	None during testing
Water quality parameters and frequency	Temperature, pH, dissolved oxygen, and salinity
Temperature	15 ± 1°C
Salinity	30 ± 2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment –July 1997)
Lighting	Ambient laboratory illumination (moderate intensity)
Reference toxicant	Initiated concurrently with test; same test methods as above using SDS to generate an EC50 value; results compared to lab mean ± 2 SD
Endpoint	Fertilization of eggs
Test validity	≥ 50% and ≤ 100% mean control fertilization
Reference protocols	Environment Canada (1992), (EPS/1/RM/27 with 1997 amendments)



## 3. RESULTS

---

### 3.1 7-D TOPSMELT (*ATHERINOPS AFFINIS*) SURVIVAL AND GROWTH TOXICITY TEST

The test results are summarized in Table 1 and the raw statistical analyses are provided in Appendix A.

The highest concentration tested was approximately 71.0% due to salinity adjustment. The mean survival in both the negative and brine controls was 100%. Mean dry weight in the pooled controls was 0.95mg. The negative and brine controls were not significantly different for the growth and survival endpoints ( $p=1.00$  and  $p=0.72$ , respectively).

The *A. affinis* survival and growth toxicity test showed no adverse effects on survival or growth in all tested concentrations relative to the pooled controls ( $p\leq 0.05$ ). For the survival and growth endpoints the NOEC was 71.0, and the LOEC was  $>71.0\%$  (v/v). The LC50 for survival was  $>71.0\%$  (v/v). The IC50 and IC25 for growth were both  $>71.0\%$  (v/v).

### 3.2 ECHINODERM (*DENDRASTER EXCENTRICUS*) FERTILIZATION TOXICITY TEST

The test results are summarized in Table 2 and the raw statistical analyses are provided in Appendix B.

The highest concentration tested was 75.1% due to salinity adjustment. Mean fertilization in the pooled controls was 76.6%. The negative and brine controls were not significantly different ( $p=0.68$ ).

The *D. excentricus* fertilization toxicity test exhibited adverse effects on egg fertilization in all except the lowest [4.7%(v/v)] test concentrations relative to the pooled controls ( $p\leq 0.05$ ). The NOEC was 4.7 and LOEC was 9.4 %(v/v). The IC50 and IC25 (95% confidence limits) values were 50.7 (48.1 – 53.6) and 17.5 (11.6 – 22.6) %(v/v), respectively.

### 3.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The tests met all passing criteria for test validity as outlined in the respective protocols. Water quality parameters during the test were all within the acceptable range of values. Point estimates for the reference toxicant tests were all within the laboratory mean  $\pm 2$  standard deviations, indicating that the tests were within acceptable limits of variability.

**Table 3.** Summary of results for the 7-d Topsmelt (*Atherinops affinis*) survival and growth toxicity test

<b>TEST CONCENTRATION (% v/v)</b>	<b>SURVIVAL (%) (MEAN ± SD)</b>	<b>GROWTH (DRY WEIGHT MG) (MEAN ± SD)</b>
D-Control	100.0 ± 0.0	0.93 ± 0.06
Brine Control	100.0 ± 0.0	0.96 ± 0.18
Pooled Controls	100.0 ± 0.0	0.95 ± 0.13
4.4	100.0 ± 0.0	1.06 ± 0.26
9.0	100.0 ± 0.0	0.87 ± 0.06
18.0	100.0 ± 0.0	0.97 ± 0.17
36.0	96.0 ± 8.9	0.92 ± 0.13
71.0	100.0 ± 0.0	0.87 ± 0.16

<b>TEST ENDPOINT</b>	<b>SURVIVAL (% v/v)</b>	<b>GROWTH (% v/v)</b>
NOEC	71.0	71.0
LOEC	>71.0	>71.0
LC50	>71.0	na
IC50	na	>71.0
IC25	na	>71.0

\*Indicates significant difference ( $p \leq 0.05$ ) relative to the pooled controls.  
SD – Standard Deviation; na – not applicable.

**Table 4.** Summary of results for the Echinoderm (*Dendraster excentricus*) fertilization toxicity test

<b>TEST CONCENTRATION (% v/v)</b>	<b>PROPORTION FERTILIZED (%) (MEAN ± SD)</b>
Negative Control	77.0 ± 2.4
Brine Control	76.2 ± 2.5
Pooled Control	76.6 ± 2.3
4.7	75.0 ± 2.6
9.4	61.2 ± 1.0*
18.8	57.0 ± 1.8*
37.5	49.2 ± 1.0*
75.1	25.8 ± 1.5*

<b>TEST ENDPOINT</b>	<b>PROPORTION FERTILIZED % (v/v)</b>
NOEC	4.7
LOEC	9.4
IC50 (95% CL)	50.7 (48.1 – 53.6)
IC25 (95% CL)	17.5 (11.6 – 22.6)

\*Indicates significant difference ( $p \leq 0.05$ ) relative to the pooled controls.  
SD – Standard Deviation; CL – Confidence Limits.

## 4. REFERENCES

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- Environment Canada. 1992. Biological test method: fertilization of echinoids (sea urchins and sand dollars). Environmental Protection Series, Report EPS 1/RM/27, December 1992. Environment Canada, Conservation and Protection, Ottawa, ON. 68 pp + appendices. Amended November 1997.
- EVS (EVS Environment Consultants). 2004. Topsmelt (*Atherinops affinis*) 7-d larval survival and growth test. EVS SOP 1100-5. In: EVS Consultants Laboratory Standard Operating Procedures (SOP) Manual. Volume II: Water Toxicity Tests. EVS Environment Consultants, North Vancouver, BC.
- US EPA (U.S. Environmental Protection Agency). 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 3<sup>rd</sup> edition. US Environmental Protection Agency, Office of Water (4303T). US Environmental Protection Agency, Washington, DC. EPA/821/R-02/014. 464 pp.
- US EPA. 1995. Short term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. 2<sup>nd</sup> edition. US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Washington, DC. EPA/600/R-95/136. 563 pp.
- Tidepool Scientific Software. 1994. TOXCALC: Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.23. Tidepool Scientific Software, McKinleyville, CA. 80 pp.

## **APPENDIX A**

---

Raw Data and Statistical Analyses:

*Atherinops affinis*

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client Azimukh (Polans)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

EVS Analysts AWD, JxS  
 Test Initiation Date Aug 27, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	G-Creek 082404	→	→
Amount Received	1 x 20L	→	→
Date Collected	24-Aug-04	→	→
Date Received	27-Aug-04	→	→
Temperature (°C)	20.0 <sup>B</sup> 20.0	20.0 <sup>D</sup> 20.0	20.0 <sup>D</sup> 20.0
pH	7.6 <sup>B</sup> 8.1	7.6 <sup>D</sup> 8.2	7.5 <sup>D</sup> 8.3
DO (mg/L)	10.1 <sup>B</sup> 7.4	10.0 <sup>D</sup> 7.5	11.0 <sup>D</sup> 7.5 <sup>B</sup>
Conductivity (µmhos/cm)	9230	—	—
Salinity (ppt)	5.2 <sup>B</sup> 28	5.1 <sup>D</sup> 28	5.2 <sup>D</sup> 28
Ammonia (mg/L N)			
Chlorine (mg/L Cl)			
Other	D Salinity adj to 30 ± 2 ppt w/ 90 ppt MSB		

**DILUTION/CONTROL WATER** (initial water quality)  
 Water Type UV Sterilized S.W.  
 Temperature (°C) 20.0  
 pH 7.8  
 Dissolved Oxygen (mg/L) 7.4  
 Salinity 28

**TEST CONDITIONS**  
 Temperature Range (°C) 20.0 - 21.0  
 pH Range 7.8 - 8.3  
 Dissolved Oxygen Range (mg/L) 6.4 - 7.6  
 Salinity (ppt) 28  
 Photoperiod (L:D h) 16:8  
 Aeration Provided? No  
 Other —

**TEST SPECIES INFORMATION**  
 Source ABS (Aquatic Bio Systems)  
 Date Received Aug 26, 2004  
 Age (on Day 0) 10-d  
 Reference Toxicant Copper  
 Current Reference Toxicant Result (incl. 95% CL)  
 Reference Toxicant Test Date Aug 27, 2004  
 7-d survival LC50 121 (107-137) µg/L  
 7-d growth IC50 128 (115-153) µg/L  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
 7-d survival LC50 132 ± 48 µg/L CV: 18%  
 7-d growth IC50 138 ± 51 µg/L CV: 20%

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	% (✓/✓)	71	>71	>71		
Growth		71	>71		>71	>71

Other \_\_\_\_\_

Data Verified By [Signature] Date Verified Oct-27/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID G-Creek @ 082404  
 Test Initiation Date/Time Aug 27, 2004 @ 12:20 L  
 Source/Date Received ABS / Aug 26, 2004

Concentration % (V/V)	Temperature (°C)													
	0	old	1 New	2	3	4	5	6	7					
Control	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.0	20.5
Brine Control	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.5	20.0
4.4	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.5	20.5
9.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.5	20.5
18	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.5	20.5
36	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.5	20.0	20.5	20.5
71	20.0	20.5	20.0	20.5	20.0	20.5	20.0	20.5	21.0	20.0	20.6	20.0	20.0	20.5
Tech. Initials	~	~	~	~	~	~	~	~	~	~	~	~	~	~

Concentration % (V/V)	pH													
	0	1	2	3	4	5	6	7						
Control	7.8	8.0	8.0	8.1	7.9	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.9	7.9
Brine Control	7.8	8.0	8.0	8.1	7.9	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.9	7.9
4.4	7.7	8.1	8.1	8.1	8.1	8.0	8.1	8.0	8.1	8.0	8.1	7.9	7.9	8.0
9.0	7.8	8.3	8.1	8.2	8.1	8.0	8.2	8.0	8.1	8.1	8.1	8.0	7.9	8.0
18	7.8	8.2	8.1	8.2	8.2	8.0	8.2	8.0	8.1	8.1	8.1	8.0	8.0	8.1
36	7.9	8.3	8.2	8.2	8.2	8.0	8.2	8.1	8.2	8.1	8.1	8.1	8.0	8.1
71	8.1	8.3	8.3	8.3	8.2	8.0	8.3	8.2	8.3	8.2	8.2	8.2	8.1	8.1
Tech. Initials	~	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Temp. Calibrated Hg Thermometer pH H-A-52  
 Comments \_\_\_\_\_

Test Set Up By AWB Data Verified By Quipik Date Verified Oct 20/04

**EVS ENVIRONMENT CONSULTANTS**

**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID G-Creek 082404  
 Test Initiation Date/Time Aug 20<sup>th</sup>, 2004 @ 12:30  
 Source/Date Received ABS / Aug 26<sup>th</sup>, 2004

Concentration ‰ (‰)	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Control	28	28	28	28	28	28	28	28
Brine Control	28	28	28	28	28	28	28	28
4.4	28	28	28	28	28	28	28	28
9.0	28	28	28	28	28	28	28	28
18	28	28	28	28	28	28	28	28
36	28	28	28	28	28	28	28	28
71	28	28	28	28	28	28	28	28
Tech. Initials	~	~	~	~	~	~	~	~

Concentration ‰ (‰)	Dissolved Oxygen (mg/L)													
	0	1	2	3	4	5	6	7						
Control	7.4	6.5	7.5	6.9	7.5	7.0	7.5	7.0	7.5	6.4	7.4	7.6	6.5	6.6
Brine Control	7.4	6.6	7.5	6.8	7.5	6.9	7.5	6.9	7.5	6.6	7.4	7.5	6.4	6.9
4.4	7.4	6.7	7.5	6.7	7.5	6.9	7.5	6.9	7.5	6.7	7.5	7.6	6.6	6.5
9.0	7.4	6.6	7.5	6.8	7.5	6.9	7.5	7.0	7.5	6.8	7.5	7.6	6.6	6.5
18	7.4	6.4	7.5	6.8	7.5	6.9	7.5	6.9	7.5	6.8	7.6	7.5	6.7	6.5
36	7.4	6.5	7.6	6.9	7.5	6.9	7.5	6.9	7.5	6.8	7.5	7.5	6.8	6.4
71	7.4	6.5	7.6	6.8	7.5	6.9	7.5	6.9	7.5	6.7	7.4	7.5	6.7	6.5
Tech. Initials	~	~	~	~	~	~	~	~	~	~	~	~	~	~

WQ Instruments Used: Salinity II-A-030304 DO II-A-3  
 Comments \_\_\_\_\_

Test Set Up By AWO Data Verified By Galpin Date Verified Oct-20/04



**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID Cr. Creek 082404  
 Test Species/Batch *A. affinis* / Aug 17-04  
 Test Initiation Date/Time Aug 23, 2004 @ 1230L  
 No. of Organisms/Volume 5 / 200mL

‰ (v/v) Concentration	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Control	A	A 31	5	5	5	5	5	5	5	
	B	32	5	5	5	5	5	5	5	
	C	33	5	5	5	5	5	5	5	
	D	34	5	5	5	5	5	5	5	
	E	35	5	5	5	5	5	5	5	
Brine	A	36	5	5	5	5	5	5	5	
	B	37	5	5	5	5	5	5	5	
	C	38	5	5	5	5	5	5	5	
	D	39	5	5	5	5	5	5	5	
	E	40	5	5	5	5	5	5	5	
4.4	A	41	5	5	5	5	5	5	5	
	B	42	5	5	5	5	5	5	5	
	C	43	5	5	5	5	5	5	5	
	D	44	5	5	5	5	5	5	5	
	E	45	5	5	5	5	5	5	5	
9.0	A	546	5	5	5	5	5	5	5	
	B	547	5	5	5	5	5	5	5	
	C	548	5	5	5	5	5	5	5	
	D	549	5	5	5	5	5	5	5	
	E	680	5	5	5	5	5	5	5	
Technician Initials	JxS		m	~	~	~	~	~	~	

Sample Description clear, colorless  
 Data Verified By Galpin Date Verified Oct 20/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID G-Creek 082404  
 Test Species/Batch *A. affinis* / Aug 7-04  
 Test Initiation Date/Time Aug 27, 2004 @ 12:00h  
 No. of Organisms/Volume 5/200mL

‰ (µL) Concentration	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
18	A	<sup>23</sup> A 51 <sup>46</sup>	5	5	5	5	5	5	5	
	B	<sup>23</sup> 52 <sup>47</sup>	5	5	5	5	5	5	5	
	C	<sup>23</sup> 53 <sup>48</sup>	5	5	5	5	5	5	5	
	D	<sup>23</sup> 54 <sup>49</sup>	5	5	5	5	5	5	5	
	E	<sup>23</sup> 55 <sup>50</sup>	5	5	5	5	5	5	5	
36	A	<sup>23</sup> 56 <sup>51</sup>	5	5	5	5	5	5	5	
	B	<sup>23</sup> 57 <sup>52</sup>	5	5	5	5	5	5	5	
	C	<sup>23</sup> 58 <sup>53</sup>	5	5	5	5	5	5	4	
	D	<sup>23</sup> 59 <sup>54</sup>	5	5	5	5	5	5	5	
	E	<sup>23</sup> 60 <sup>55</sup>	5	5	5	5	5	5	5	
71	A	61	5	5	5	5	5	<sup>23</sup> 4 <sup>5</sup>	<sup>23</sup> 4 <sup>5</sup>	
	B	62	5	5	5	5	5	5	5	
	C	63	5	5	5	5	5	5	5	
	D	64	5	5	5	5	5	5	5	
	E	65	5	5	5	5	5	5	5	
	A	6								
	B	7								
	C	8								
	D	9								
	E	0								
Technician Initials		JCS	m	-	JCS	r	~	JCS	JCS	

Sample Description clear, colorless  
 Data Verified By Galpin Date Verified Oct 20/04

**EVS ENVIRONMENT CONSULTANTS**

**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA**

Client Ammath (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Start Date (Day 0) August 28<sup>th</sup>, 2009  
 Sample ID G-creek 082404  
 Balance Type/Serial Number Sartorius BP211D

Sample ID % (v/v)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
Control	A	A 31	1228.40	1233.24	5	5	pre-wt: 1228.42 mg	↓
	B	32	1229.96	1234.81	5	5		
	C	33	1231.09	1235.98	5	5		
	D	34	1226.23	1230.46	5	5	reweighed 1230.49 mg ✓	
	E	35	1218.59	1223.06	5	5		
Brine Control	A	36	1226.59	1231.11	5	5		↓
	B	37	1234.73	1239.03	5	5		
	C	38	1220.42	1226.76	5	5		
	D	39	1232.69	1237.55	5	5		
	E	40	1236.53	1240.57	5	5		
4.4%	A	41	1227.94	1232.63	5	5		↓
	B	42	1224.25	1231.84	5	5		
	C	43	1235.61	1240.72	5	5	reweighed 1240.68 mg ✓	
	D	44	1219.66	1223.97	5	5		
	E	45	1225.29	1230.00	5	5	pre-wt: 1225.29 mg	

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Craig K

Date Verified Oct. 20/09

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Start Date (Day 0) August 27<sup>th</sup>, 2004  
 Sample ID G-creek 082404  
 Balance Type/Serial Number Sartorius BP 211D

Sample ID % (J/J)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
18	A	A 46	1217.86	1222.48	5	5		↓
	B	47	1225.29	1228.77	5	5		
	C	48	1236.54	1242.18	5	5		
	D	49	1239.07	1244.52	5	5		
	E	50	1241.45	1246.42	5	5	reweighed: 1246.43 mg ✓	
36	A	51	1227 <sup>5</sup> 42	1230.87	5	5		↓
	B	52	1224.43	1228.50	5	5		
	C	53	1239.89	1243.83	4	4		
	D	54	1231.71	1236.86	5	5		
	E	55	1236.12	1240.57	5	5		
8.8	A	56	1233.41	1237.89	5	5		↓
	B	57	1232.69	1236.99	5	5		
	C	58	1218.75	1223.49	5	5		
	D	59	1232.98	1237.03	5	5		
	E	60	1222.96	1227.12	5	5	pre wt: 1222.96 mg	

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galpin

Date Verified Oct 20/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA**

Client Arizuma (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Start Date (Day 0) August 27, 2004  
 Sample ID G-Creek 082404  
 Balance Type/Serial Number Sartorius BP211.D

Sample ID % (y)	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
<sup>07</sup> 72 71	A	A 61	1236.40	1239.74	5	5		↓
	B	62	1236.44	1240.25	5	5		
	C	63	<del>1223.84</del> 1219.08	1224.54	5	5	reweighed 1224.57 mg	
	D	64	1228.47	1233.11	5	5		
	E	65	1243.42	1247.95	5	5	pre-wt: 1243.44 mg	
	A	6						
	B	7						
	C	8						
	D	9						
	E	10						
	A	1						
	B	2						
	C	3						
	D	4						
	E	5						

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galji G

Date Verified Oct 20/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: 0400384

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: G\_CREEK

Sample Type: EFF2-Industrial

Start Date: 8/27/2004

End Date: 9/3/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	D-Control	5							5	5	1233.24	1228.4
	2	2	D-Control	5							5	5	1234.81	1229.96
	3	3	D-Control	5							5	5	1235.98	1231.09
	4	4	D-Control	5							5	5	1230.46	1226.23
	5	5	D-Control	5							5	5	1223.06	1218.59
	6	1	Brine Control	5							5	5	1231.11	1226.59
	7	2	Brine Control	5							5	5	1239.03	1234.73
	8	3	Brine Control	5							5	5	1226.76	1220.42
	9	4	Brine Control	5							5	5	1237.55	1232.69
	10	5	Brine Control	5							5	5	1240.57	1236.53
	11	1	4.400	5							5	5	1232.63	1227.94
	12	2	4.400	5							5	5	1231.84	1224.25
	13	3	4.400	5							5	5	1240.72	1235.61
	14	4	4.400	5							5	5	1223.97	1219.66
	15	5	4.400	5							5	5	1230	1225.29
	16	1	9.000	5							5	5	1237.89	1233.41
	17	2	9.000	5							5	5	1236.99	1232.69
	18	3	9.000	5							5	5	1223.49	1218.75
	19	4	9.000	5							5	5	1237.03	1233.08
	20	5	9.000	5							5	5	1227.12	1222.96
	21	1	18.000	5							5	5	1222.48	1217.86
	22	2	18.000	5							5	5	1228.77	1225.29
	23	3	18.000	5							5	5	1242.18	1236.54
	24	4	18.000	5							5	5	1244.52	1239.09
	25	5	18.000	5							5	5	1246.42	1241.45
	26	1	36.000	5							5	5	1230.87	1225.42
	27	2	36.000	5							5	5	1228.5	1224.43
	28	3	36.000	5							4	4	1243.83	1239.89
	29	4	36.000	5							5	5	1236.86	1231.71
	30	5	36.000	5							5	5	1240.57	1236.12
	31	1	71.000	5							5	5	1239.74	1236.4
	32	2	71.000	5							5	5	1240.25	1236.44
	33	3	71.000	5							5	5	1224.54	1219.08
	34	4	71.000	5							5	5	1233.11	1228.47
	35	5	71.000	5							5	5	1247.95	1243.42

Comments: Azimuth - Polaris Mine; G-Creek, 09-0302-54 ;0400384

**Larval Fish Growth and Survival Test-7 Day Survival**

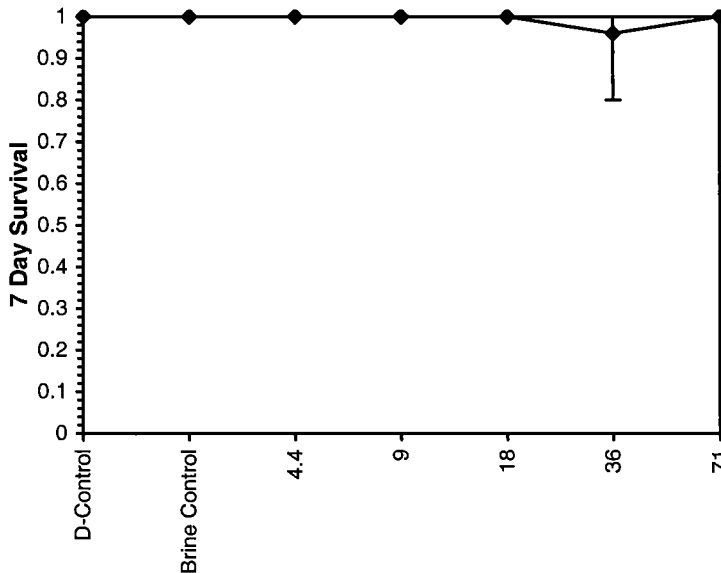
Start Date: 8/27/2004      Test ID: 400384      Sample ID: G\_CREEK-082404  
 End Date: 9/3/2004      Lab ID: BCEVS-EVS Environment Cc      Sample Type: EFF2-Industrial  
 Sample Date: 8/24/2004      Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: Azimuth - Polaris Mine; G-Creek, 09-0302-54 ;0400384

Conc-%	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.4	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
18	1.0000	1.0000	1.0000	1.0000	1.0000
36	1.0000	1.0000	0.8000	1.0000	1.0000
71	1.0000	1.0000	1.0000	1.0000	1.0000

Conc-%	Mean	SD	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%	N		
D-Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
Brine Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		
4.4	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
9	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
18	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00
36	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	16.00
71	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.41613	0.9	-3.8705	19.8512
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	71	>71		1.40845

**Dose-Response Plot**



Statistical comparison were against the D-control.

**Larval Fish Growth and Survival Test-7 Day Survival**

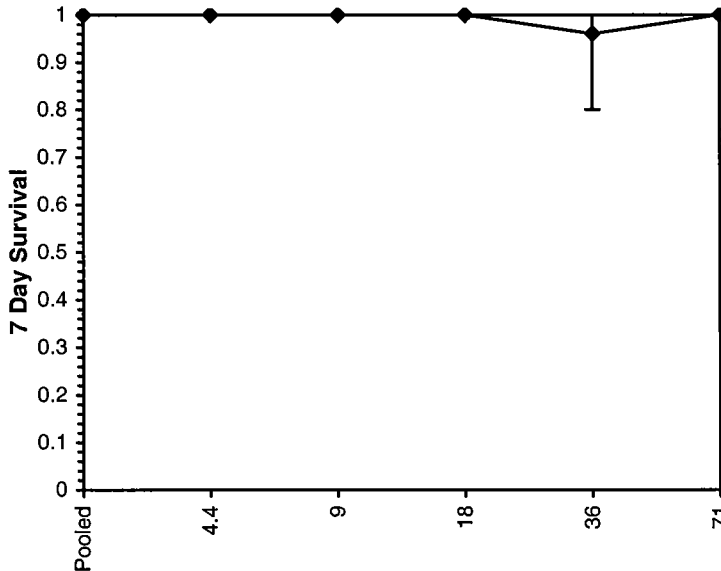
Start Date: 8/27/2004	Test ID: 400384	Sample ID: G_CREEK-082404
End Date: 9/3/2004	Lab ID: BCEVS-EVS Environment Cc	Sample Type: EFF2-Industrial
Sample Date: 8/24/2004	Protocol: EPAW 95-EPA West Coast	Test Species: AA-Atherinops affinis
Comments: Azimuth - Polaris Mine; G-Creek, 09-0302-54 ;0400384		

Conc-%	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	1.0000
Brine Control	1.0000	1.0000	1.0000	1.0000	1.0000
4.4	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000
18	1.0000	1.0000	1.0000	1.0000	1.0000
36	1.0000	1.0000	0.8000	1.0000	1.0000
71	1.0000	1.0000	1.0000	1.0000	1.0000

Conc-%	Mean	SD	Transform: Arcsin Square Root				Rank Sum	1-Tailed Critical
			Mean	Min	Max	CV%		
Pooled	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	10	
4.4	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	21.00
9	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	21.00
18	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	21.00
36	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	21.00
71	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	21.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.38831	0.91	-4.1486	23.0852
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.30601		
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	71	>71		1.40845

**Dose-Response Plot**



Statistical comparison were against the pooled control.



**Larval Fish Growth and Survival Test-7 Day Growth (US)**

Start Date: 8/27/2004      Test ID: 400384      Sample ID: G\_CREEK-082404  
 End Date: 9/3/2004      Lab ID: BCEVS-EVS Environment C      Sample Type: EFF2-Industrial  
 Sample Date: 8/24/2004      Protocol: EPAW 95-EPA West Coast      Test Species: AA-Atherinops affinis  
 Comments: Azimuth - Polaris Mine; G-Creek, 09-0302-54 ;0400384

Conc-%	1	2	3	4	5
D-Control	0.9680	0.9700	0.9780	0.8460	0.8940
Brine Control	0.9040	0.8600	1.2680	0.9720	0.8080
4.4	0.9380	1.5180	1.0220	0.8620	0.9420
9	0.8960	0.8600	0.9480	0.7900	0.8320
18	0.9240	0.6960	1.1280	1.0860	0.9940
36	1.0900	0.8140	0.7880	1.0300	0.8900
71	0.6680	0.7620	1.0920	0.9280	0.9060

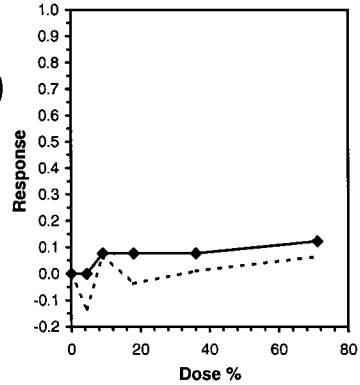
Conc-%	Mean	SD	Transform: Untransformed					N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	Mean					N-Mean	
D-Control	0.9312	0.0585	0.9312	0.8460	0.9780	6.283	5				0.9938	1.0000	
Brine Control	0.9624	0.1811	0.9624	0.8080	1.2680	18.820	5						
4.4	1.0564	0.2642	1.0564	0.8620	1.5180	25.007	5	-1.252	2.360	0.2361	0.9938	1.0000	
9	0.8652	0.0604	0.8652	0.7900	0.9480	6.980	5	0.660	2.360	0.2361	0.9177	0.9235	
18	0.9656	0.1704	0.9656	0.6960	1.1280	17.643	5	-0.344	2.360	0.2361	0.9177	0.9235	
36	0.9224	0.1328	0.9224	0.7880	1.0900	14.396	5	0.088	2.360	0.2361	0.9177	0.9235	
71	0.8712	0.1631	0.8712	0.6680	1.0920	18.721	5	0.600	2.360	0.2361	0.8712	0.8766	

Auxillary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94863	0.9	0.95961	2.51611
Bartlett's Test indicates equal variances (p = 0.05)	11.0427	15.0863		
The control means are not significantly different (p = 0.72)	0.36654	2.30601		

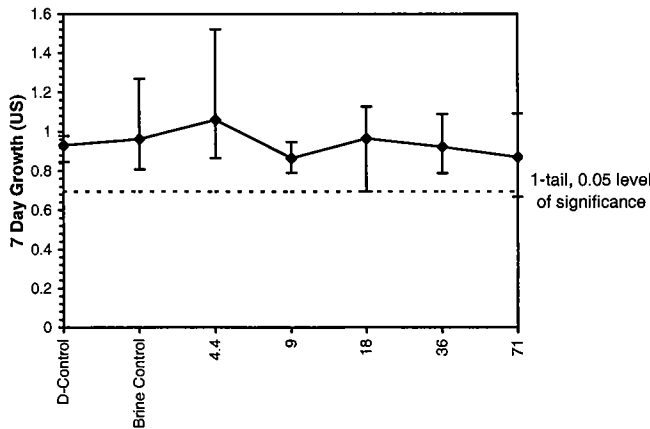
  

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	71	>71		1.40845	0.23609	0.25353	0.02479	0.02502	0.44403	5, 24

Point	%	SD	95% CL(Exp)	Skew
IC05	7.405			
IC10	53.535			
IC15	>71			
IC20	>71			
IC25	>71			
IC40	>71			
IC50	>71			



Dose-Response Plot



Statistical comparison were against the D-control.

**Larval Fish Growth and Survival Test-7 Day Growth (US)**

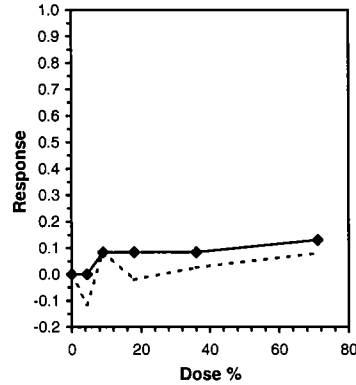
Start Date: 8/27/2004 Test ID: 400384 Sample ID: G\_CREEK-082404  
 End Date: 9/3/2004 Lab ID: BCEVS-EVS Environment C: Sample Type: EFF2-Industrial  
 Sample Date: 8/24/2004 Protocol: EPAW 95-EPA West Coast Test Species: AA-Atherinops affinis  
 Comments: Azimuth - Polaris Mine; G-Creek, 09-0302-54 ;0400384

Conc-%	1	2	3	4	5
D-Control	0.9680	0.9700	0.9780	0.8460	0.8940
Brine Control	0.9040	0.8600	1.2680	0.9720	0.8080
4.4	0.9380	1.5180	1.0220	0.8620	0.9420
9	0.8960	0.8600	0.9480	0.7900	0.8320
18	0.9240	0.6960	1.1280	1.0860	0.9940
36	1.0900	0.8140	0.7880	1.0300	0.8900
71	0.6680	0.7620	1.0920	0.9280	0.9060

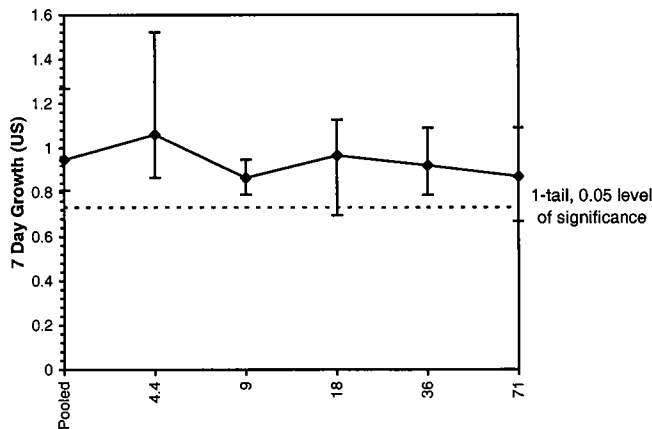
Conc-%	Mean	SD	Transform: Untransformed					N	1-Tailed			Isotonic	
			Mean	Min	Max	CV%	t-Stat		Critical	MSD	Mean	N-Mean	
Pooled	0.9468	0.1280	0.9468	0.8080	1.2680	13.514	10				1.0016	1.0000	
4.4	1.0564	0.2642	1.0564	0.8620	1.5180	25.007	5	-1.258	2.462	0.2146	1.0016	1.0000	
9	0.8652	0.0604	0.8652	0.7900	0.9480	6.980	5	0.936	2.462	0.2146	0.9177	0.9163	
18	0.9656	0.1704	0.9656	0.6960	1.1280	17.643	5	-0.216	2.462	0.2146	0.9177	0.9163	
36	0.9224	0.1328	0.9224	0.7880	1.0900	14.396	5	0.280	2.462	0.2146	0.9177	0.9163	
71	0.8712	0.1631	0.8712	0.6680	1.0920	18.721	5	0.868	2.462	0.2146	0.8712	0.8698	

Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94174	0.91	1.04686	2.00659						
Bartlett's Test indicates equal variances (p = 0.18)	7.64107	15.0863								
The control means are not significantly different (p = 0.72)	0.36654	2.30601								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	71	>71		1.40845	0.21455	0.22661	0.02493	0.02531	0.44385	5, 29

Point	%	SD	95% CL(Exp)	Skew
IC05	7.147			
IC10	48.255			
IC15	>71			
IC20	>71			
IC25	>71			
IC40	>71			
IC50	>71			



Dose-Response Plot



Statistical comparison were against the pooled control.

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST DATA SUMMARY**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

EVS Analysts AWD, JXS, AXF  
 Test Initiation Date Aug 27, 2004

Sample	Initial Sample	Refresh Samples	
	Day 0	Day 2	Day 4
Identification	04-Cu-001	/	
Amount Received	1 x 1 L		
Date Collected	15-March-04		
Date Received			
Temperature (°C)			
pH			
DO (mg/L)			
Conductivity (µmhos/cm)			
Salinity (ppt)			
Ammonia (mg/L N)			
Chlorine (mg/L Cl)			
Other			

**DILUTION/CONTROL WATER** (initial water quality)

Water Type Filtered, UV sterilized S.W.  
 Temperature (°C) 20.0  
 pH 7.8  
 Dissolved Oxygen (mg/L) 7.4  
 Salinity 28

**TEST CONDITIONS**

Temperature Range (°C) 20.0-21.0  
 pH Range 7.8-8.2  
 Dissolved Oxygen Range (mg/L) 6.4-7.7  
 Salinity (ppt) 28  
 Photoperiod (L:D h) 16:8  
 Aeration Provided? No  
 Other -

**TEST SPECIES INFORMATION**

Source ABS (Aquatic Biosystems)  
 Date Received Aug 26, 2004  
 Age (on Day 0) 10-d  
 Reference Toxicant Copper  
 Current Reference Toxicant Result (incl. 95% CL)  
 Reference Toxicant Test Date Aug 27, 2004  
 7-d survival LC50 121 (107-137) µg/L Cu  
 7-d growth IC50 128 (85-150) µg/L Cu  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
 7-d survival LC50 132 ± 48 µg/L CV: 18%  
 7-d growth IC50 131 ± 52 µg/L CV: 20%

**TEST RESULTS**

Endpoint	Conc. Units	NOEC	LOEC	LC50 (95% CL)	IC50 (95% CL)	IC25 (95% CL)
Survival	µg/L	100	180	121 (107-137)		
Growth		56	100		128 (85-150)	93 (53-124)

Other \_\_\_\_\_

Data Verified By Galpin

Date Verified Oct. 27/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST - WATER QUALITY DATA

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID Cu Ref/fox  
 Test Initiation Date/Time Aug 27, 2004 / 12:45  
 Source/Date Received ABS / Aug 28, 2004

Concentration µg/L	Temperature (°C)													
	0	1	2	3	4	5	6	7						
Control	20.0	20.5	20.5	20.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	21.0	20.5	
320	20.0	20.5	20.5	20.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	21.0	20.5	
560	20.0	20.5	20.5	20.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	21.0	20.5	
1000	20.0	20.5	20.0	20.6	20.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	21.0	20.5
1800	20.0	20.5	20.0	20.5	20.0	20.0	20.5	20.0	20.5	20.0	20.5	20.0	21.0	20.5
3200	20.0	20.5	20.0	20.5	20.0	20.0	20.5	—————						
Tech. Initials	~	~	~	~	~	~	~	~	~	~	~	~	~	

Concentration µg/L	pH													
	0	1	2	3	4	5	6	7						
Control	7.8	8.0	8.0	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
320	7.8	8.0	8.0	8.0	7.9	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.8	7.8
560	7.8	8.1	8.0	7.9	7.9	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.8	7.8
1000	7.8	8.1	8.0	8.1	7.9	8.0	7.9	8.0	7.9	8.0	7.9	7.9	7.8	7.9
1800	7.8	8.1	8.0	8.0	7.9	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.9	7.9
3200	7.8	8.0	8.0	8.0	7.9	8.0	7.9	—————						
Tech. Initials	~	~	~	~	~	~	~	~	~	~	~	~	~	

WQ Instruments Used: Temp. Calibrated Hg Thermometer pH H-A-52  
 Comments \_\_\_\_\_

Test Set Up By AWB Data Verified By Galfrk Date Verified Oct. 20/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TEST – WATER QUALITY DATA**

Client Arizumath (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID Lu Kuffert  
 Test Initiation Date/Time Aug 28<sup>th</sup>, 2004 @ 1245L  
 Source/Date Received ABS / Aug 26<sup>th</sup>, 2004

Concentration µg/L	Salinity (ppt)							
	0	1	2	3	4	5	6	7
Control	28	28	28	28	28	28	28	28
320	28	28	28	28	28	28	28	28
560	28	28	28	28	28	28	28	28
1000	28	28	28	28	28	28	28	28
1800	28	28	28	28	28	28	28	28
3200	28	28	28	28	28	28	28	28
Tech. Initials	^	^	^	JMS	^	^	JMS	JMS

Concentration µg/L	Dissolved Oxygen (mg/L)															
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Control	7.4	6.7	7.5	6.6	7.5	6.9	7.5	7.0	7.7	6.7	7.4	7.6	6.7	6.6		
320	7.4	6.4	7.5	6.7	7.5	6.9	7.5	6.9	7.5	6.6	7.4	7.6	6.8	6.7		
560	7.4	6.5	7.5	6.6	7.5	6.9	7.5	7.0	7.5	6.6	7.4	7.6	6.9	6.8		
1000	7.4	6.5	7.5	6.7	7.5	7.0	7.5	7.1	7.5	6.7	7.4	7.6	6.7	6.7		
1800	7.4	6.6	7.5	6.7	7.5	7.0	7.5	7.0	7.5	6.4	7.4	7.7	6.7	6.7		
3200	7.4	6.6	7.5	6.7	7.5	7.1	7.5	7.0	7.5							
Tech. Initials	^	^	^	^	^	JMS	^	^	^	^	^	JMS	JMS	JMS		

WQ Instruments Used: Salinity II-A-030304 DO II-A-3  
 Comments \_\_\_\_\_

Test Set Up By AWD Data Verified By Galpin Date Verified Oct-20/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST – DAILY SURVIVAL DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID Cu Reflot  
 Test Species/Batch *A. affinis* / Aug 27-04  
 Test Initiation Date/Time Aug 27, 2004 @ 12:45 L  
 No. of Organisms/Volume 5/200mL

Concentration	Rep.	Pan No.	Number of Survivors – Day of Test							Comments
			1	2	3	4	5	6	7	
Control	A	A 1	5	5	5	5	5	5	5	
	B	2	5	5	5	5	5	5	5	
	C	3	5	5	5	5	5	5	5	
	D	4	5	5	5	5	5	5	5	
	E	5	5	5	5	5	5	5	5	
320	A	6	5	5	5	5	5	4	4	
	B	7	5	5	5	5	5	5	5	
	C	8	5	5	5	5	5	5	5	
	D	9	5	5	5	5	5	5	5	
	E	0	5	5	5	5	5	5	5	
560	A	11	5	5	5	5	5	5	5	
	B	12	5	5	5	5	5	5	5	
	C	13	5	5	5	5	5	5	5	
	D	14	5	5	5	5	5	5	5	
	E	15	5	5	5	5	5	5	5	
1000	A	16	4	4	4	4	4	4	4	
	B	17	5	5	5	5	5	5	5	
	C	18	5	5	5	5	5	5	5	
	D	19	4	2	2	2	2	2	2	
	E	20	4	4	4	4	4	3	3	
Technician Initials		JWS	m	r	ms	r	r	AXF	JWS	

Sample Description clear, colorless  
 Data Verified By Galpin Date Verified Oct-27/04

**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* TOXICITY TEST - DAILY SURVIVAL DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Sample ID Cu refbox  
 Test Species/Batch *A. affinis* / Aug 27-04  
 Test Initiation Date/Time Aug 27, 2004 @ 12:45  
 No. of Organisms/Volume 5/200mL

Concentration	Rep.	Pan No.	Number of Survivors - Day of Test							Comments
			1	2	3	4	5	6	7	
49/L 1800	A	A 21	2	2	2	2	2	2	2	
	B	22	2	0	0	~	~	~	~	
	C	23	5	3	3	3	3	2	0	
	D	24	1	1	1	1	1	0		
	E	25	2	1	1	0	~	~		
3200	A	26	0	~	~	~	~	~	~	
	B	27	0	~	~	~	~	~	~	
	C	28	2	2	~	~	~	~	~	
	D	29	15	1	~	~	~	~	~	
	E	30	0	~	~	~	~	~	~	
	A	1								
	B	2								
	C	3								
	D	4								
	E	5								
	A	6								
	B	7								
	C	8								
	D	9								
	E	0								
Technician Initials		Jes	~	~	Jes	~	~	AKK/SKS	Jes	

Sample Description clear, colorless  
 Data Verified By Qaljhk Date Verified Oct. 27/04

EVS ENVIRONMENT CONSULTANTS

7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST – DRY WEIGHT DATA

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Start Date (Day 0) August 29<sup>th</sup>, 2004  
 Sample ID Cu Pellet  
 Balance Type/Serial Number Sartorius BP211.D

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
791L Control	A	A 1	1236.92	1240.48	5	5		Awo/SA
	B	2	1234.84	1239.67	5	5		
	C	3	1233.83	1238.43	5	5		
	D	4	1234.81	1239.99	5	5	pre-wt: 1234.82 reweighed: 1240.01 mg ✓	
	E	5	1236.85 <sup>pre</sup>	1241.27	5	5		
320	A	6	1236.55	1239.45	4	4		
	B	7	1223.58	1227.87	5	5		
	C	8	1228.35	1233.01	5	5		
	D	9	1236.84	1240.60	5	5	reweighed: 1240.62 mg ✓	
	E	10	1230.58	1235.34	5	5		
560	A	11	1240.99	1244.89	5	5		
	B	12	1240.22	1243.80	5	5		
	C	13	1232.03	1236.09	5	5		
	D	14	1222.70	1228.06	5	5	reweighed 1228.01 mg ✓	
	E	15	1227.91	1232.58	5	5		

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galpin

Date Verified Oct. 20/04



**EVS ENVIRONMENT CONSULTANTS**  
**7-d *Atherinops affinis* SURVIVAL AND GROWTH TOXICITY TEST - DRY WEIGHT DATA**

Client Azimuth (Polaris)  
 EVS Project No. 09-0302-54  
 EVS Work Order No. 0400384

Start Date (Day 0) August 27<sup>th</sup>, 2004  
 Sample ID Cu Re/tox  
 Balance Type/Serial Number Sartorius BP 211 D

Sample ID	Rep.	Pan No.	Pan Weight (mg) <sup>1</sup>	Final Weight (mg) (pan + biomass) <sup>1</sup>	Number of Survivors	Number Weighed	Comments (e.g., confirmation weights, organisms lost in transfer)	Tech. Init.
49/L	A	A 16	1231.06	1234.17	84	84		↓
	B	17	1232.73	1336.19	5	5		
	C	18	1227.40	1232.10	5	5		
	D	19	1225.62	1227.27	2	2		
	E	20	1229.98	1233.36	3	3		
180.0	A	21	1233.34	1235.48	2	2	pre-wt: 1233.29	↓
	B	22	1226.36		0			
	C	23	1228.36					
	D	24	1229.37					
	E	25	1226.55					
320.0	A	26	1219.08					↓
	B	27	1224.60					
	C	28	1229.45					
	D	29	1236.52					
	E	30	1236.61					

1. Re-confirm weights for 10% of final weights and record under "Comments"; relative percent difference (RPD) between pairs of weights should be ≤10% of organism weight.

Data Verified By Galpin

Date Verified Oct 20/04

Test: LF-Larval Fish Growth and Survival Test

Test ID: RTAACu39

Species: AA-Atherinops affinis

Protocol: EPAW 95-EPA West Coast

Sample ID: REF-Ref Toxicant

Sample Type: CU-Copper

Start Date: 8/27/2004

End Date: 9/3/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	No. Fish Weighed	Total Wgt(mg)	Tare Wgt(mg)
	1	1	D-Control	5							5	5	1240.48	1236.92
	2	2	D-Control	5							5	5	1239.67	1234.84
	3	3	D-Control	5							5	5	1238.43	1233.83
	4	4	D-Control	5							5	5	1239.99	1234.81
	5	5	D-Control	5							5	5	1241.27	1236.78
	6	1	32.000	5							4	4	1239.45	1236.55
	7	2	32.000	5							5	5	1227.87	1223.58
	8	3	32.000	5							5	5	1233.01	1228.35
	9	4	32.000	5							5	5	1240.6	1236.84
	10	5	32.000	5							5	5	1235.34	1230.58
	11	1	56.000	5							5	5	1244.89	1240.99
	12	2	56.000	5							5	5	1243.8	1240.22
	13	3	56.000	5							5	5	1236.09	1232.03
	14	4	56.000	5							5	5	1228.06	1222.7
	15	5	56.000	5							5	5	1232.58	1227.91
	16	1	100.000	5							4	4	1234.17	1231.06
	17	2	100.000	5							5	5	1236.19	1232.73
	18	3	100.000	5							5	5	1232.1	1227.4
	19	4	100.000	5							2	2	1227.27	1225.62
	20	5	100.000	5							3	3	1233.36	1229.98
	21	1	180.000	5							2	2	1235.48	1233.34
	22	2	180.000	5							0	0	0	0
	23	3	180.000	5							0	0	0	0
	24	4	180.000	5							0	0	0	0
	25	5	180.000	5							0	0	0	0
	26	1	320.000	5							0	0	0	0
	27	2	320.000	5							0	0	0	0
	28	3	320.000	5							0	0	0	0
	29	4	320.000	5							0	0	0	0
	30	5	320.000	5							0	0	0	0

Comments: 09-0302-54, 0400384

**Larval Fish Growth and Survival Test-7 Day Survival**

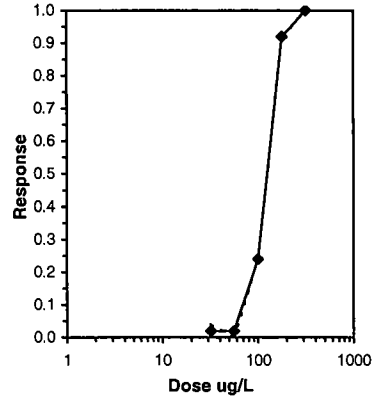
Start Date: 8/27/2004      Test ID: RTAACu39      Sample ID: REF-Ref Toxicant  
 End Date: 9/3/2004      Lab ID: BCEVS-EVS Environment Cc Sample Type: CU-Copper  
 Sample Date:      Protocol: EPAW 95-EPA West Coast Test Species: AA-Atherinops affinis  
 Comments: 09-0302-54, 0400384

Conc-ug/L	1	2	3	4	5
D-Control	1.0000	1.0000	1.0000	1.0000	1.0000
32	0.8000	1.0000	1.0000	1.0000	1.0000
56	1.0000	1.0000	1.0000	1.0000	1.0000
100	0.8000	1.0000	1.0000	0.4000	0.6000
180	0.4000	0.0000	0.0000	0.0000	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

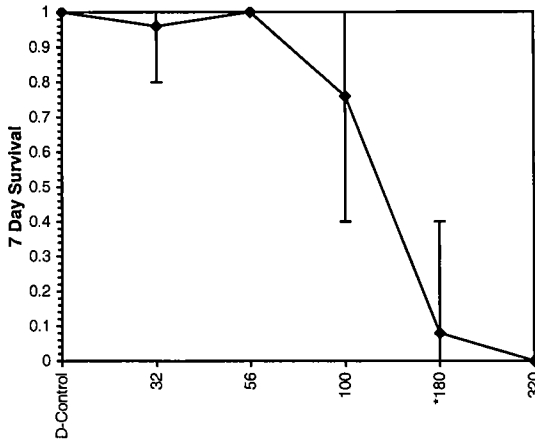
Conc-ug/L	Transform: Arcsin Square Root						Rank Sum	1-Tailed Critical	Number Resp	Total Number	
	Mean	SD	Mean	Min	Max	CV%					
D-Control	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5		0	25	
32	0.9600	0.0894	1.2977	1.1071	1.3453	8.207	5	25.00	17.00	1	25
56	1.0000	0.0000	1.3453	1.3453	1.3453	0.000	5	27.50	17.00	0	25
100	0.7600	0.2608	1.0737	0.6847	1.3453	26.959	5	20.00	17.00	6	25
*180	0.0800	0.1789	0.3174	0.2255	0.6847	64.711	5	15.00	17.00	23	25
320	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	5			25	25

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.87543	0.888	0.19148	2.19139
Equality of variance cannot be confirmed				
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	180	134.164	

Trim Level	EC50	95% CL	
0.0%			
5.0%	121.21	107.05	137.25
10.0%	122.51	106.69	140.68
20.0%	124.90	100.06	155.92
Auto-2.0%	121.16	107.14	137.03 ug/L Cu



**Dose-Response Plot**



**Larval Fish Growth and Survival Test-7 Day Growth (US)**

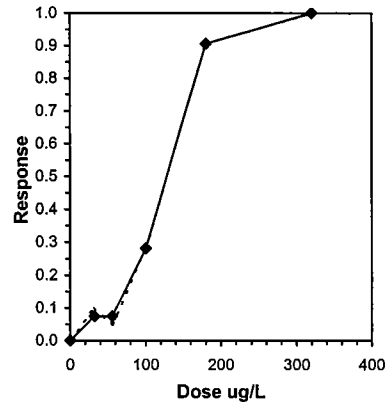
Start Date: 8/27/2004 Test ID: RTAACu39 Sample ID: REF-Ref Toxicant  
 End Date: 9/3/2004 Lab ID: BCEVS-EVS Environment Cr Sample Type: CU-Copper  
 Sample Date: Protocol: EPAW 95-EPA West Coast Test Species: AA-Atherinops affinis  
 Comments: 09-0302-54, 0400384

Conc-ug/L	1	2	3	4	5
D-Control	0.7120	0.9660	0.9200	1.0360	0.8980
32	0.5800	0.8580	0.9320	0.7520	0.9520
56	0.7800	0.7160	0.8120	1.0720	0.9340
100	0.6220	0.6920	0.9400	0.3300	0.6760
180	0.4280	0.0000	0.0000	0.0000	0.0000
320	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Mean	SD	Transform: Untransformed					N	1-Tailed			Isotonic	
			Mean	Min	Max	CV%	t-Stat		Critical	MSD	Mean	N-Mean	
D-Control	0.9064	0.1208	0.9064	0.7120	1.0360	13.330	5				0.9064	1.0000	
32	0.8148	0.1529	0.8148	0.5800	0.9520	18.764	5	0.859	2.300	0.2451	0.8388	0.9254	
56	0.8628	0.1413	0.8628	0.7160	1.0720	16.373	5	0.409	2.300	0.2451	0.8388	0.9254	
*100	0.6520	0.2178	0.6520	0.3300	0.9400	33.401	5	2.387	2.300	0.2451	0.6520	0.7193	
*180	0.0856	0.1914	0.0856	0.0000	0.4280	223.607	5	7.701	2.300	0.2451	0.0856	0.0944	
320	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	5				0.0000	0.0000	

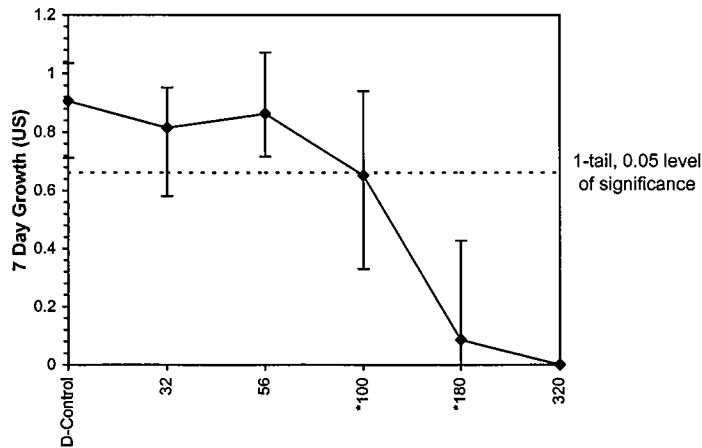
Auxiliary Tests						Statistic	Critical	Skew	Kurt			
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)						0.97983	0.888	0.24836	0.34826			
Bartlett's Test indicates equal variances (p = 0.81)						1.6194	13.2767					
Hypothesis Test (1-tail, 0.05)			NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test			56	100	74.8331		0.24513	0.27045	0.56964	0.0284	9.0E-07	4, 20

Linear Interpolation (200 Resamples)					
Point	ug/L	SD	95% CL(Exp)	Skew	
IC05*	21.45	21.58	1.69	91.64	0.6918
IC10	61.43	22.13	0.00	103.56	-0.1239
IC15	72.10	20.41	1.19	118.52	-0.5135
IC20	82.78	15.91	41.12	121.23	-0.0104
IC25	93.45	13.98	53.16	124.15	0.0254
IC40	115.28	11.42	71.83	139.88	-0.3487
IC50	128.08	10.81	84.76	150.27	-0.4718



\* indicates IC estimate less than the lowest concentration

Dose-Response Plot



## **APPENDIX B**

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Raw Data and Statistical Analyses:

*Dendraster excentricus*

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY**

Client AZIMOTH CONSULTING GROUP EVS Analysts KES / AKN  
 EVS Project No. 09-0302-54/04-1424-044 Test Initiation Date 27 AUGUST 2004  
 EVS Work Order No. 0400385

**SAMPLE**

Identification G-CREEK-082404  
 Amount Received 5X20L  
 Date Collected 24 AUGUST 2004  
 Date Received 27 AUGUST 2004  
 Temperature (°C) 15.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 10.0 @ 8.5  
 Conductivity (µmhos/cm) 9240  
 Salinity (ppt) 5 @ 28  
 Ammonia (mg/L N) -  
 Chlorine (mg/L Cl) -  
 Other ① Salinity adjustment

**TEST SPECIES**

Organism Dendroaster eccentricus  
 Source Westwind Sealab Supplies, 27 Aug. 2004  
 Date Received 27 August 2004  
 Reference Toxicant SDS  
 Current Reference Toxicant Result  
 Reference Toxicant Test Date 27 August 2004  
 IC50 (and 95% CL) 2.3 (2.1-2.4) mg/L SDS  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
3.9 ± 4.6 mg/L SDS; CV% = 60

**DILUTION/CONTROL WATER** (initial water quality)

Water Type UV Sterilized, 0.5µm filtered SW  
 Temperature (°C) 16.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 8.3  
 Salinity (ppt) 28  
 Other -

**TEST CONDITIONS**

Temperature Range (°C) 15.0 - 16.0  
 pH Range 8.0 - 8.1  
 Dissolved Oxygen Range (mg/L) 8.2 - 8.5  
 Salinity Range (ppt) 28  
 Sperm:Egg Ratio 2000:1  
 Test Duration 10:10  
 Other -

**TEST RESULTS**

IC50: 50.7 (48.1 - 53.6) % V/V  
IC25: 17.5 (11.6 - 22.6) % V/V  
NOEC: 4.7 % V/V  
LOEC: 9.4 % V/V

Data Verified By Qualifly

Date Verified Oct. 26/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY**

Client AZIMUTH CONSULTING GROUP  
 EVS Project No. 09-0302-54/04-1424-044  
 EVS Work Order No. 0400385  
 Logbook Echinoid #13 Pages 53-57

Test Initiation Date/Time 27 August 2004 @ 13:34  
 Test Species Dendraster eccentricus  
 Source/Date Received Westwind Sealab Supplies/27 August 2004  
 Test Duration 10:10

Sample ID	Conc/Rep % V/V	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
9-CREEK 082404						
CONTROL		16.0	8.0	28	8.3	
BRINE CTL		16.0	8.1	28	8.3	
	4.7	16.0	8.0	28	8.42	
	9.4	16.0	8.0	28	8.3	
	18.8	16.0	8.0	28	8.3	
	37.5	15.5 <del>16.0</del>	8.0	28	8.2	
	75.1	15.0 <del>16.0</del>	8.0	28	8.5	
Tech. Init.	Kef	Kef	Kef	Kef	Kef	

WQ Instruments Used: Temp. Calibrated Hg thermometer pH II-A-51 Salinity II-A-03030 DO II-A-011202  
 Data Verified By Gulfi Date Verified Oct. 26/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST - EGG COUNT (SAMPLES)**

Client AZIMUTH CONSULTING GROUP

Test Initiation Date/Time 27 August 2004 @ 13:34

EVS Project No. 09-0302-54/04-1424-044

Test Species Dendraster eccentricus

EVS Work Order No. 0400385

Source/Date Received Westwind Sealab Supplies/27 August 2004

Logbook Echinoid #13 Pages 53-57

Test Duration 10:10

Sperm:Egg Ratio 2000:1

Sample ID % v/v	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
4.7	A	78	22		df
	B	74	26		↓
	C	76	24		↓
	D	72	28		↓
9.4	A	61	39		df
	B	62	38		↓
	C	62	38		↓
	D	60	40		↓
18.8	A	56	44		df
	B	58	42		↓
	C	41 59	41		↓
	D	55	45		↓
37.5	A	49	51		df
	B	50	50		↓
	C	50	50		↓
	D	48	52		↓
75.1	A	25	75		↓
	B	27	73		df
	C	24	76		↓
	D	27	73		↓
CONTROL SEA WATER	A	77	<del>77</del> 23		df
	B	80	20		↓
	C	74	26		↓
	D	77	23		↓

Data Verified By Galpin

Date Verified Oct-26/04



**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNT (SAMPLES)**

Client AZIMUTH CONSULTING GROUP.

Test Initiation Date/Time 27 AUGUST 2004 @ 13:34

EVS Project No. 09-0302-54/04-1424-014

Test Species Dendraster eccentricus

EVS Work Order No. 0400385

Source/Date Received Westwind Sealab Supplies/27 August 2004

Logbook Echinoid #13 Pages 53-57

Test Duration 10:10

Sperm:Egg Ratio 2000:1

Sample ID	Replicate	Number of Fertilized Eggs	Number of Unfertilized Eggs	Comments	Tech. Initials
BRINE CONTROL	A	76	24		kat
	B	73	27		↓
	C	79	21		
	D	77	23		
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				
	A				
	B				
	C				
	D				

Data Verified By Galjit

Date Verified Oct-21/04

Test: SC-Sperm Cell Fertilization test

Test ID: 0400385

Species: DE-Dendroaster excentricus

Protocol: EPS1/RM/27-EC 92 (Sperm Cell)

Sample ID: G CREEK-082404

Sample Type: EFF2-Industrial

Start Date: 8/27/2004 10:10

End Date: 8/27/2004

Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	77	23	
	2	2	D-Control	100	80	20	
	3	3	D-Control	100	74	26	
	4	4	D-Control	100	77	23	
	5	1	B-Control	100	76	24	
	6	2	B-Control	100	73	27	
	7	3	B-Control	100	79	21	
	8	4	B-Control	100	77	23	
	9	1	4.700	100	78	22	
	10	2	4.700	100	74	26	
	11	3	4.700	100	76	24	
	12	4	4.700	100	72	28	
	13	1	9.400	100	61	39	
	14	2	9.400	100	62	38	
	15	3	9.400	100	62	38	
	16	4	9.400	100	60	40	
	17	1	18.800	100	56	44	
	18	2	18.800	100	58	42	
	19	3	18.800	100	59	41	
	20	4	18.800	100	55	45	
	21	1	37.500	100	49	51	
	22	2	37.500	100	50	50	
	23	3	37.500	100	50	50	
	24	4	37.500	100	48	52	
	25	1	75.100	100	25	75	
	26	2	75.100	100	27	73	
	27	3	75.100	100	24	76	
	28	4	75.100	100	27	73	

Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400385)

**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 8/27/2004 10:10 Test ID: 400385 Sample ID: G CREEK-082404  
 End Date: 8/27/2004 Lab ID: BCEVS-EVS Environment Cc Sample Type: EFF2-Industrial  
 Sample Date: 8/24/2004 Protocol: EPS1/RM/27-EC 92 (Sperm ( Test Species: DE-Dendraster excentricus  
 Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400385)

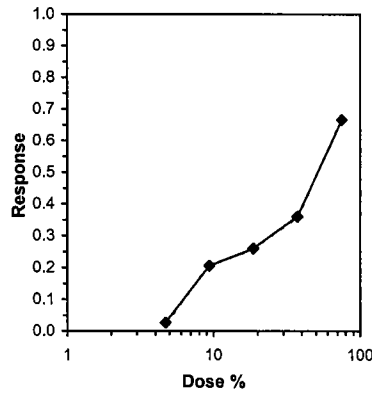
Conc-%	1	2	3	4
D-Control	0.7700	0.8000	0.7400	0.7700
B-Control	0.7600	0.7300	0.7900	0.7700
4.7	0.7800	0.7400	0.7600	0.7200
9.4	0.6100	0.6200	0.6200	0.6000
18.8	0.5600	0.5800	0.5900	0.5500
37.5	0.4900	0.5000	0.5000	0.4800
75.1	0.2500	0.2700	0.2400	0.2700

Conc-%	Mean	SD	Transform: Untransformed				N	1-Tailed			Isotonic	
			Mean	Min	Max	CV%		t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.7700	0.0245	0.7700	0.7400	0.8000	3.181	4				0.7700	1.0000
B-Control	0.7625	0.0250	0.7625	0.7300	0.7900	3.279	4					
4.7	0.7500	0.0258	0.7500	0.7200	0.7800	3.443	4	1.546	2.410	0.0312	0.7500	0.9740
*9.4	0.6125	0.0096	0.6125	0.6000	0.6200	1.563	4	12.175	2.410	0.0312	0.6125	0.7955
*18.8	0.5700	0.0183	0.5700	0.5500	0.5900	3.203	4	15.460	2.410	0.0312	0.5700	0.7403
*37.5	0.4925	0.0096	0.4925	0.4800	0.5000	1.944	4	21.450	2.410	0.0312	0.4925	0.6396
*75.1	0.2575	0.0150	0.2575	0.2400	0.2700	5.825	4	39.616	2.410	0.0312	0.2575	0.3344

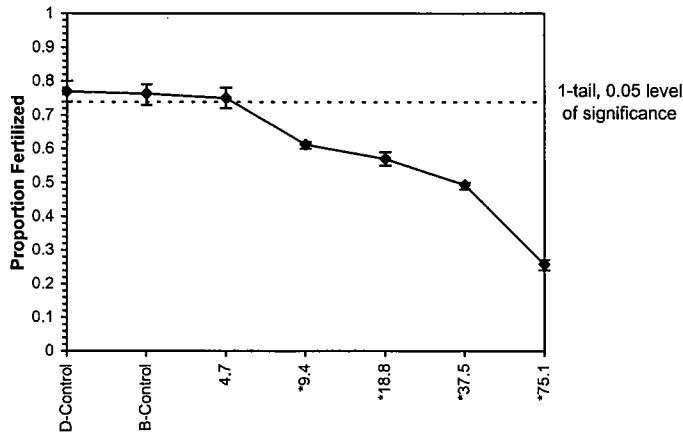
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96771	0.884	-0.0461	-0.3022
Bartlett's Test indicates equal variances (p = 0.47)	4.56528	15.0863		
The control means are not significantly different (p = 0.68)	0.42857	2.44691		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	4.7	9.4	6.6468	21.2766	0.03118	0.04049	0.14215	0.00033	5.1E-18	5, 18

Log-Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)	Skew	
IC05	5.180	0.661	1.565	6.056	-2.4799
IC10	6.314	0.363	5.072	7.317	-0.3761
IC15	7.655	0.380	6.468	8.804	-0.0227
IC20	9.242	0.946	8.159	13.672	1.6390
IC25	16.673	2.353	10.367	23.598	0.0429
IC40	41.060	0.897	38.450	44.063	-0.0075
IC50	51.581	0.976	49.063	54.697	0.0961



Dose-Response Plot



Statistical comparisons were against the D-control

**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 8/27/2004 10:10 Test ID: 400385 Sample ID: G CREEK-082404  
 End Date: 8/27/2004 Lab ID: BCEVS-EVS Environment Cc Sample Type: EFF2-Industrial  
 Sample Date: 8/24/2004 Protocol: EPS1/RM/27-EC 92 (Sperm ( Test Species: DE-Dendraster excentricus  
 Comments: Azimuth Consulting Group (Polaris), 09-0302-54 (0400385)

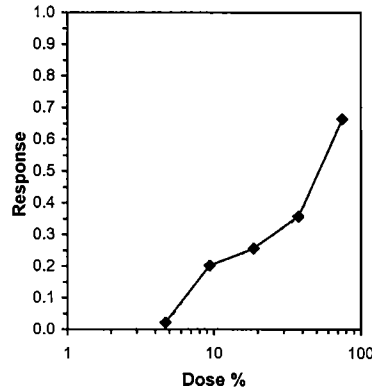
Conc-%	1	2	3	4
D-Control	0.7700	0.8000	0.7400	0.7700
B-Control	0.7600	0.7300	0.7900	0.7700
4.7	0.7800	0.7400	0.7600	0.7200
9.4	0.6100	0.6200	0.6200	0.6000
18.8	0.5600	0.5800	0.5900	0.5500
37.5	0.4900	0.5000	0.5000	0.4800
75.1	0.2500	0.2700	0.2400	0.2700

Conc-%	Mean	SD	Transform: Untransformed					N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	Mean					N-Mean	
Pooled	0.7663	0.0233	0.7663	0.7300	0.8000	3.036	8				0.7663	1.0000	
4.7	0.7500	0.0258	0.7500	0.7200	0.7800	3.443	4	1.390	2.508	0.0293	0.7500	0.9788	
*9.4	0.6125	0.0096	0.6125	0.6000	0.6200	1.563	4	13.156	2.508	0.0293	0.6125	0.7993	
*18.8	0.5700	0.0183	0.5700	0.5500	0.5900	3.203	4	16.793	2.508	0.0293	0.5700	0.7439	
*37.5	0.4925	0.0096	0.4925	0.4800	0.5000	1.944	4	23.424	2.508	0.0293	0.4925	0.6427	
*75.1	0.2575	0.0150	0.2575	0.2400	0.2700	5.825	4	43.533	2.508	0.0293	0.2575	0.3361	

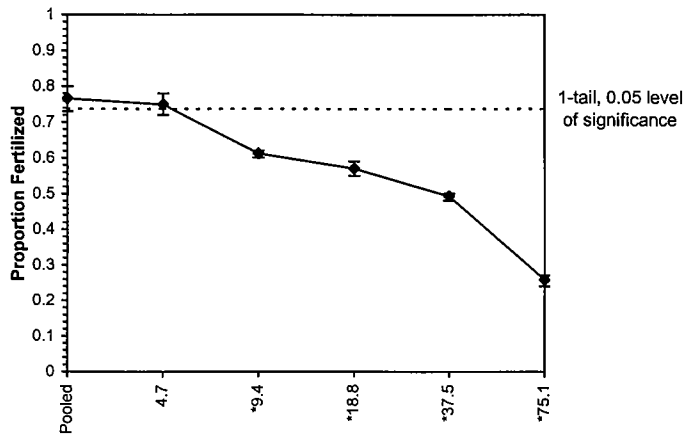
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.98075	0.896	-0.1412	-0.2089
Bartlett's Test indicates equal variances (p = 0.44)	4.83474	15.0863		
The control means are not significantly different (p = 0.68)	0.42857	2.44691		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	4.7	9.4	6.6468	21.2766	0.02931	0.03826	0.16613	0.00036	1.9E-21	5, 22

Log-Logit Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)	Skew	
IC05	5.346	0.452	3.380	6.032	-1.8281
IC10	6.555	0.307	5.439	7.178	-0.4707
IC15	7.892	0.273	6.858	8.579	-0.3014
IC20	9.379	0.715	8.461	12.502	1.9342
IC25	17.460	2.031	11.554	22.636	0.0330
IC40	40.999	0.628	38.998	42.863	0.1265
IC50	50.738	0.809	48.086	53.622	0.1685 %v/v



Dose-Response Plot



Statistical comparisons were against the ~~B-control~~  
*Pooled Control*

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST DATA SUMMARY**

Client Azimuth Consulting Group EVS Analysts KES, AKN  
 EVS Project No. 09-0302-54/04-1424-044 Test Initiation Date 27 AUGUST 2004  
 EVS Work Order No. 0400385

**SAMPLE**

Identification SDS Ref Tox Stock Sol<sup>n</sup>  
 Amount <sup>Prep'd</sup> Received 1X1L  
 Date <sup>Prep'd</sup> Collected 26 April 2004  
 Date Received n/a  
 Temperature (°C) \_\_\_\_\_  
 pH \_\_\_\_\_  
 Dissolved Oxygen (mg/L) \_\_\_\_\_  
 Conductivity (µmhos/cm) \_\_\_\_\_  
 Salinity (ppt) \_\_\_\_\_  
 Ammonia (mg/L N) \_\_\_\_\_  
 Chlorine (mg/L Cl) \_\_\_\_\_  
 Other \_\_\_\_\_

**TEST SPECIES**

Organism Dendroaster eccentricus  
 Source Westwind Sealab Supplier/  
 Date Received 27 August 2004  
 Reference Toxicant SDS  
 Current Reference Toxicant Result  
 Reference Toxicant Test Date 27 August 2004  
 IC50 (and 95% CL) 2.3 (2.1-2.4) mg/L SDS  
 Reference Toxicant Warning Limits (mean ± 2SD) and CV  
3.9 ± 4.6 mg/L SDS, CV% = 60

**DILUTION/CONTROL WATER** (initial water quality)

Water Type UV Sterilized, 0.5µm filtered SW  
 Temperature (°C) 16.0  
 pH 8.0  
 Dissolved Oxygen (mg/L) 8.3  
 Salinity (ppt) 28  
 Other —

**TEST CONDITIONS**

Temperature Range (°C) 16.0  
 pH Range 8.0  
 Dissolved Oxygen Range (mg/L) 8.3  
 Salinity Range (ppt) 28  
 Sperm:Egg Ratio 2000:1  
 Test Duration 10:10  
 Other —

**TEST RESULTS**

IC 50: 2.3 (2.1-2.4) mg/L SDS  
 IC 25: 1.3 (1.2-1.4) mg/L SDS  
 NOEC: < 1 mg/L SDS  
 LOEC: 1 mg/L SDS

Data Verified By Qualifit

Date Verified Oct. 26/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST INITIAL WATER QUALITY**

Client AZIMOTH CONSULTING GROUP  
 EVS Project No. 09-0302-54 / 04-1424-044  
 EVS Work Order No. 0400385  
 Logbook Echinoid #13 Pages 53-57

Test Initiation Date/Time 27 August 2004 @ 13:34  
 Test Species Dendroster excentricus  
 Source/Date Received Westwind Seablab Supplier / 27 Aug 2004  
 Test Duration 10:10

Sample ID	Conc/Rep	Temperature (°C)	pH	Salinity (ppt)	Dissolved Oxygen (mg/L)	Comments
SDS mg/L	CONTROL	16.0	8.0	28	8.3	
	1.0	16.0	8.0	28	8.3	
	1.8	16.0	8.0	28	8.3	
	3.2	16.0	8.0	28	8.3	
	5.6	16.0	8.0	28	8.3	
	10.0	16.0	8.0	28	8.3	
Tech. Init.	<i>del</i>	<i>del</i>	<i>del</i>	<i>del</i>	<i>del</i>	

WQ Instruments Used: Temp. Calibrated Hg pH II-A-51 Salinity II-A-02023 DO II-A-011202  
 Data Verified By *Galpik* Date Verified Oct 21/04

**EVS ENVIRONMENT CONSULTANTS  
ECHINOID FERTILIZATION TOXICITY TEST – EGG COUNTS (CONTROLS)**

Client AZIMUTH CONSULTING GROUP

Test Initiation Date/Time 27 August 2004 @ 13:34

EVS Project No. 09-0302-54/04-1424-044

Test Species Dendraster excentricus

EVS Work Order No. 0400385

Test Duration 10:10

Logbook Echinoid #13 Pages 53-57

Sperm:Egg Ratio 2000:1

Concentration SDS mg/L	Replicate	No. Fertilized Eggs	No. Unfertilized Eggs	Comments	Tech. Initials
<b>Reference Toxicant</b>					
1.0	A	70	30		kat
	B	72	28		↓
	C	69	31		↓
	D	68	32		↓
1.8	A	45	55		kat
	B	47	53		↓
	C	46	54		↓
	D	49	51		↓
3.2	A	25	75		kat
	B	26	74		↓
	C	24	76		↓
	D	27	73		↓
5.6	A	10	90		kat
	B	14	86		↓
	C	9	91		↓
	D	10	90		↓
10.0	A	2	98		kat
	B	2	98		↓
	C	1	99		↓
	D	2	98		↓
<b>Control Seawater</b>					
	A	81 77	23		kat
	B	74 80	20		↓
	C	74	26		↓
	D	77	23		↓

Data Verified By Galpin

Date Verified Oct. 21/04

Test: SC-Sperm Cell Fertilization test      Test ID: rtscsds9  
 Species: DE-Dendroaster excentricus      Protocol: EPS1/RM/27-EC 92 (Sperm Cell)  
 Sample ID: REF-Ref Toxicant      Sample Type: SDS-Sodium dodecyl sulfate  
 Start Date: 8/27/2004 10:10      End Date: 8/27/2004      Lab ID: BCEVS-EVS Environment Consultants

Pos	ID	Rep	Group	Total Counted	Number Fertilized	Number Unfertilized	Notes
	1	1	D-Control	100	77	23	
	2	2	D-Control	100	80	20	
	3	3	D-Control	100	74	26	
	4	4	D-Control	100	77	23	
	5	1	1.0	100	70	30	
	6	2	1.0	100	72	28	
	7	3	1.0	100	69	31	
	8	4	1.0	100	68	32	
	9	1	1.8	100	45	55	
	10	2	1.8	100	47	53	
	11	3	1.8	100	46	54	
	12	4	1.8	100	49	51	
	13	1	3.2	100	25	75	
	14	2	3.2	100	26	74	
	15	3	3.2	100	24	76	
	16	4	3.2	100	27	73	
	17	1	5.6	100	10	90	
	18	2	5.6	100	14	86	
	19	3	5.6	100	9	91	
	20	4	5.6	100	10	90	
	21	1	10.0	100	2	98	
	22	2	10.0	100	2	98	
	23	3	10.0	100	1	99	
	24	4	10.0	100	2	98	

Comments: Azimuth Consulting Group 09-0302-54 (0400385)



**Sperm Cell Fertilization test-Proportion Fertilized**

Start Date: 8/27/2004 10:10 Test ID: rtscsds9 Sample ID: REF-Ref Toxicant  
 End Date: 8/27/2004 Lab ID: BCEVS-EVS Environment Cr Sample Type: SDS-Sodium dodecyl sulfate  
 Sample Date: Protocol: EPS1/RM/27-EC 92 (Sperm t Test Species: DE-Dendraster excentricus  
 Comments: Azimuth Consulting Group 09-0302-54 (0400385)

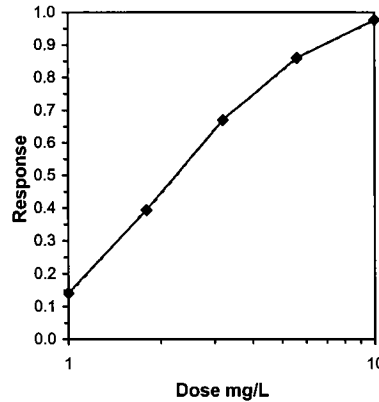
Conc-mg/L	1	2	3	4
D-Control	0.7700	0.8000	0.7400	0.7700
1	0.7000	0.7200	0.6900	0.6800
1.8	0.4500	0.4700	0.4600	0.4900
3.2	0.2500	0.2600	0.2400	0.2700
5.6	0.1000	0.1400	0.0900	0.1000
10	0.0200	0.0200	0.0100	0.0200

Conc-mg/L	Mean	SD	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
D-Control	0.7700	0.0245	0.7700	0.7400	0.8000	3.181	4					
*1	0.6975	0.0171	0.6975	0.6800	0.7200	2.448	4	5.813	2.410	0.0301		
*1.8	0.4675	0.0171	0.4675	0.4500	0.4900	3.653	4	24.254	2.410	0.0301		
*3.2	0.2550	0.0129	0.2550	0.2400	0.2700	5.063	4	41.292	2.410	0.0301		
*5.6	0.1075	0.0222	0.1075	0.0900	0.1400	20.627	4	53.118	2.410	0.0301		
*10	0.0175	0.0050	0.0175	0.0100	0.0200	28.571	4	60.334	2.410	0.0301		

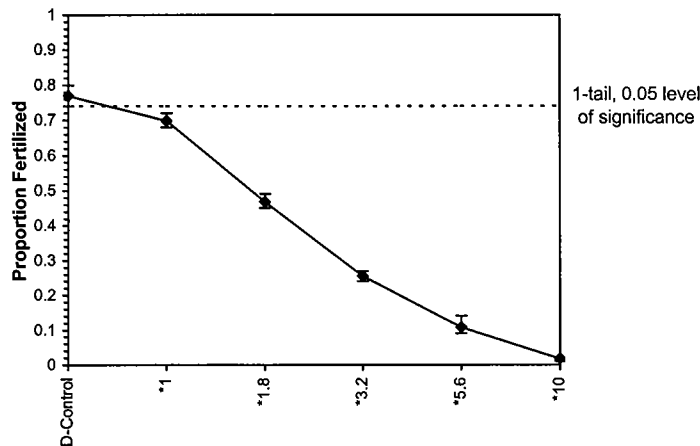
Auxiliary Tests	Statistic	Critical	Skew	Kurt						
Shapiro-Wilk's Test indicates normal distribution ( $p > 0.01$ )	0.94353	0.884	0.48689	0.03974						
Bartlett's Test indicates equal variances ( $p = 0.33$ )	5.73659	15.0863								
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	<1	1			0.03006	0.03904	0.38532	0.00031	3.5E-22	5, 18

Log-Linear Interpolation (200 Resamples)					
Point	mg/L	SD	95% CL(Exp)	Skew	
IC05*	0.2818	0.0398	0.1777	0.4281	0.4398
IC10*	0.6429	0.1027	0.3830	1.0315	0.5219
IC15	1.0278	0.0806	0.6655	1.1534	-1.2547
IC20	1.1671	0.0441	1.0139	1.2853	-0.3348
IC25	1.3159	0.0419	1.1718	1.4292	-0.2285
IC40	1.8295	0.0507	1.6670	1.9678	-0.0985
IC50	2.2774	0.0469	2.1219	2.4035	-0.2200 mg/L SDS

\* indicates IC estimate less than the lowest concentration



Dose-Response Plot



## **APPENDIX C**

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### Chain-of-Custody Form

# CHAIN-OF-CUSTODY/TEST REQUEST FORM



195 Pemberton Avenue  
North Vancouver, BC  
Canada V7P 2R4  
Tel: 604-986-4331  
Fax: 604-662-8548  
www.evsenvironment.com

Please see instructions for completion on back. Shaded areas to be completed by EVS Laboratory upon sample receipt.

Client Name: AZIMUTH CONSULTING FOR TECHNICAL Client Contact Name: Cheryl Mackintosh/Bruce Donald Ship to: EVS Environment Consultants  
Address: 218-2900 West Broadway Vancouver BC V6K 2G8 Phone: 604-730-1220 195 Pemberton Ave.  
Fax: 604-739-9070 North Vancouver, BC, V7P 2R4 Shipping Date: Aug. 25, 2004  
Sampled By: Randy Butler C. Mackintosh Attn: Edmund Canavia

Collection Date (dd/mmm/yy)	Time (24-h clock)	Sample Identification	1 Type of Each Sample	Material Safety Data Sheet Attached? (✓)	Sample Collection Method G = grab, C = composite	Number of Sample Containers x Volume of Sample Container (i.e., 1 x 20 L)	2 Sample Container Type by Code				3 Notes? (e.g. preserved, saltwater, freshwater, may contain sewage)	4 Test(s) Requested	5 EVS Receipt Check	6 EVS Laboratory Receipt	7 EVS Laboratory Test Results	8 EVS Laboratory Test Report	9 EVS Laboratory Test Certificate	10 EVS Laboratory Test Summary	11 EVS Laboratory Test Details	12 EVS Laboratory Test Comments	
							Rain bow trout	9Ltr LCSD	Daphnia magna	48-hr LCSD											7-day Topswim
For composite sample record date & time starting and ending																					
24 Aug/04	15:00	G-Creek <del>081704</del> <sup>213</sup> 082404 <sup>1</sup>	E		G	5x20LCC	✓	✓	✓	✓	Freshwater ~2.4ppt										

PO/Reference No.: TC-03-03 Comments/Instructions: 1) The sample ID was changed from G-Creek 081704 to G-Creek 082404 by the client's request.

Project Title: Polaris MMER

Results Needed By:

A) Released By: <u>C. Mackintosh</u> Date: <u>Aug. 28/04</u> Company: <u>Azimuth</u> Time: <u>9:00am</u> Courier name: <u>First Air / FedEx</u> Shipping containers secured by: <input checked="" type="checkbox"/> Tape <input checked="" type="checkbox"/> Straps <input type="checkbox"/> Lock <input type="checkbox"/> Other _____ Custody seals used? Yes No <input checked="" type="checkbox"/> METAL STRIPS	B) Received by: <u>AXF</u> Date: <u>27 AUG 04</u> Company: <u>EUS</u> Time: <u>0945</u> Shipping containers received secure? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Custody seals intact? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	C) Released By: _____ Date: _____ Company: _____ Time: _____ Courier name: _____ Shipping containers secured by: <input type="checkbox"/> Tape <input type="checkbox"/> Straps <input type="checkbox"/> Lock <input type="checkbox"/> Other _____ Custody seals used? Yes No <input type="checkbox"/> (circle one)	D) Received by: _____ Date: _____ Company: _____ Time: _____ Shipping containers received secure? <input type="checkbox"/> Yes <input type="checkbox"/> No Custody seals intact? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
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1 Receiving Water (RW); Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)  
 2 Collapsible Carboy (CC); Glass Jar (GJ); Jerry Can (JC); Plastic HDPE (P); Plastic Bucket (PB); Other (Please Specify)  
 3 Please note any conditions the lab should be aware of for safety and storage concerns  
 4 Acceptable (A); Unacceptable (U). Please note specifics (e.g., broken, leaking, lid not on) under Comments/Instructions

Revision Date: Sept. 25, 2000

Distribution of copies: White, yellow, pink - accompany the shipment  
 Orange - retained by consignor (e.g., shipper)  
 Yellow - retained by consignee (e.g., receiver)  
 Pink - for use as needed  
 White - returned to consignor by consignee

109.24 / 2004

09-108-10  
 0100382 / 383 / 384 / 385  
 RAT / DPHH / TOPSWIM / ETH

EVS Laboratory Receipt

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**APPENDIX F**

**Letter from Environment Canada to Teck Cominco Metals, Ltd. re: Polaris 2004  
Annual Report (dated August 9, 2005)**



Environment Canada  
Environnement Canada

**Prairie & Northern Region**  
Environment Canada  
Rm 200, 4999 98th Ave.  
Edmonton, AB T6B 2X3

Bruce Donald  
Cominco Mining Partnership & Teck Cominco Metals Ltd.  
Bag 2000  
Kimberley, BC  
V1A3E1

August 9, 2005

Dear Bruce Donald,

**RE: Polaris 2004 Annual Report**

In our review of the Polaris 2004 Annual Effluent and Water Quality Report, due March 31, 2005, it was noted that some Environmental Effects Monitoring (EEM) information does not appear to have been provided as required under Metal Mining Effluent Regulations (Schedule 5, Part 1). Please see the appended list of deficiencies relating to effluent characterization, water quality monitoring and sublethal toxicity testing for your facility.

If missing information was collected but not included in the above report, please submit this information to Environment Canada by September 30, 2005. Please ensure that all deficiencies are addressed in future reports. Failure to provide all information required under the Environmental Effects Monitoring Program will result in non-compliance.

Please be reminded that guidance is provided on the National EEM Website to assist you, at [http://www.ec.gc.ca/eem/English/Publications/web\\_publication/ec\\_water/](http://www.ec.gc.ca/eem/English/Publications/web_publication/ec_water/). If you have any questions, please do not hesitate to contact me [Phone (780) 951-8754, [jenny.ferone@ec.gc.ca](mailto:jenny.ferone@ec.gc.ca)].

Sincerely,

  
Jenny Ferone, Regional EEM Coordinator

cc Peter Blackall  
Chuck Brumwell  
Ken Russell

Recycling Paper / Papier Recycle



**Polaris (7834-3-37/C263-9)**  
**2004 Annual Effluent and Water Quality Review**

**General:**

- Methods, detection limits, and QA/QC need to be included in the future.
- Latitude/longitude and description of reference and exposure areas need to be included in hard copy.
- No units given in the hard copy for measured parameters in the Effluent or Water Quality tables.

**Effluent Characterization:**

- Collected and analyzed four effluent samples, but due to short discharge period (July and August only) only two were more than one month apart. Remaining two were only three days short of being one month apart.
- No methods described or detection limits, no QA/QC data or description.

**Water Quality:**

- Only two water sampling dates were more than one month apart due to short sampling period (July and August). Three samples were analyzed.
- No latitude or longitude of reference or exposure sampling areas in hard copy; No description of the ref or exp area – both described as Garrow Bay.
- No methods described or detection limits, no QA/QC data or description.

**Sublethal Toxicity:**

Please note that laboratories performing sublethal tests should provide all information required on the Environment Canada checklists (Annex C of the Metal Mining Guidance Document).

- A subset of the sublethal reports submitted by mines in the Prairie and Northern Region were sent for independent verification by Environment Canada toxicologists. This subset includes the test results submitted by your facility. We will inform you of any additional sublethal deficiencies identified by our reviewers once they have finished their review.
- For first sampling LC50 reported twice for fish species.
- First and second sampling: No LC50 done for sand dollar.
- All comments below are for both sampling dates (July 27 and August 24) unless otherwise stated

***Atherinops affinis***

- Information on labeling/coding of sample was not reported.
- Temperature of sample upon arrival at lab was not reported.
- The date that the sample was received at the lab was not reported.
- Dates or days during test when sub-samples or multiple samples were used, was not reported.
- The date for test completion was not reported.
- Temperature, DO, pH, and salinity of test solution and controls were not reported for each 24hr exposure period. They were only reported for the start of the test.
- Only give the final average mortality for each test concentration instead of the mortality as noted during each 24hr observation period

- Only give the average dry weight of each concentration instead of for each replicate of each concentration – also no indication if preserved in formalin/ethanol or not. If not preserved then 2 test concentration have weights <0.85mg (17.3% & 69%).
- No preparation procedure of salinity adjustment was reported.

### ***Champia parvula***

- Information on labeling and coding of sample was not reported.
- The date for sample receipt at the lab was not reported.
- The date for test completion was not reported.
- Procedure and preparation of the hypersaline brine was not reported.
- The type and quantity of chemicals (if any) added to the control/dilution water was not reported.
- Temperature, DO, pH and salinity of test solutions and controls were not reported for the start and 48hr of the exposure period or for the beginning and end of the recovery period.
- No note if there was anything unusual about the test organism prior to the test or if there was anything unusual about the test itself.
- Only the mean # of cystocarps per plant for each test concentration was reported. Needed to report the mean # of cystocarps per plant in each test vessel (in each replicate of each conc. and controls).
- No indication of quantitative statistic used to determine IC25 value.

### ***Dendraster excentricus***

- Information on labeling/coding of sample, the date it was received and its temperature upon arrival at lab were all not reported.
- There was no mention of the condition of the adult organisms prior to use.
- No note if there was anything unusual about the test organisms prior to use or anything unusual about the test itself.
- No procedure for salinity adjustment was reported – only statement that they followed EC guidance document.
- Only 100eggs/ vessel were used – should have been 2000 for the 10mL test volume.
- No indication of quantitative statistic used to determine the IC25 value.

## **APPENDIX G**

**Letter from Azimuth Consulting Group, Inc. to Environment Canada re:  
Clarification of reporting issues outlined in August 9, 2005 letter (dated September  
14, 2005)**





**Azimuth Consulting  
Group Inc.**  
218-2902 West Broadway  
Vancouver, BC  
Canada V6K 2G8

Phone: 604-730-1220  
Fax: 604-739-8511  
[www.azimuthgroup.ca](http://www.azimuthgroup.ca)

Jenny Ferone  
Regional EEM Coordinator  
Prairie & Northern Region  
Environment Canada  
Rm 200, 4999 98<sup>th</sup> Ave.  
Edmonton, AB, T6B 2X3

September 14, 2005

Dear Ms. Ferone,

**Re: Clarification of reporting issues outlined in Environment  
Canada's letter to Teck Cominco regarding the Polaris 2004 EEM  
Annual Report**

---

This letter is being written on behalf of Teck Cominco Metals Ltd. in response to Environment Canada's letter to Teck Cominco, dated August 9, 2005, regarding purported deficiencies in the Polaris 2004 Annual Effluent and Water Quality Report. Azimuth staff prepared the report and will be addressing the issues outlined in your letter by providing a revised 2004 EEM Annual Report. However, there are a few questions and clarifications that we would like to draw to your attention, to ensure that we include all required information in the revised report and that there are no misunderstandings or further deficiencies. Our specific responses to each of the points raised in the review letter are as follows:

**General:**

- Methods, detection limits and QA/QC will be included in all future reports
- Latitude and longitude and a description of the reference and exposure areas will be provided in the hard copy
- Units for water quality will be provided

**Effluent Characterization:**

- Effluent was collected and tested within allowable time periods, given the short duration of effluent discharge at Polaris.
- Methods, detection limits and QA/QC will be provided in the hard copy

**Water Quality:**

- Sampling of water quality was optimized to collect as many samples as possible, given short duration of discharge
- Latitude and longitude of exposure and reference areas were provided in the electronic copy; these will also be provided in the hard copy
- Methods, detection limits and QA/QC will be provided in the hard copy

**Sublethal Toxicity:**

- *“The first sampling LC50 reported twice for fish species.”* We presume the reviewers referring to the topsmelt tests. If so, we conducted 3 acute lethality tests on topsmelt in 2004. Results of all three tests are reported in the EEM under point *iii* of the Results. These values are listed as >72.6%, >69.0% and >71.0%.
- *“First and second sampling: No LC50 done for sand dollar.”* The sand dollar test is strictly a sublethal fertilization test, and no LC50 is measured.

**Atherinops affinis**

- Information on labeling and coding of samples will be reported
- Temperature on sample receipt at the lab will be reported.
- Date of sample receipt at the lab will be reported
- Dates or days when sub- or multiple samples were used will be reported
- Date for test completion will be reported
- *“Temperature, DO, pH, and salinity of test solution and controls were not reported for each 24hr exposure period...”* The laboratory (EVS) hand writes temperature, DO and pH on hard copy forms and does not enter these electronically. PDF copies of these forms will be provided with our hard copy report.
- *“Only give the final average mortality for each test concentration instead of the mortality as noted during each 24hr observation period.”* As above, these are written by hand in hard copy by the lab. PDF copies will be provided with the final report.
- *Comment regarding the dry weights of each replicate for each test concentration... “If not preserved then 2 test concentration have weights <0.85mg (17.3%, and 69%).”* Dry weights will be reported for each replicate of each concentration. Note that the 0.85mg test validity benchmark only refers to the **controls**. If there is a sublethal effect, such as slower growth, exposed animals will necessarily weigh less than the control and may weigh less than 0.85 mg.
- *“No preparation procedure of salinity adjustment was reported.”* Information regarding salinity adjustment was presented under point *ix* under Test Facilities and Conditions. The following text was included:
  - ix. *Indication that EC guidance document for salinity adjustment was followed*
    - *The following was done for all 3 tests:*
      - *No deviations from EC guidance document on preparation of hypersaline brine (HSB)*

- *HSB prepared from natural seawater concentrated to 90ppt (by freezing/refreezing to remove frozen layer and concentrate salts)*
- *No deviations from EC guidance document for salinity adjustment of sample*
- *HSB was added to samples to salinity adjust them to 30ppt*

We presume that this level of information is sufficient. If not, please let us know what additional information is required. Note that for the topsmelt and echinoderm tests, the lab reports state: *“Salinity: 30±2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment – July 1997)”*

### ***Champia parvula***

- Information on labeling and coding will be provided in the revised final report
- Date for sample receipt at the lab will be reported
- Date for test completion will be reported
- *“Procedure and preparation of the hypersaline brine was not reported.”* Under point *vii.* of Test Conditions and Facilities we indicate:
  - *No deviations from EC guidance document on preparation of hypersaline brine*
  - *HSB prepared from natural seawater at 90ppt*
  - *No deviations from EC guidance document for salinity adjustment of sample*
  - *Salinity adjustment: 600mL effluent + 250mL HSB + 8.5mL test nutrient solution*
  - *Salinity of samples adjusted from 4ppt to 30ppt*

The lab report indicated for hypersaline brine that it was *“Prepared from natural seawater, at 90 ppt salinity.\* As per EC guidance document on salinity adjustment”*. We presume that this is a sufficient level of detail. If not, please advise us what additional information the laboratory can provide to satisfy this comment.

- *“No note if there was anything unusual about the test organism prior to the test or if there was anything unusual about the test itself”*. We will include appropriate observations about the test in future reports. With regards to the organisms, under point *iii* of Test Organisms we indicated that *“[test species]...*
  - *Sexually mature male and female branches*
  - *Obtained from USEPA, Hatfield Marine Science Center, Newport Oregon, 1995*
  - *Appear in good health*
  - *Females have trichogynes, males have sori with spermatia*

We presume this is a sufficient level of detail. If not, please advise us on what additional information the laboratory can provide to satisfy this comment.

- *“No indication of quantitative statistic used to determine the IC25 value.”* Under point *iii.* of Results, we stated *“Quantal statistic method was linear interpolation”*. We presumed this was sufficient. Please advise if the reviewer wishes us to elaborate on this method.

### ***Dendraster excentricus***

- Information on labeling/coding, date of receipt, temperature at arrival at laboratory will be provided
- *“There was no mention of the condition of the adult organisms prior to use.”* Under point xi (Test Organisms) it is stated that *“organisms appear healthy”*. We presumed this was sufficient information. If not, please elaborate on what additional level of detail is required.
- Future reports will note if there is anything unusual observed about the organisms or the test.
- *“No procedure for salinity adjustment was reported – only statement that they followed EC guidance document”* Under point ix (Test Facilities and Conditions) we make the following comments on hypersaline brine and salinity adjustment.
  - x. *Procedure for preparation of hypersaline brine (HSB) as per EC guidance document on salinity adjustment – July 1997*
    - *Test 1: na*
    - *Test 2: 30 ppt adjusted with hypersaline brine (HSB). Preparation of HSB and salinity adjustment as per EC guidance document on Salinity adjustment – July 1997*
    - *Test 2: 30 ppt adjusted with hypersaline brine (HSB). Preparation of HSB and salinity adjustment as per EC guidance document on Salinity adjustment – July 1997*
  - xi. *Procedure for salinity adjustment as per EC guidance document on salinity adjustment – July 1997*
    - *No deviations from EC guidance for salinity adjustment*
    - *Test 1: na*
    - *Test 2: salinity adjusted from 2.8 to 28 ppt*
    - *Test 3: salinity adjusted from 5 to 28 ppt*

We presume that this is a sufficient level of detail and was according to EC guidance. For both topsmelt and echinoderm tests the original lab report methods for salinity state *“30±2 (sample adjusted with hypersaline brine [HSB]. Preparation of HSB and salinity adjustment as per EC guidance document on salinity adjustment – July 1997)”* Please advise if your reviewers would like us to obtain more information from the laboratory.

- The laboratory does use 2000 eggs/10 mL, although a subset of 100 eggs are evaluated to determine the overall fertilization rate. We will clarify this.
- Quantitative statistic for determining IC25 will be provided.

We have raised a few issues where further guidance from your office is required. These are stated above as assumptions where clarification is requested from your office. We have incorporated all other appropriate additional information requested by the reviewers into a revised 2004 Polaris Annual Report. Once we have received a response from your office we will finalize this revised report. If we do not have a response from your office by Monday September 26, 2005, we will finalize the report

following our assumptions as stated in this letter, and submit the revised report by the September 30, 2005 deadline.

We would also like to communicate to Environment Canada that the electronic and hardcopy versions of the EEM report are not harmonized, as different information is requested for the two reports. As it is currently, the addition of the electronic report results in a duplication of effort and confuses the reporting requirements, rather than resulting in a more streamlined reporting process.

Sincerely,

---

Cheryl Mackintosh, M.R.M., R.P.Bio.

**Azimuth Consulting Group Inc.**

218-2902 Broadway West

Vancouver, BC, V6K 2G8

P: 604-730-1220

F: 604-739-8511

e-mail: [cmackintosh@azimuthgroup.ca](mailto:cmackintosh@azimuthgroup.ca)

## **APPENDIX H**

**Polaris Mine – Revised 2004 3rd Quarter Metal Mining Effluent Regulations  
Report (dated March 22, 2005)**



March 22, 2005

Prairie & Northern Region  
Environment Canada  
Room 200, 4999 98<sup>th</sup> Ave.  
Edmonton, AB T6B 2X3

**Attention: Peter Blackall, Regional Director of Environmental Protection**

Dear Sir;

**Re: Polaris Mine – Revised 2004 3<sup>rd</sup> Quarter Metal Mining Effluent Regulations Report**

Please find attached a **revised** Polaris Mine 3<sup>rd</sup> Quarter MMER regulatory data tables. The reason for the revision is to ensure consistency between the data entered electronically online through the RISS system, and the hard copy Annual and 3<sup>rd</sup> Quarter reports provided. As explained in the original 3<sup>rd</sup> Quarter report cover letter, effluent from Garrow Lake ceased flowing by mid-August but surface run off from adjacent slopes maintained minimal water flow at the designated final discharge point into August. By August 17, there was water at the final discharge point in a pool, but flow was too low to be measured. As a result, regulatory concentration data in the 3<sup>rd</sup> Quarter had originally been submitted with average daily flows of 0 m<sup>3</sup> per day for the weeks of Aug. 17, Aug. 24, and Aug. 31, 2004. However, we continued to collect effluent, water quality and acute and sublethal toxicity samples on these latter three dates. Upon submitting the regulatory data into the online RISS system for the annual report, these August concentration data were not accepted with a flow rate of zero. Thus a nominal flow rate of 1 m<sup>3</sup> per day was entered. As a result the loadings data set is slightly different from the data submitted in the original 3<sup>rd</sup> Quarter report. Note that these low flow conditions during August, as well as their implications for effluent sampling, were discussed with Environment Canada representatives early in August.

If you have any questions regarding the annual report or aspects of the application of the MMER to the Polaris Mine, please feel free to contact me at any time.

Yours truly,

*Original signed by B. Donald*

Bruce Donald

Attachments: Revised 2003 3<sup>rd</sup> Quarter Regulatory Data

cc: Walter Kuit (Teck Cominco Limited)

Randy Baker (Azimuth Consulting Group)



**2004 3rd QUARTER MMER REPORT - REVISED**  
**LOCATION - FINAL DISCHARGE POINT FROM GARROW LAKE (GARROW LAKE DAM SIPHONS)**  
**CONCENTRATIONS OF EFFLUENT FOR MMER SCHEDULE 4 SAMPLED WEEKLY**

Sample Taken During The Week of	Date Sample Taken	DELETERIOUS SUBSTANCE (mg/L) <sup>1</sup>								pH <sup>1</sup>	Collection Method
		Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226 <sup>1</sup>		
5-Jul-04	7-Jul-04	0.00100	0.00265	0.0050	0.00269	0.00442	0.1980	117	0.0200	8.05	Grab
12-Jul-04	13-Jul-04	0.00200	0.00070	0.0050	0.00032	0.00204	0.1060	5.7	0.0070	7.90	Grab
19-Jul-04	20-Jul-04	0.00200	0.00043	0.0050	0.00084	0.00088	0.0435	3.0	0.0050	7.86	Grab
26-Jul-04	27-Jul-04	0.00100	0.00052	0.0050	0.00157	0.00207	0.0429	3.0	0.0050	7.87	Grab
2-Aug-04	3-Aug-04	0.00020	0.00082	0.0050	0.00280	0.00338	0.0349	3.3	0.0060	8.00	Grab
9-Aug-04	10-Aug-04	0.00100	0.00100	0.0055	0.00120	0.00748	0.0482	3.0	0.0050	8.04	Grab
16-Aug-04	17-Aug-08	0.00020	0.00121	0.0050	0.00177	0.00644	0.0418	5.3	0.0100	7.95	Grab
23-Aug-04	24-Aug-04	0.00020	0.00134	0.0050	0.00119	0.00967	0.0498	4.4	0.0080	7.84	Grab
30-Aug-04	31-Aug-04	0.00020	0.00137	0.0050	0.00261	0.01340	0.0794	14.5	0.0080	7.90	Grab
6-Sep-04	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>
13-Sep-04	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>
20-Sep-04	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>
27-Sep-04	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>

Note<sup>1</sup> - All concentrations are in mg/L except Radium 226 which is Bq/L and pH which is in pH units

Note<sup>2</sup> - "nd" refers to no effluent discharge to sample

**MONTHLY MEAN CONCENTRATIONS OF EFFLUENT FOR MMER SCHEDULE 4**

MONTH OF	MONTHLY MEAN CONCENTRATION <sup>1</sup> OF DELETERIOUS SUBSTANCE <sup>3</sup>							
	Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226
July/04	0.0015	0.00107	0.0050	0.00135	0.00235	0.0976	32	0.0093
August/04	0.0004	0.00115	0.00510	0.00191	0.00807	0.0508	6.1	0.0074
September/04	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>	nd <sup>2</sup>

Note<sup>1</sup> - All concentrations are in mg/L except Radium 226 which is Bq/L

Note<sup>2</sup> - "nd" refers to no effluent discharge to sample

Note<sup>3</sup> - Monthly Mean Concentrations - the MEAN value of the concentrations measured in all water samples collected during each month when a deleterious substance is deposited.

### MASS LOADING OF DELETERIOUS SUBSTANCE FOR EACH DAY SAMPLED

Sample Taken During The Week of	Date Sample Taken	DAILY MASS LOADING OF DELETERIOUS SUBSTANCE (kg/day) <sup>1</sup>								Average Daily Flow Rate (m <sup>3</sup> /day)
		Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226 <sup>1</sup>	
5-Jul-04	7-Jul-04	0.018	0.048	0.091	0.049	0.080	3.588	2120	362,440	18,122
12-Jul-04	13-Jul-04	0.752	0.264	1.880	0.120	0.767	39.850	2143	2,631,608	375,944
19-Jul-04	20-Jul-04	0.205	0.044	0.512	0.086	0.090	4.458	307	512,395	102,479
26-Jul-04	27-Jul-04	0.028	0.015	0.141	0.044	0.058	1.211	85	141,090	28,218
2-Aug-04	3-Aug-04	0.005	0.022	0.132	0.074	0.089	0.923	87	158,700	26,450
9-Aug-04	10-Aug-04	0.026	0.026	0.142	0.031	0.194	1.248	78	129,470	25,894
16-Aug-04	17-Aug-08	0.000	0.000	0.000	0.000	0.000	0.000	0	0	1
23-Aug-04	24-Aug-04	0.000	0.000	0.000	0.000	0.000	0.000	0	0	1
30-Aug-04	31-Aug-04	0.000	0.000	0.000	0.000	0.000	0.000	0	0	1
6-Sep-04	nd <sup>2</sup>	0	0	0	0	0	0	0	0	0
13-Sep-04	nd <sup>2</sup>	0	0	0	0	0	0	0	0	0
20-Sep-04	nd <sup>2</sup>	0	0	0	0	0	0	0	0	0
27-Sep-04	nd <sup>2</sup>	0	0	0	0	0	0	0	0	0

Note<sup>1</sup> - Mass Loading is in kilograms per day of the deleterious substance deposited except Radium 226 which is in Bq per day

Note<sup>2</sup> - "nd" refers to no effluent discharge to sample

### MASS LOADING PER CALENDAR MONTH FOR EACH DELETERIOUS SUBSTANCE

CALENDAR MONTH OF	MASS LOADING <sup>1</sup> FOR DELETERIOUS SUBSTANCE (kg/month) <sup>2</sup>								Average Weekly Flow Rate <sup>3</sup> (m <sup>3</sup> /week)	Total Monthly Volume <sup>4</sup> (m <sup>3</sup> /month)
	Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226 <sup>2</sup>		
July/04	7.77	2.87	20.33	2.31	7.71	380.58	36,078.15	28,268,381	131,191	4,066,913
August/04	0.19	0.29	1.70	0.65	1.76	13.46	1,022.95	1,786,654	10,469	324,551
September/04	0	0	0	0	0	0	0	0	0	0

Note<sup>1</sup> - Total Mass Loading for Calendar month calculated by multiplying the Average Daily Mass Loading for the Month x # days in the month

Note<sup>2</sup> - Mass loading units are in kg per month except Radium 226, which is in Bq per month

Note<sup>3</sup> - Average Weekly Flow Rate calculated by multiplying Average Daily Flow Rate x 7 days per week

Note<sup>4</sup> - Total Monthly Volume calculated by multiplying Average Daily Flow Rate for the month x days in month