Appendices C-F*

Remedial Investigation Report
Tru-Grit Abrasives, Inc.
1110 E. Alexander Avenue
Tacoma, WA
Cleanup Site ID: 1294

December 17, 2021

Prepared for CanAm Minerals Inc. by Landau Associates

***Main Text and Appendices A and B are in a separate document**

APPENDIX C

2018 Bioassay Lab Reports

ECOANALYSTS, INC.

TOXICOLOGY TESTING RESULTS

TRU-GRIT REMEDIAL INVESTIGATION
TACOMA, WASHINGTON

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All testing reported herein was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and EcoAnalysts is not responsible for use of less than the complete report. The test results summarized in this report apply only to the sample(s) evaluated.

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APPENDICES

Appendix A: Test and Reference Toxicant Test Results
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ACRONYMS AND ABBREVIATIONS

AFDW:	Ash-free dry weight
cm:	Centimeter
CSL:	Cleanup Screening Level
°C:	Degrees Celsius
EC_{50}:	Effective Concentration that results in a 50% reduction in a sub-lethal endpoint
g:	Grams
LC_{50}:	Lethal Concentration that results in a 50% reduction in survival
L:	Liter
µm:	Micrometer
mg:	Milligram
mg/L:	Milligrams per liter
mL:	Milliliter
mm:	Millimeter
NELAP:	National Environmental Laboratory Accreditation Program
NOEC:	No Observed Effect Concentration
ppt:	Parts per Thousand
PSEP:	Puget Sound Estuary Protocols (PSEP 1995)
SCO:	Sediment Cleanup Objective
SCUM:	Sediment Cleanup User's Manual
SMS:	Sediment Management Standards
SOP:	Standard Operation Procedure
SMARM:	Sediment Management Annual Review Meeting
UIA:	Unionized ammonia
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
WAC:	Washington Administrative Code
WDOE:	Washington (State) Department of Ecology

1. INTRODUCTION

EcoAnalysts conducted biological toxicity testing with sediment samples collected as part of a remedial investigation being performed at the Tru-Grit Site Areas in the Blair Waterway, Tacoma, Washington. Sediments were evaluated for biological effects following guidance provided by the Washington State Department of Ecology (WDOE) Sediment Management Standards (SMS) under the Washington Administrative Code (WAC) 173-204-315. This report presents the results of the toxicity testing portion of the Tru-Grit remedial investigation.

2. METHODS

This section summarizes the test methods followed for this biological characterization. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the Sediment Management Standards of Washington State (SMS, 2013), the Sediment Cleanup User's Manual II (SCUM II; WDOE 2017), and the various updates presented during the Sediment Management Annual Review Meeting (SMARM). Sediment toxicity was evaluated using three standard PSEP bioassays; the 10-day amphipod test, the 20-day juvenile polychaete survival and growth test, and the benthic larval development test.

2.1 Sample Collection and Receipt

Four test sediments were collected on January 25, 2018 and were received at the EcoAnalysts laboratory on the same day as collection. At the direction of Landau Associates, three of the four sediments were evaluated for toxicological effects for the purposes of this program. Reference sediment from Carr Inlet, WA was collected by EcoAnalysts on January 26, 2018 and received on the same day. Sediment samples were stored in a walk-in cold room at 4 ± 2°C in the dark. The test sediment was not sieved prior to testing. All testing was conducted within the 8-week sediment hold time.

2.2 Bulk Sediment Ammonia and Sulfides Measurements

Prior to testing, bulk sediment porewater total sulfides and ammonia concentrations were measured to determine whether any methods modifications or supplemental testing would be required. Bulk sediments are homogenized test composites that have not been further processed for bioassay testing. The results of the bulk sediment analyses are summarized in Table 2-1.

Table 2-1: Bulk Sediment Porewater Measurements

Treatment	Total Ammonia (mg/L)	Unionized Ammonia (mg/L) [1]	Salinity (ppt)	pH	Total Sulfides (mg/L)	Hydrogen Sulfide (mg/L)[1]
G-5-012518	19.3	0.328	28	7.7	ND	ND
SG-14-012518	13.0	0.175	29	7.6	0.002	0.000
SG-16-012518	11.8	0.159	29	7.6	0.002	0.000

[1] Calculated using the analysis temperature of 20.4°C
ND = Not detected

2.3 Sample Grain Size and Reference Comparison

Sediment grain size is one of the characteristics used in selecting the appropriate reference sediment(s) to compare the chemical and biological responses of project sediments. The percent fines value is defined as the amount of sediment that passes through a 62.5-µm sieve, expressed as a percentage of the total sample analyzed. This is also the sum of the silt and clay fraction of sediment. Wet-sieve grain size results for the reference treatments were conducted in the field (at the time of collection) and after receipt at the EcoAnalysts laboratory. The percent-fines determination of the project sediments is summarized in Table 2-2. The targeted reference sample percent fines value was within the recommended range of ≤20% of the test sediment percent fines (WDOE 2017).

Table 2-2. Sample and Reference Grain Size Comparison

Treatment	Percent Fines[1]	Treatment Compared To:
Carr Inlet (Reference)	50%	
G-5-012518	30%	Carr Inlet (Reference)
SG-14-012518	44%	
SG-16-012518	58%	

[1] Wet sieve results

All project samples were compared to the Carr Inlet reference (50% fines) for the purposes of evaluating the sediment under the sediment management standards. Station coordinates for the reference samples are summarize in Table 2-3.

Table 2-3. Reference Station Coordinates

Station	Latitude	Longitude
Carr Inlet (Reference)	47.331500	-122.677776

2.4 10-day Amphipod Bioassay

The 10-day amphipod acute toxicity test was conducted with *Eohaustorius estuarius*. Test organisms were supplied by Northwestern Aquatic Sciences in Newport, OR and held in native sediment at 15°C prior to test initiation. Organisms were fed during the holding period a diet of ground TetraMin® ad libitum. Native sediment from Yaquina Bay, OR was provided by the organism supplier for use as the control treatment sediment in the test. This matrix has been used successfully in prior tests with this species and is known to support positive organism health and survival.

The amphipod bioassay was conducted as 10-day static exposures with five replicates for each test treatment, reference treatment, and control. Two centimeters of sediment (approximately 175 mL) were placed into each 1-L glass chamber with 775 mL of overlying water. Trickle-flow aeration was provided through glass pipettes, and care was taken to avoid disturbing the sediment surface. Test chambers were placed into randomly assigned positions and allowed to equilibrate to test conditions overnight.

Prior to the test initiation, water quality measurements were taken in all replicates for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in both interstitial (pore water) and overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. Sediment pore water was extracted via centrifugation. During the test, water quality was

monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, organisms were randomly allocated to each of the test chambers. Initial stocking densities were 20 organisms per test chamber. Amphipods that did not bury within approximately one hour were replaced with healthy amphipods. No food was provided during the 10-day exposure for the amphipod test.

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen to recover all organisms. The number of surviving and dead amphipods was then enumerated.

2.5 20-day Juvenile Polychaete Bioassay

The 20-day polychaete survival and growth test was conducted with juvenile polychaete worms (*Neanthes arenaceodentata*). Test organisms were obtained from Aquatic Toxicology Support in Bremerton, WA and held in seawater at 20°C (Neanthes were cultured in water-only and were not held in sediment prior to testing). Native sediment of the amphipod *Eohaustorius estuarius* from Yaquina Bay, OR was provided by Northwestern Aquatic Sciences for use as the control treatment sediment for the test. This coarse sand control sediment has been routinely tested in conjunction with this species at this laboratory and results from historical testing have demonstrated acceptable organism health and sediment quality.

The polychaete bioassay was conducted as a 20-day static-renewal test, with overlying exchanges of 300 mL of water occurring every third day. Each test treatment, reference treatment, and control consisted of five replicates of 1-L glass chambers, which were filled with two centimeters of sediment (approximately 175 mL) and 775 mL of overlying water. Trickle-flow aeration was provided through glass pipettes, and care was taken to avoid disturbing the sediment surface. Test chambers were then randomly assigned positions and allowed to equilibrate to test conditions overnight.

Prior to the test initiation, water quality measurements were taken in a surrogate chamber for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in both interstitial (pore water) and overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. Sediment pore water was extracted via centrifugation. During the test, water quality was monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, organisms were randomly allocated to each of the test chambers. Initial stocking densities were five worms per test chamber. During the test, organisms were fed a diet of 40-mg of TetraMarin® slurry every other day (approximately 8-mg dry weight per worm). Pre-test initial biomass was determined by taking dry weight and ash-free dry weight (AFDW) measurements of three replicates of five worms each on Day 0.

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen. All worms were recovered, enumerated, rinsed in deionized water (to remove salt), and transferred to pre-weighed aluminum foil weigh boats. After drying in an oven at 60°C for approximately 24 hours, each weigh-boat was removed, cooled in a desiccator and weighed to obtain dry weight measurements. They were then heated to 550°C for 2 hours to determine the ashed weight. Ash-free dry weights (AFDW) were calculated to correct for the influence of sediment grain size differences between treatments:

$$\boldsymbol{AFDW = Dry\ weight - Ashed\ weight}$$

Both dry weight and AFDW were used to determine individual worm weight and growth rates.

2.6 Larval Developmental Bioassay

The bivalve larval development test was conducted with the mussel, *Mytilus galloprovincialis*. Adult organisms were obtained from Taylor Shellfish in Shelton, WA and were held in unfiltered seawater at 12°C prior to artificial spawning. Two control treatments were employed: a clean seawater control and a sediment control, composed of *E. estuarius* native sediment from Yaquina Bay, OR.

The larval development bioassay was conducted as a static exposure with five replicates for each test treatment, reference treatment, and control. Approximately 18 g (±1 g) of sediment was placed into each 1-L glass chamber with 900 mL of overlying water. Test chambers were then shaken for 10 seconds and placed into randomly assigned positions. The larval test was performed without aeration unless dissolved oxygen levels fell below threshold levels for action.

Prior to the test initiation, water quality measurements were taken in the surrogate chamber for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in the overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. During the test, water quality was monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, mussels were placed in clean seawater and acclimated at 16°C for approximately 20 minutes. The water bath temperature was then increased over a period of 15 minutes to 20°C. Mussels were held at 20°C and monitored for spawning individuals. Spawning females and males were removed from the water bath and placed in individual containers with seawater. These individuals were allowed to spawn until sufficient gametes were available to initiate the test. After the spawning period, eggs were transferred to fresh seawater and filtered through a 0.5 mm Nitex® mesh screen to remove large debris, feces, and excess gonadal matter. A composite was made of the sperm and diluted with fresh seawater. The fertilization process was initiated by adding sperm to the isolated egg containers. Egg-sperm solutions were periodically homogenized with a perforated plunger during the fertilization process and sub-samples observed under the microscope for egg and sperm viability. Approximately one to one and a half hours after fertilization, embryo solutions were checked for fertilization rate. Only those embryo stocks with >90% fertilization were used to initiate the tests. Embryo solutions were rinsed free of excess sperm and then combined to create one embryo stock solution. Density of the embryo stock solution was determined by counting the number of embryos in a subsample of homogenized stock solution. This was used to determine the volume of embryo stock solution to deliver approximately 27,000 embryos to each test chamber.

The protocol calls for test termination when 95% of the embryos in the control have reached the prodissoconch I stage (approximately 48-60 hours). At termination, the overlying seawater was decanted into a clean 1-L jar and mixed with a perforated plunger. From this container, a 10 mL subsample was transferred to a scintillation vial and preserved in 5% buffered formalin. Larvae were subsequently stained with a dilute solution of Rose Bengal in 70% alcohol to help visualization of larvae. The number of normal and abnormal larvae was enumerated on an inverted microscope. Normal larvae included all D-shaped prodissoconch I stage larvae. Abnormal larvae included abnormally shaped prodissoconch I larvae and all early stage larvae.

2.7 Seawater for Bioassay Testing

Filtered seawater used in this study came from the northern Hood Canal at Port Gamble, Washington. This seawater source has been used successfully on similar bioassay testing programs and extensive testing on a variety of test species has shown that there is no significant potential for toxicity or bioaccumulation from this water supply. Acceptable survival of organisms in control sediment has been achieved consistently in previous dredge material testing conducted by the laboratory. Chemical analyses of this water source resulted in no significant contaminants of concern or bioaccumulation potential.

Seawater was adjusted with the addition of deionized water, if necessary, to lower the salinity for testing.

2.8 Data Management and Analysis

All water quality and endpoint data were entered into Excel spreadsheets. Water quality parameters were summarized by calculating the mean, minimum, and maximum values for each test treatment. Endpoint data were calculated for each replicate and the mean values and standard deviations were determined for each test treatment.

All hand-entered data was reviewed for data entry errors, which were corrected prior to summary calculations. A minimum of 10% of all calculations and data sorting were reviewed for errors. Review counts were conducted on any apparent outliers.

For the larval test, the normalized combined mortality and abnormality endpoint was used to evaluate the test sediment. This was based on the number of normal larvae in each treatment and reference sample divided by the mean number of normal larvae in the control replicates, as defined in the SCUM II guidance document (Ecology 2015).

Experiment-wide survival, growth, and development data were analyzed using one-way analysis of variance (ANOVA). When ANOVA showed a significant difference, multiple comparison t-tests then compared survival in each of the control and test sediments against survival in the reference sediments. Prior to analyses, normality and homogeneity of variance was assessed. When necessary to satisfy these assumptions, proportional survival data were arcsine square-root transformed. Solid-phase analyses were performed with GraphPad Prism, Version 7.03. Statistical analyses of all dose-response tests were performed using CETIS Comprehensive Toxicity Data Analysis and Database Software. Comparisons between the lab control and each test concentration were performed following recommended USEPA decision matrices (USEPA 2002).

2.9 Quality Assurance/Quality Control

The quality assurance objectives for toxicity testing conducted by the testing laboratory are detailed in the laboratory's quality assurance plans (QAPs). These objectives for accuracy and precision involve all aspects of the testing process, including the following:

- Water and Sediment Sampling and Handling
- Source and Condition of Test Organisms
- Condition of Equipment
- Test Conditions
- Instrument Calibration
- Use of Reference Toxicants

- Record Keeping
- Data Evaluation

Each test organism was evaluated in reference toxicant tests during the test period to establish the sensitivity of the test organisms (Lee 1980). The reference toxicant LC_{50} or EC_{50} should be within two standard deviations of the historical laboratory mean. Water quality measurements were monitored to ensure that they fell within prescribed limits.

The methods employed in every phase of the toxicity testing program are detailed in the EcoAnalysts Standard Operating Procedures (SOP). All EcoAnalysts staff members receive regular, documented training in all SOPs and test methods. Finally, all data collected and produced as a result of these analyses were recorded on approved data sheets. If an aspect of a test deviated from protocol, the test was evaluated to determine whether it was valid according to the regulatory agencies responsible for approval of the proposed permitting action.

3. RESULTS

The results of the sediment testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets are provided Appendix A and statistical analyses are provided in Appendix B.

3.1 10-day Amphipod Bioassay

The bioassay test with *E. estuarius* was validated with 1% mortality in the control, which met the performance criterion of ≤ 10% mortality for SMS evaluations. This result indicates that the test conditions were suitable for adequate amphipod survival. Mean mortality in the Carr Inlet reference treatment was 3%, which also met the performance criteria (≤ 25% reference treatment mortality), indicating that the reference sediment was acceptable for suitability determination. Mean mortality in the three project samples was between 18% – 23%. All endpoint results are summarized in Table 3-1.

All water quality parameters were within the acceptable limits throughout the duration of the test (Table 3-2).

A reference-toxicant test was performed on the batch of test organisms utilized for this study. The LC_{50} value was within ±2 standard deviations from the laboratory historical mean. This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia and sulfides concentrations were below any trigger values, indicating a mortality effect due to ammonia and/or sulfides was unlikely (Table 3-3 and Table 3-4). Total ammonia concentrations at test initiation and termination were below the potential trigger of 0.8 mg/L unionized ammonia (Inouye 2015). Similarly, total sulfides were below potential trigger value of 0.122 mg/L hydrogen sulfide throughout the duration of testing, indicating that purging of overlying water to remove excess ammonia and/or sulfides was not warranted (Inouye 2015).

A summary of the test conditions is presented in Table 3-5.

Table 3-1. Test Results for *Eohaustorius estuarius*

Treatment	Replicate	Number Initiated	Number Surviving	Number Missing or Dead	Mortality (%)	Mean Mortality (%)	SD
Control	1	20	20	0	0	1.0	2.2
	2	20	20	0	0		
	3	20	20	0	0		
	4	20	20	0	0		
	5	20	19	1	5		
Carr Inlet Reference	1	20	19	1	5	3.0	4.5
	2	20	20	0	0		
	3	20	20	0	0		
	4	20	18	2	10		
	5	20	20	0	0		
G-5-012518	1	20	18	2	10	19.0	7.4
	2	20	16	4	20		
	3	20	16	4	20		
	4	20	17	3	15		
	5	20	14	6	30		
SG-14-012518	1	20	20	0	0	18.0	15.2
	2	20	18	2	10		
	3	20	12	8	40		
	4	20	17	3	15		
	5	20	15	5	25		
SG-16-012518	1	20	14	6	30	23.0	10.4
	2	20	15	5	25		
	3	20	17	3	15		
	4	20	13	7	35		
	5	20	18	2	10		

Table 3-2. Water Quality Summary for *Eohaustorius estuarius*

Treatment	Dissolved Oxygen (mg/L) ≥ 5.1 mg/L			Temperature (°C) 15 ± 1°C			Salinity (ppt) 28 ± 1 ppt			pH 7 - 9 units		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	8.2	7.9	8.4	15.7	15.4	15.9	28	28	29	8.1	7.9	8.2
Carr Inlet Reference	8.1	7.8	8.4	15.7	15.4	16.1	28	28	28	8.0	7.9	8.2
G-5-012518	8.1	7.7	8.3	15.7	15.4	16.1	28	28	29	8.1	8.0	8.3
SG-14-012518	8.1	7.9	8.3	15.7	15.4	16.0	28	28	29	8.1	8.0	8.1
SG-16-012518	8.2	7.8	8.3	15.7	15.5	16.0	28	28	29	8.1	8.0	8.1

Temperature values are rounded to whole number for comparison to targeted range

Table 3-3 Ammonia Summary for *Eohaustorius estuarius*

Treatment	Overlying Ammonia (mg/L Total)		Interstitial Ammonia (mg/L Total)	
	Day 0	Day 10	Day 0	Day 10
Control	0.154	0.214	NM	NM
Carr Inlet Reference	0.285	0.00	3.17	0.081
G-5-012518	1.120	1.69	11.1	6.61
SG-14-012518	0.883	0.00	8.54	1.06
SG-16-012518	0.681	0.00	7.57	0.553
Treatment	**Overlying Ammonia (mg/L UIA)**		**Interstitial Ammonia (mg/L UIA)**	
	Day 0	**Day 10**	**Day 0**	**Day 10**
Control	0.004	0.004	NM	NM
Carr Inlet Reference	0.007	0.000	0.047	0.000
G-5-012518	0.026	0.060	0.163	0.050
SG-14-012518	0.023	0.000	0.126	0.010
SG-16-012518	0.019	0.000	0.140	0.005

NOEC (concurrent reference-toxicant test derived) = 69.7 mg/L total, 0.825 mg/L UIA
Trigger value of 0.8 mg/L UIA (Inouye 2015)
NM = not measured; insufficient porewater recovered for analysis

Table 3-4. Sulfide Summary for *Eohaustorius estuaries*

Treatment	Overlying Total Sulfides (mg/L)		Interstitial Total Sulfides (mg/L)	
	Day 0	Day 10	Day 0	Day 10
Control	0.003	ND	NM	NM
Carr Inlet Reference	0.004	ND	0.028	0.002
G-5-012518	0.00	0.006	0.012	0.022
SG-14-012518	0.00	0.00	0.00	ND
SG-16-012518	0.001	0.003	0.00	0.002
Treatment	**Overlying Hydrogen Sulfide (mg/L)**		**Interstitial Hydrogen Sulfide (mg/L)**	
	Day 0	**Day 10**	**Day 0**	**Day 10**
Control	0.000	ND	NM	NM
Carr Inlet Reference	0.000	ND	0.003	0.001
G-5-012518	0.000	0.000	0.001	0.005
SG-14-012518	0.000	0.000	0.000	ND
SG-16-012518	0.000	0.000	0.000	0.000

Trigger value of 0.122 mg/L hydrogen sulfide (Inouye 2015)
NM – not measured; insufficient volume for analysis.
ND – not detected.

Table 3-5.Test Condition Summary for *Eohaustorius estuarius*

Test Conditions: *Eohaustorius estuarius*		
Samples Collected	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Samples Received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample Storage Conditions	4°C, dark	
Test Dates	February 23 – March 5, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 29 days
Source of Control Sediment	Yaquina Bay, OR	
Test Species	*E. estuarius*	
Organism Supplier	Northwestern Aquatic Sciences	
Organisms Acquired	February 22, 2018	
Organism Acclimation	1 Day	
Organism Age	Mature; 3-5 mm	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017), SOP No. SED002.09	
Test Location	EcoAnalysts, Port Gamble, WA	
Test Type/Duration	10-Day/ Static	
Control Water	North Hood Canal seawater, 0.45 µm-filtered	
Test Lighting	Continuous	
Test Chamber	1000-mL Glass Chamber	
Replicates per Treatment	5 + 2 surrogates	
Organisms per Replicate	20	
Exposure Volume	175 mL sediment (2 cm) / 775 mL of overlying seawater	
Feeding	None	
Water Renewal	None	
Test Dissolved Oxygen	Recommended: > 5.1 mg/L (target)	Actual: 7.7 – 8.4 mg/L
Test Temperature	Recommended: 15 ± 1°C	Actual: 15.4 – 16.1 °C
Test Salinity	Recommended: 28 ± 1 ppt	Actual: 28 – 29 ppt
Test pH	Recommended: 7 – 9 (target)	Actual: 7.9 – 8.3
Control Performance Standard	Recommended: ≤ 10% mortality	Actual: 1%
Reference Performance Standard (as per SMS)	Recommended: ≤ 25% mortality	Actual: 3%
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant LC_{50} (mg/L)	144.3	1.361
Running Lab Mean LC_{50} (mg/L) Acceptable Range (mg/L)	144.7 71.2 – 294.4	1.273 0.577 – 2.807
Reference Toxicant NOEC (mg/L)	69.7	0.825
Deviations from Test Protocol	None	

3.2 20-day Juvenile Polychaete Bioassay

No mortality was observed in the *N. arenaceodentata* control sediment. Mean individual growth (MIG) in the control was 0.767 mg/ind/day (dry weight) and 0.444 mg/ind/day (AFDW). These values fall within the test acceptability criteria of <10% mean mortality and ≥0.38 mg/ind/day AFDW (WDOE 2017), indicating that the test conditions were suitable for adequate polychaete survival and growth. A summary of the test endpoint results for all samples is shown in Table 3-6.

Mean individual growth as dry weight for the Carr Inlet reference treatment was 0.678 mg/ind/day and mean individual growth as ash-free dry weight was 0.458 mg/ind/day. When compared to the control, MIG expressed as AFDW was 1.03, which met the reference performance standard of ≥0.80 (WDOE 2017).

Mean mortality in the project sediments was 0%. Mean individual growth (as dry weight) in the test treatments ranged from 0.649 to 0.789 mg/ind/day while mean individual growth in the AFDW assessment (which removes variability caused by gut contents) ranged from 0.495 to 0.534 mg/ind/day.

All water quality parameters were within the acceptable limits throughout the duration of the test (Table 3-7). Initial mean individual biomass (pretest) of the test organisms was 0.439 mg per individual dry weight, which met the initial size requirement of 0.25 – 1.0 mg/individual.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The LC_{50} value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia and sulfides concentrations were below any trigger values, indicating a mortality effect due to ammonia and/or sulfides was unlikely (Table 3-8 and Table 3-9). Ammonia concentrations observed in the *N. arenaceodentata* test were below the 10 mg/L total ammonia and 0.46 mg/L UIA no-effects thresholds for purging while hydrogen sulfide concentrations were well below the potential trigger value of 3.4 mg/L throughout the duration of testing. This indicates that purging of overlying water to remove excess ammonia and/or sulfides would not be warranted (Kendall and Barton 2004).

A complete summary of test conditions is presented in Table 3-10. No deviations from testing protocol were observed in the *N. arenaceodentata* bioassay.

Table 3-6. Test Results for *Neanthes arenaceodentata*

Treatment	Rep	Number Initiated	Survivors	Mean Mortality (%)	Individual Growth (mg/ind/day)					
					Dry Weight	Mean	Std Dev	AFDW	Mean	Std Dev
Control	1	5	5	0%	0.678	0.767	0.166	0.401	0.444	0.066
	2	5	5		0.960			0.522		
	3	5	5		0.569			0.382		
	4	5	5		0.712			0.407		
	5	5	5		0.916			0.508		
Carr Inlet Reference	1	5	5	0%	0.827	0.678	0.092	0.535	0.458	0.046
	2	5	5		0.601			0.452		
	3	5	5		0.682			0.426		
	4	5	5		0.674			0.458		
	5	5	5		0.604			0.419		
G-5-012518	1	5	5	0%	0.540	0.649	0.097	0.412	0.495	0.080
	2	5	5		0.788			0.599		
	3	5	5		0.653			0.492		
	4	5	5		0.689			0.547		
	5	5	5		0.576			0.424		
SG-14-012518	1	5	5	0%	0.768	0.789	0.038	0.514	0.534	0.030
	2	5	5		0.854			0.575		
	3	5	5		0.776			0.552		
	4	5	5		0.788			0.528		
	5	5	5		0.758			0.501		
SG-16-012518	1	5	5	0%	0.711	0.745	0.070	0.506	0.512	0.042
	2	5	5		0.848			0.570		
	3	5	5		0.753			0.512		
	4	5	5		0.758			0.521		
	5	5	5		0.658			0.451		

Table 3-7. Water Quality Summary for *Neanthes arenaceodentata*

Treatment	Dissolved Oxygen (mg/L) ≥ 4.6 mg/L			Temperature (°C) 20 ± 1°C			Salinity (ppt) 28 ± 2 ppt			pH 7 - 9 units		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	7.4	7.1	7.8	20.1	18.9	21.0	28	28	28	7.9	7.7	8.0
Carr Inlet Reference	7.4	7.1	7.9	20.1	18.9	20.9	28	28	28	8.0	7.7	8.1
G-5-012518	7.4	7.1	7.8	19.7	18.7	20.3	28	28	28	8.0	7.8	8.1
SG-14-012518	7.4	7.2	7.9	20.0	18.7	20.8	28	28	29	8.0	7.9	8.1
SG-16-012518	7.1	6.7	7.8	19.8	18.9	20.2	28	28	28	7.9	7.7	8.0

Temperature values are rounded to whole number for comparison to targeted range

Table 3-8 Ammonia Summary for *Neanthes arenaceodentata*

Treatment	Overlying Ammonia (mg/L Total)		Interstitial Ammonia (mg/L Total)	
	Day 0	Day 20	Day 0	Day 20
Control	0.102	0.614	NM	1.25
Carr Inlet Reference	0.239	0.196	5.22	0.350
G-5-012518	1.09	0.136	10.4	1.36
SG-14-012518	0.828	0.116	8.46	0.964
SG-16-012518	0.746	0.143	5.58	1.81

Treatment	Overlying Ammonia (mg/L UIA)		Interstitial Ammonia (mg/L UIA)	
	Day 0	Day 20	Day 0	Day 20
Control	0.002	0.016	NM	0.013
Carr Inlet Reference	0.005	0.008	0.084	0.002
G-5-012518	0.022	0.004	0.211	0.007
SG-14-012518	0.021	0.005	0.168	0.007
SG-16-012518	0.015	0.005	0.113	0.006

NOEC (concurrent reference-toxicant test derived) = 162 mg/L total, 1.49 mg/L UIA
Kendall and Barton 2004: No effects threshold of 10 mg/L total, 0.46 mg/L UIA for ammonia purging; interstitial not reported
NM = not measured; insufficient porewater recovered for analysis

Table 3-9. Sulfide Summary for *Neanthes arenaceodentata*

Treatment	Overlying Total Sulfides (mg/L)		Interstitial Total Sulfides (mg/L)	
	Day 0	Day 20	Day 0	Day 20
Control	0.003	0.006	NM	0.000
Carr Inlet Reference	0.002	ND	0.000	ND
G-5-012518	0.000	0.001	0.004	0.000
SG-14-012518	0.000	0.000	0.000	0.008
SG-16-012518	0.000	ND	0.000	ND
Treatment	**Overlying Hydrogen Sulfide (mg/L)**		**Interstitial Hydrogen Sulfide (mg/L)**	
	Day 0	**Day 20**	**Day 0**	**Day 20**
Control	0.000	0.000	NM	0.000
Carr Inlet Reference	0.000	ND	0.000	ND
G-5-012518	0.000	0.000	0.000	0.000
SG-14-012518	0.000	0.000	0.000	0.002
SG-16-012518	0.000	ND	0.000	ND

Kendall and Barton 2004: Hydrogen sulfide value of 3.4 mg/L is a no-effects threshold for overlying water; interstitial not reported
NM – not measured; insufficient volume for analysis.
ND – not detected.

Table 3-10. Test Condition Summary for *Neanthes arenaceodentata*

Test Conditions: *Neanthes arenaceodentata*		
Samples Collected	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Samples Received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample Storage Conditions	4°C, dark	
Test Dates	February 23 – March 15, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 29 days
Source of Control Sediment	Yaquina Bay, OR	
Test Species	*N. arenaceodentata*	
Organism Supplier	Aquatic Toxicology Support	
Organisms Acquired	February 22, 2018	
Organism Acclimation	1 Day	
Organism Age	Juvenile; 18 days post-emergence	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017) SOP No. SED009.08	
Test Location	EcoAnalysts, Port Gamble, WA	
Test Type/Duration	20-Day/ Static Renewal	
Control Water	North Hood Canal seawater, 0.45 µm-filtered	
Test Lighting	Continuous	
Test Chamber	1000-mL Glass Chamber	
Replicates per Treatment	5 + 2 surrogates	
Organisms per Replicate	5	
Exposure Volume	175 mL sediment (2 cm) / 775 mL of overlying seawater	
Feeding	40 mg ground TetraMin® per chamber every other day	
Water Renewal	Every third day (1/3 of overlying water)	
Test Dissolved Oxygen	Recommended: > 4.6 mg/L (target)	Actual: 6.7 – 7.9 mg/L
Test Temperature	Recommended: 20 ± 1°C	Actual: 18.7 – 21.0 °C
Test Salinity	Recommended: 28 ± 2 ppt	Actual: 28 – 29 ppt
Test pH	Recommended: 7 – 9 (target)	Actual: 7.7 – 8.1
Initial Biomass	Recommended: 0.5 – 1.0 mg Minimum: 0.25 mg (dry wt)	Actual: 0.439 mg
Control Performance Standard	Recommended Mortality: < 10% Recommended Growth: ≥ 0.38 mg/ind/day (AFDW)	Actual Mortality: 0% Actual Growth: 0.444 mg/ind/day (AFDW)
Reference Performance Standard	Recommended Mortality: ≤ 20% Recommended Growth: $MIG_R/MIG_C > 0.80$	Actual Mortality: 0% Actual Growth: 1.03 AFDW
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant LC_{50} (mg/L)	226.4	1.939
Running Lab Mean LC_{50} (mg/L) Acceptable Range (mg/L)	163.7 102.9 – 260.3	1.644 0.944– 2.864
Reference Toxicant NOEC (mg/L)	162	1.49
Deviations from Test Protocol	None	

3.3 Larval Development Bioassay

The larval development test with *M. galloprovincialis* was validated by 93.9% and 83.1% normal survivorship in the water-only control and sediment control, respectively. Normal survivorship is defined as the mean number of normal larvae within the control divided by the stocking density. These values were within the SMS acceptability criterion of ≥70%. A summary of the test results for all samples is shown in Table 3-11. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in, Table 3-12, Table 3-13, and Table 3-14.

Mean normal survival of the reference sediment was 88.7% and 98.1% of the control responses, which met the SMS reference acceptability criterion (N_R/N_C) of ≥65%. This is defined as the number of normal larvae in the reference sample(s) (N_R) divided by the number of normal larvae in the control (N_C). The test mean chamber stocking density (measured at test initiation) was 34.5 embryos/mL and was within the test objective of 20 – 40 embryos/mL.

Water quality parameters were within the acceptable limits throughout the duration of the test.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The EC_{50} value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia concentrations observed in the *M. galloprovincialis* test were below the No Observed Effect Concentration (NOEC) values derived from the concurrent ammonia reference-toxicant test (Table 3-13; compare to NOEC 3.04 mg/L total, 0.047 UIA), as well as the purging trigger of 0.04 UIA (Inouye 2015). This indicates that ammonia concentrations within the sediment samples should not have contributed to any adverse biological effects observed in the test treatments. Hydrogen sulfide concentrations were also below the trigger value of 0.0025 mg/L (Inouye 2015).

Table 3-11. Test Results for *Mytilus galloprovincialis*

Treatment	Rep	Number Normal	Number Abnormal	Mean # Normal (N)	Control Normal Survival N_C/I (%)	Reference Normal Survival Relative to Control N_R/N_C (%)	Performance Standard
Control	1	328	5	324.4	93.9		≥0.70; Meets Criterion
	2	314	13				
	3	344	14				
	4	317	11				
	5	319	12				
Sediment Control	1	277	8	287.2	83.1		≥0.70; Meets Criterion
	2	272	8				
	3	284	6				
	4	314	6				
	5	289	6				
Carr Inlet Reference	1	300	14	287.6		88.7[1] / 100[2]	≥0.65; Meets Criterion
	2	282	5				
	3	265	3				
	4	304	0				
	5	287	4				
G-5-012518	1	279	3	274.2	See Section 4.3 for Larval Test Suitability Determination		
	2	269	4				
	3	325	3				
	4	232	7				
	5	266	11				
SG-14-012518	1	266	6	249.2			
	2	243	5				
	3	226	4				
	4	253	2				
	5	258	5				
SG-16-012518	1	175	3	230.6			
	2	257	2				
	3	239	3				
	4	233	2				
	5	249	4				

[1]Relative to Control
[2]Relative to Sediment Control
I = Mean Initial Count (stocking density); 345.4
N_C = Mean Normal in Control
N_R = Mean Normal in Reference

Table 3-12. Water Quality Summary for *Mytilus galloprovincialis*

Treatment	Dissolved Oxygen (mg/L) ≥5.0 mg/L			Temperature (°C) 16 ± 1°C			Salinity (ppt) 28 ± 1 ppt			pH 7 - 9 units		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	8.1	7.7	8.6	16.5	16.4	16.7	28	28	28	7.7	7.6	7.8
Sediment Control	7.8	6.7	8.8	16.9	16.6	17.0	28	28	28	7.7	7.7	7.8
Carr Inlet Reference	7.3	6.7	8.0	16.9	16.9	17.0	28	28	28	7.7	7.6	7.8
G-5-012518	6.6	5.9	8.0	16.5	16.4	16.8	28	28	28	7.7	7.6	7.8
SG-14-012518	7.6	7.2	8.4	16.8	16.6	17.0	28	28	28	7.7	7.7	7.8
SG-16-012518	7.4	7.1	8.1	16.8	16.6	17.0	28	28	28	7.7	7.7	7.8
Temperature values are rounded to whole number for comparison to targeted range												

Table 3-13. Ammonia and Sulfide Summary for *Mytilus galloprovincialis*

Treatment	Overlying Total Ammonia (mg/L)		Overlying Total Sulfides (mg/L)	
	Day 0	Final (Day 2)	Day 0	Final (Day 2)
Control	0.008	0.110	0.001	0.003
Sediment Control	0.000	0.0889	0.001	0.007
Carr Inlet Reference	0.000	0.0849	0.004	0.000
G-5-012518	0.004	0.136	0.003	0.004
SG-14-012518	0.000	0.142	0.006	0.003
SG-16-012518	0.000	0.140	0.004	0.002
Treatment	**Overlying UIA (mg/L)**		**Overlying Hydrogen Sulfide (mg/L)**	
	Day 0	**Final (Day 2)**	**Day 0**	**Final (Day 2)**
Control	0.000	0.002	0.000	0.000
Sediment Control	0.000	0.001	0.000	0.001
Carr Inlet Reference	0.000	0.001	0.001	0.000
G-5-012518	0.000	0.002	0.001	0.000
SG-14-012518	0.000	0.002	0.001	0.000
SG-16-012518	0.000	0.002	0.001	0.000

NOEC (concurrent reference-toxicant test derived) = 3.04 mg/L total, 0.047 UIA
Trigger values: 0.04 mg/L UIA and 0.0025 mg/L hydrogen sulfide (Inouye 2015)

Table 3-14. Test Condition Summary for *Mytilus galloprovincialis*

Test Conditions: *Mytilus galloprovincialis*		
Date sampled	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Date received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample storage conditions	4°C, dark	
Test dates	February 21 – 23, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 27 days
Test Species	*M. galloprovincialis*	
Supplier	Taylor Shellfish	
Date acquired	December 29, 2017	
Age class	<2-h old embryos	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017) SOP No. SED005.05	
Test location	EcoAnalysts Port Gamble Laboratory	
Test type/duration	48-54 Hour static test	
Control water	North Hood Canal sea water, 0.45µm filtered	
Test dissolved oxygen	Recommended: > 5.0 mg/L	Observed: 5.9 – 8.8 mg/L
Test temperature	Recommended: 16 ± 1 °C	Observed: 16.4 – 17.0 °C
Test Salinity	Recommended: 28 ± 1 ppt	Observed: 28 ppt
Test pH	Recommended: 7 - 9	Observed: 7.6 – 7.8
Stocking Density	Recommended: 20 – 40 embryos/mL	Observed: 34.5 embryos/mL
Control performance standard (SMS)	Recommended: Control normal survival ≥ 70%	Observed: 93.9% Control / 83.1% Sediment Control; Pass
Reference performance standard (SMS)	Recommended: Reference normal survival relative to control ≥ 65%	Observed: 88.7% Control 100% Sediment Control; Pass
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant EC_{50} (total ammonia)	EC_{50} = 5.70 mg/L	EC_{50} = 0.087 mg/L
Mean; Acceptable Range (total ammonia)	5.64; 2.81 – 11.34 mg/L	0.093; 0.041 – 0.207 mg/L
NOEC Combined proportion normal (total ammonia)	3.04 mg/L	0.047 mg /L
Test Lighting	50 – 100 foot candles	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 1 surrogate (used for WQ measurements throughout the test)	
Exposure volume	18 g sediment/ 900 mL water	
Feeding	None	
Water renewal	None	
Deviations from Test Protocol	None	

4. DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology's Sediment Cleanup User's Manual II (SCUM II; WDOE 2017). Comparisons were made for each treatment against the appropriate reference sample. Two numerical comparisons were made under SMS, the Sediment Cleanup Objective (SCO) and the Cleanup Screening Level (CSL).

4.1 Amphipod Test Suitability Determination

Under the SMS program, a treatment will fail SCO if mean mortality in the test is >25% and the difference between mean mortality in the treatment compared to mean mortality in the reference is statistically significant ($p < 0.05$). Treatments fail the CSL if mean mortality in the test treatment is ≥30% relative to the reference sediment and the difference is statistically significant.

None of the project sediments from the Tru-Grit remedial investigation fail the SCO and CSL criteria for the amphipod test as shown in Table 4-1.

Table 4-1. SMS Comparison for *Eohaustorius estuarius*

Treatment	Mean Mortality (%)	Compared To:	Statistically Different than Reference? (p=0.05)	Mortality Comparison to Reference M_T-M_R (%)	Fails SCO?[1] (> 25%)	Fails CSL?[2] (≥ 30%)
Control	1					
Carr Inlet Reference	3					
G-5-012518	19	Carr Inlet Reference	Yes	16	No	No
SG-14-012518	18		Yes	15	No	No
SG-16-012518	23		Yes	20	No	No

[1]SCO: Statistical Significance and M_T >25%
[2]CSL: Statistical Significance and M_T-M_R ≥ 30%
M_T = Treatment Mortality
M_R = Reference Mortality

4.2 Juvenile Polychaete Test Suitability Determination

Suitability determinations for the juvenile polychaete test were based on mean individual growth (MIG). A test treatment fails SCO criteria if MIG is statistically lower in the test treatment, relative to the reference, and if the ratio of the MIG in the test treatment is <0.70 to that of the reference. The treatments will fail CSL criteria if the MIG is significantly lower than the reference treatment and the ratio between the MIG of the treatment and the MIG of the reference is <0.50.

None of the project sediments from the Tru-Grit remedial investigation fail the SCO and CSL criteria for the juvenile polychaete test as shown in Table 4-2.

Table 4-2. SMS Comparison for *Neanthes arenaceodentata*

Treatment	MIG (mg/ind/day)	Compared To:	Statistically Less than Reference? (p=0.05)	MIG Relative to Reference (MIG_T/MIG_R)	Fails SCO?[1] (< 0.70)	Fails CSL?[2] (< 0.50)
Dry Weight						
Control	0.767					
Carr Inlet Reference	0.678					
G-5-012518	0.649	Carr Inlet Reference	No	0.96	No	No
SG-14-012518	0.789		No	1.16	No	No
SG-16-012518	0.745		No	1.10	No	No
Ash-Free Dry Weight						
Control	0.444					
Carr Inlet Reference	0.458					
G-5-012518	0.495	Carr Inlet Reference	No	1.08	No	No
SG-14-012518	0.534		No	1.17	No	No
SG-16-012518	0.512		No	1.12	No	No

[1]SCO: Statistical Significance and MIG_T/MIG_R <70%
[2]CSL: Statistical Significance and MIG_T/MIG_R <50%
MIG_T = Treatment Mean Individual Growth
MIG_R = Reference Mean Individual Growth

4.3 Larval Test Suitability Determination

Larval test treatments fail SCO criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.85 of the normal development in the reference. Treatments fail CSL criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.70 of the normal development in the reference.

Project sample SG-16 failed SCO criteria for the bivalve development evaluation. The remaining two project samples did not fail the CSL or SCO criteria (Table 4-3).

Table 4-3. SMS Comparison for *Mytilus galloprovincialis*

Treatment	Mean Normal Survival (%)[1]	Mean Number Normal	Compared To:	Statistically Less than Reference? (p=0.10)	Normal Survival to Reference N_T/N_R	Fails SCO?[4] <0.85	Fails CSL?[5] <0.70
Control	93.9	324.4					
Sediment Control	83.1	287.2					
Carr Inlet Reference	88.7[2] / 98.1[3]	287.6					
G-5-012518	84.5[2]/ 92.8[3]	274.2	Carr Inlet Reference	No	0.953	No	No
SG-14-012518	76.8[2] / 86.8[3]	249.2		Yes	0.866	No	No
SG-16-012518	71.1[2] / 80.3[3]	230.6		Yes	0.802	Yes	No

[1] Control data is normalized to the stocking density; reference and project treatments are normalized to the control(s)
[2] Comparison to Control
[3] Comparison to Sediment Control
[4] SCO: Statistical Significance and (N_T/N_R) <0.85
[5] SL: Statistical Significance and (N_T/N_R) <0.70
N_T =Treatment Mean Number Normal Survivorship
N_R =Reference Mean Number Normal Survivorship
N_C =Control Mean Number Normal Survivorship

5. SUMMARY

A summary of the biological tests conducted on the Tru-Grit remedial investigation sediments evaluated under the SMS sediment quality criteria (Table 5-1) is provided below.

Sample SG-16 failed SCO for the larval development test only. All remaining project samples pass the SCO and CSL performance criteria for all tests performed.

Table 5-1. Summary of SMS Evaluation.

Treatment	Sediment Cleanup Objectives			Cleanup Screening Levels		
	Amphipod	Polychaete	Larval	Amphipod	Polychaete	Larval
G-5-012518	Pass	Pass	Pass	Pass	Pass	Pass
SG-14-012518	Pass	Pass	Pass	Pass	Pass	Pass
SG-16-012518	Pass	Pass	**Fail**	Pass	Pass	Pass

6. REFERENCES

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APPENDIX A. ..... TEST AND REFERENCE TOXICANT TEST RESULTS

1. *Eohaustorius estuarius 10-Day Test*
2. *Neanthes arenaceodentata 20-Day Test*
3. *Mytilus galloprovincialis Bivalve Larval Test*

APPENDIX B. ..... STATISTICAL COMPARISONS

STATISTICAL RESULTS: *EOHAUSTORIUS ESTUARIUS* TEST
STATISTICAL RESULTS: *NEANTHES ARENACEODENTATA* TEST
STATISTICAL RESULTS: *MYTILUS GALLOPROVNICIALIS* LARVAL TEST

APPENDIX C. .....CHAIN-OF-CUSTODY LOGS AND PRE-TEST DOCUMENTS

APPENDIX A. TEST AND REFERENCE TOXICANT TEST RESULTS

1. *Eohaustorius estuarius* 10-Day Test

EcoAnalysts

10 DAY BENTHIC TEST
INTERACTIVE DATA SETUP

GENERAL

CLIENT:	Landau
PROJECT:	Blair Waterway
JOB NUMBER:	PG1103
PROJECT MANAGER:	Brian Hester
TEST SPECIES:	*Eohaustorius estuarius*
ORGANISM BATCH:	NAS022218
TEST PROTOCOL:	PSEP 1995
LABORATORY:	Port Gamble
TEST LOCATION:	Bath 5
TEST START DATE:	23Feb18
TEMP. RECORDER#:	NA
DILUTION WATER BATCH:	FSW022118.01
FEEDING INFORMATION:	none
WATER RENEWAL INFO:	none

TEST START TIME:	1431 UB, JL
TEST START TIME:	0900

DATE RECEIVED:	25Jan18
SAMPLE STORAGE:	4 Degrees Celsius - dark
SAMPLE TREATMENT:	none
TEST CHAMBER:	1 L mason jars
EXPOSURE VOLUME:	2 cm sediment/ 775 mL water
REFERENCE TOXICANT #1:	ammonia
REF. TOX. MATERIAL #1:	ammonium chloride

NH3 REFTOX CONC (mg/L)

0
15
30
60
120
240

	CLIENT SAMPLE ID	SAMPLE ID
1	Control	Eoh sand
2	Carr Reference	
3	G-5	
4	SG-14	
5	SG-16	

DAILY DATA QA CHECKS: (Date/Initials)

2/23/18	JL 2/23
2/24/18	UB 2/24
2/25/18	UB 2/25
2/26/18	JL 2/26
2/27/18	UB 2/27
2/28/18	JL 3/5
3/1/18	↓
3/2/18	
3/3/18	UB 3/3
3/4/18	CR 3/4
3/5/18	JL 3/5

TEST PARAMETERS	TARGET	ACCEPTABLE RANGE / COMMENTS
DO: (mg/L)	>5.1	60% Sat @ 15°C, 28ppt
Temp: (°C)	15 ± 1	15 ± 3
Sal: (ppt)	28 ± 1	(20 - 35 ppt)
pH:	7 - 9	Optimal

ECO ANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	JOB NO.	PROJECT MAN.	LABORATORY	PROTOCOL	SPECIES
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 5	PSEP 1995	*Eohaustorius estuarius*

ENDPOINT DATA & OBSERVATIONS

#S= Number on the Surface
#M= Number of Mortality
L=Anoxic Surface
F=Fungal Patches
D=No Air Flow (DO?)
U=Excess food
N=Normal
B=No Burrows

INITIAL # OF ORGANISMS: 20

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10
DATE	2/24	2/25	2/26/18	2/27	2/28	3/1	3/02	3/3	3/4	3/5/18
TECHNICIAN	UB	UB	BA	UB	UB	UB	JC	UB	GR	BA

Sample ID	REP	JAR #	INITIAL #	DAY 1 OBSERVNS.	DAY 2 OBSERVNS.	DAY 3 OBSERVNS.	DAY 4 OBSERVNS.	DAY 5 OBSERVNS.	DAY 6 OBSERVNS.	DAY 7 OBSERVNS.	DAY 8 OBSERVNS.	DAY 9 OBSERVNS.	DAY 10 OBSERVNS.	NUMBER REMAINING
Control / Eoh sand	1			N	N	N	N	N	N	N	N	N	N	20
	2			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	3													20
	4													20
	5													19
Carr Reference /	1			N	N	N	N	N	N	↓	N	↓	N	19
	2			↓	↓	N	↓	↓	↓		1S		↓	20
	3				↓	1S					N			20
	4				1S	1S					↓			18
	5				N	N								20
G-5 /	1			N	N	N	N	N	N	1S	N	↓	N	18
	2			↓	4S	↓	↓	↓	↓	N	↓	↓	1S	14
	3			2S	N	↓	↓		1S	2S	1S	1S	1S	16
	4			1S	↓	1S	1S		N	3S	1S	N	1S	17
	5			N		N	N	↓	1S	N	N	↓	N	14,2M
SG-14 /	1			N	N	N	N	N	N	N	N	↓	N	20
	2			1S	2S	1S	↓	↓	↓	1S	3S	1S	↓	18,1M
	3			N	N	N	↓	1S	1S	N	N	N	↓	12
	4			↓	N	N	2S ①	N	N	↓	↓	↓	1S	~~15~~ ③ BA 3/5/18
	5			6S	3S	N	N	1S	↓		↓		N?	15
SG-16 /	1			N	N	N	N	2S	1S	↓	N	↓	N	14,1M
	2			↓	↓	↓	↓	N	N		↓		↓	15,1M
	3							↓	↓		1S			17
	4							↓			N			13,2M
	5							1S			↓			18

② (G-5 / all reps)

① Illegible, 2S UB 2/27

② lots of shell hash BA 3/5/18

③ 17, 1M BA 3/5/18

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10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
Control / Eoh sand	0	1	9	8.4	9	15.5	9	28	9	8.1	JL	2/23/18
Control / Eoh sand	0	2	↓	8.4	↓	15.5	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	3	↓	8.4	↓	15.6	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	4	↓	8.4	↓	15.4	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	5	↓	8.4	↓	15.5	↓	28	↓	8.1	↓	↓
Control / Eoh sand	1	Surr	8	8.2	8	15.6	8	28	8	8.1	UB	2/24
Control / Eoh sand	2	Surr	8	8.2	8	15.7	8	28	8	8.1	UB	2/25
Control / Eoh sand	3	Surr	9	7.9	9	15.9	9	28	9	8.1	BH	2/26/18
Control / Eoh sand	4	Surr	9	8.1	9	15.8	9	28	9	8.2	UB	2/27
Control / Eoh sand	5	Surr	9	8.0	9	15.9	9	28	9	8.1	UB	2/28
Control / Eoh sand	6	Surr	9	8.0	9	15.8	9	28	9	8.1	UB	3/1
Control / Eoh sand	7	Surr	9	8.1	9	15.7	9	28	9	8.1	JL	3/02
Control / Eoh sand	8	Surr	9	8.2	9	15.6	9	28	9	8.2	UB	3/3
Control / Eoh sand	9	Surr	9	8.2	9	15.7	9	28	9	8.1	CR	3/4
Control / Eoh sand	10	1	9	8.3	9	15.7	9	29	9	8.0	JL	3/05
Control / Eoh sand	10	2	↓	8.2	↓	15.7	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	3	↓	8.3	↓	15.8	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	4	↓	8.2	↓	15.7	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	5	↓	8.3	↓	15.6	↓	28	↓	8.0	↓	↓

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10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
Carr Reference /	0	1	9	8.4	9	15.5	9	28	9	8.1	JL	2/23/18
Carr Reference /	0	2		8.3		15.5		28		8.0		
Carr Reference /	0	3		8.3		15.5		28		8.0		
Carr Reference /	0	4		8.3		15.6		28		8.0		
Carr Reference /	0	5		8.3		15.4		28		8.0		
Carr Reference /	1	Surr	8	8.2	8	15.6	8	28	8	8.0	UB	2/24
Carr Reference /	2	Surr	8	8.2	8	15.7	8	28	8	8.0	UB	2/25
Carr Reference /	3	Surr	9	7.8	9	15.9	9	28	9	8.0	BM	2/26/18
Carr Reference /	4	Surr	9	7.9	9	15.8	9	28	9	8.1	UB	2/27
Carr Reference /	5	Surr	9	8.1	9	15.8	9	28	9	7.9	UB	2/28
Carr Reference /	6	Surr	9	7.8	9	15.8	9	28	9	8.1	UB	3/1
Carr Reference /	7	Surr	9	8.0	9	15.8	9	28	9	8.1	JL	3/02
Carr Reference /	8	Surr	9	8.2	9	15.6	9	28	9	8.1	UB	3/3
Carr Reference /	9	Surr	9	8.2	9	15.6	9	28	9	8.2	GR	3/4
Carr Reference /	10	1	9	8.2	9	15.6	9	28	9	7.9	JL	3/05
Carr Reference /	10	2		8.2		15.7		28		7.9		
Carr Reference /	10	3		8.2		15.7		28		7.9		
Carr Reference /	10	4		7.8		16.1		28		7.9		
Carr Reference /	10	5		7.9		15.7		28		7.9		

ECO ANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
G-5 /	0	1	9	8.3	9	15.5	9	28	9	8.0	JL	2/23/18
G-5 /	0	2		8.3		15.4		28		8.0		
G-5 /	0	3		8.2		15.5		28		8.0		
G-5 /	0	4		8.3		15.4		28		8.0		
G-5 /	0	5		8.3		15.5		28		8.0		
G-5 /	1	Surr	8	8.2	8	16.0	8	28	8	8.1	UB	2/24
G-5 /	2	Surr	8	8.1	8	16.0	8	28	8	8.1	UB	2/25
G-5 /	3	Surr	9	7.9	9	15.9	9	28	9	8.0	SL	2/26/18
G-5 /	4	Surr	9	7.7	9	15.8	9	28	9	8.1	UB	2/27
G-5 /	5	Surr	9	8.1	9	15.9	9	28	9	8.1	UB	2/28
G-5 /	6	Surr	9	7.8	9	16.1	9	28	9	8.1	UB	3/1
G-5 /	7	Surr	9	8.0	9	15.9	9	28	9	8.1	JL	3/02
G-5 /	8	Surr	9	8.0	9	15.9	9	28	9	8.2	UB	3/3
G-5 /	9	Surr	9	8.0	9	15.9	9	28	9	8.3	CR	3/4
G-5 /	10	1	9	8.2	9	15.7	9	29	9	8.2	JL	3/05
G-5 /	10	2		8.2		15.6		28		8.2		
G-5 /	10	3		8.1		15.8		28		8.1		
G-5 /	10	4		8.1		15.7		28		8.2		
G-5 /	10	5		8.2		15.7		29		8.2		

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10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SG-14 /	0	1	9	8.3	9	15.5	9	28	9	8.1	JL	2/23/18
SG-14 /	0	2		8.3		15.4		28		8.0		
SG-14 /	0	3		8.3		15.5		28		8.0		
SG-14 /	0	4		8.3		15.5		28		8.1		
SG-14 /	0	5	↓	8.3	↓	15.5	↓	28	↓	8.0	↓	↓
SG-14 /	1	Surr	8	8.1	8	15.8	8	28	8	8.0	MB	2/24
SG-14 /	2	Surr	8	8.1	8	15.9	8	28	8	8.0	MB	2/25
SG-14 /	3	Surr	9	8.0	9	15.8	9	28	9	8.0	BCH	2/26/18
SG-14 /	4	Surr	9	8.0	9	15.9	9	28	9	8.1	MB	2/27
SG-14 /	5	Surr	9	8.0	9	16.0	9	28	9	8.0	MB	2/28
SG-14 /	6	Surr	9	7.9	9	15.8	9	28	9	8.1	MB	3/1
SG-14 /	7	Surr	9	7.9	9	15.9	9	28	9	8.0	J-	3/02
SG-14 /	8	Surr	9	8.0	9	15.8	9	28	9	8.1	MB	3/3
SG-14 /	9	Surr	9	8.0	9	15.9	9	28	9	8.0	CR	3/4
SG-14 /	10	1	9	8.2	9	15.7	9	29	9	8.1	JL	3/05
SG-14 /	10	2		8.2		15.8		28		8.1		
SG-14 /	10	3		8.2		15.7		29		8.1		
SG-14 /	10	4		8.2		15.8		29		8.1		
SG-14 /	10	5	↓	8.2	↓	15.9	↓	28	↓	8.1	↓	↓

ECO ANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SG-16 /	0	1	9	8.3	9	15.6	9	28	9	8.1	JL	2/23/18
SG-16 /	0	2		8.3		15.5		28		8.1		
SG-16 /	0	3		8.3		15.5		28		8.1		
SG-16 /	0	4		8.3		15.5		28		8.0		
SG-16 /	0	5	↓	8.3	↓	15.5	↓	28	↓	8.1	↓	↓
SG-16 /	1	Surr	8	8.3	8	15.7	8	28	8	8.1	MB	2/24
SG-16 /	2	Surr	8	8.2	8	15.7	8	28	8	8.1	MB	2/25
SG-16 /	3	Surr	9	7.9	9	15.8	9	28	9	8.0	DL	2/26/18
SG-16 /	4	Surr	9	8.1	9	15.7	9	28	9	8.1	MB	2/27
SG-16 /	5	Surr	9	8.0	9	15.9	9	28	9	8.1	MB	2/28
SG-16 /	6	Surr	9	7.9	9	15.8	9	28	9	8.1	MB	3/1
SG-16 /	7	Surr	9	7.8	9	15.8	9	28	9	8.1	JL	3/02
SG-16 /	8	Surr	9	8.1	9	15.7	9	28	9	8.1	MB	3/3
SG-16 /	9	Surr	9	8.2	9	15.7	9	28	9	8.1	GR	3/4
SG-16 /	10	1	9	8.2	9	16.0	9	28	9	8.1	JL	3/05
SG-16 /	10	2		8.2		15.8		28		8.1		
SG-16 /	10	3		8.2		15.8		28		8.1		
SG-16 /	10	4		8.2		15.9		29		8.1		
SG-16 /	10	5		8.2		15.9		29		8.1	↓	

Ammonia and Sulfide Analysis Record

Client/Project:	Organism:	Test Duration (days):
Landau / Blair Waterway	Eohs	10

PRETEST / INITIAL / FINAL / OTHER (circle one)
OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: _____

DAY of TEST: 8

Calibration Standards Temperature	
Date:	Temperature:
2/23/18	20.7°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter # / Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV. Ø	Surr.	2/23/18 JL	0.154	TAP	20.7	2/23/18 JL	N			10	0.003		
CARP ref			0.285								0.004		
①SG.5			1.12								0.000		
SG.14			0.883								0.000		
SG.16			0.681								0.001		
SG.17			0.591								0.002		
PW Ø			③	TAP	19.7			③			③		
CARP ref			3.17					7.8②	29	5	0.014	2	0.028
G.5			11.1					7.8	29		0.006		0.012
SG.14			8.54					7.8	29		0.00		
SG.16			7.57					7.9	29		0.00		
SG.17			6.78					7.8	30		0.00		

① IE. JL 2/23/18 ② Illegible. 7.8 pH. JL 2/23/18 ③ Insufficient volume for analyses. JL 2/23/18

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway | **Organism:** EOHS | **Test Duration (days):** 10

PRETEST / INITIAL / **FINAL** / OTHER (circle one)

OVERLYING (OV) / **POREWATER (PW)** (circle one) / Comments: _____

DAY of TEST: 10

Calibration Standards Temperature

Date: 3/05/18 | **Temperature:** 21.1°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV Θ	Surr.	3/05/18 JL	0.214	TAP	20.1	3/05 JL	N			10	ND	NA	
CAPP Ref			0.00								ND		
GS			1.69								0.006		
SG14			0.00								0.00		
SG16			0.00								0.003		
SG17			0.796								0.001		
PW Θ		3/05/18 JL	①	TAP	20.1	①		①					
CAPP Ref.			0.0805			3/5/18 BG		7.2	28	5	0.001	2	0.002
GS			6.61					7.5	28		0.011		0.022
SG14			1.06②					7.6	28		ND		
SG16			0.553					7.6	27		0.001		0.002
SG17			2.29					7.5	27		0.001		0.002

① Insufficient Volume for analyses. JL 3/05/18.

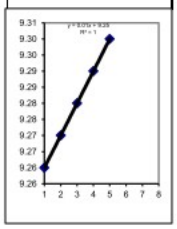
② illegible 1.06 mg/L BG 3/5/18

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Eohaustorius estuarius*
COMMENTS:	Porewater calculations performed with porewater WQ parameters		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30



Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
Day 0 OV									
Control		0.154	28	8.1	15.5	288.66	9.3187		0.004
Carr Reference		0.285	28	8.0	15.5	288.66	9.3187		0.007
G-5		1.120	28	8.0	15.5	288.62	9.3187		0.026
SG-14		0.883	28	8.0	15.5	288.64	9.3187		0.023
SG-16		0.681	28	8.1	15.5	288.68	9.3187		0.019
Day 0 PW									
Control		NM				273.16	9.2548		#VALUE!
Carr Reference		3.170	29	7.8	15.5	288.66	9.3214		0.047
G-5		11.100	29	7.8	15.5	288.62	9.3214		0.163
SG-14		8.540	29	7.8	15.5	288.64	9.3214		0.126
SG-16		7.570	29	7.9	15.5	288.68	9.3214		0.140
Day 10 OV									
Control		0.214	28	7.9	15.7	288.86	9.3192		0.004
Carr Reference		0.000	28	7.9	15.8	288.92	9.3187		
G-5		1.690	28	8.2	15.7	288.86	9.3198		0.060
SG-14		0.000	29	8.1	15.8	288.94	9.3203		
SG-16		0.000	28	8.1	15.9	289.04	9.3198		
Day 10 PW									
Control		NM				273.16	9.2548		#VALUE!
Carr Reference		0.081	28	7.2	15.8	288.92	9.3187		0.000
G-5		6.610	28	7.5	15.7	288.86	9.3187		0.050
SG-14		1.060	28	7.6	15.8	288.94	9.3187		0.010
SG-16		0.553	27	7.6	15.9	289.04	9.3160		0.005

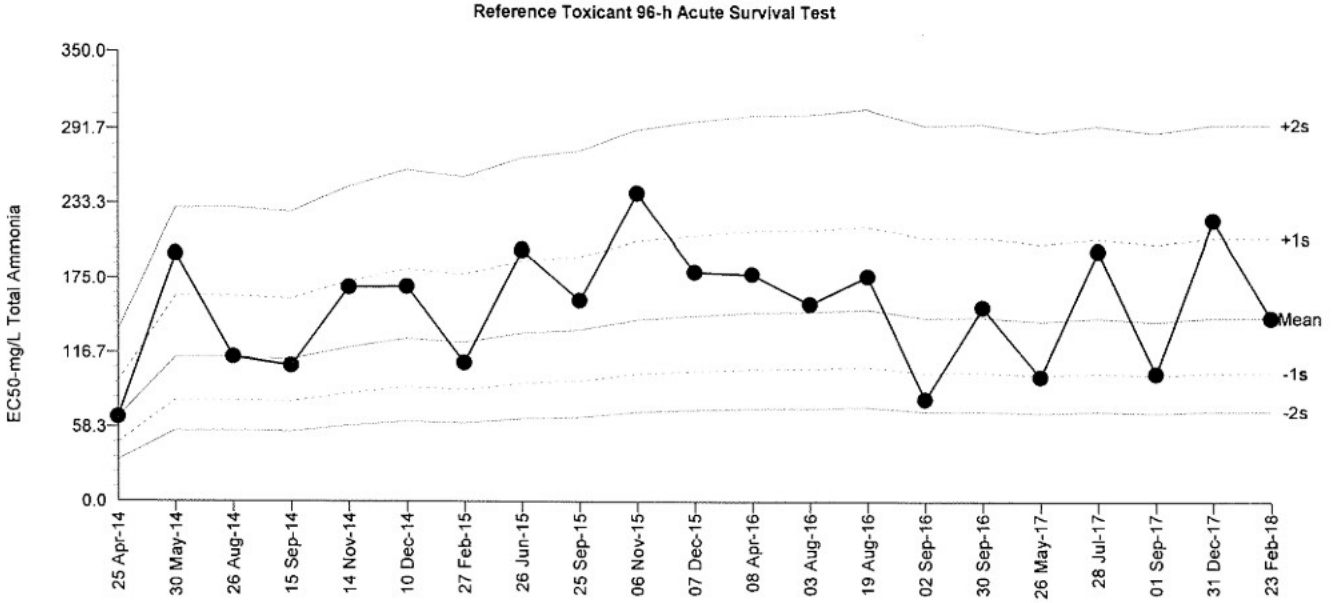
	Input				Output		
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	3	15.5	28	8.1	0.19	0.000	6.31%
Carr Reference	4	15.5	28	8.0	0.30	0.000	7.49%
G-5	0	15.5	28	8.0	0.00	0.000	#DIV/0!
SG-14	0	15.5	28	8.0	0.00	0.000	#DIV/0!
SG-16	1	15.5	28	8.1	0.07	0.000	6.58%
Day 0 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	0.0	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	28	15.5	29	7.8	3.31	0.003	11.83%
G-5	12	15.5	29	7.8	1.42	0.001	11.85%
SG-14	0	15.5	29	7.8	0.00	0.000	#DIV/0!
SG-16	0	15.5	29	7.9	0.00	0.000	#DIV/0!
Day 10 OV					0.00	0.000	#DIV/0!
Control	#VALUE!	15.7	28	7.9	#VALUE!	#VALUE!	#VALUE!
Carr Reference	#VALUE!	15.8	28	7.9	#VALUE!	#VALUE!	#VALUE!
G-5	6	15.7	28	8.2	0.32	0.000	5.25%
SG-14	0	15.8	29	8.1	0.00	0.000	#DIV/0!
SG-16	3	15.9	28	8.1	0.19	0.000	6.21%
Day 10 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	0.0	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	2	15.8	28	7.2	0.70	0.001	35.25%
G-5	22	15.7	28	7.5	4.67	0.005	21.21%
SG-14	#VALUE!	15.8	28	7.6	#VALUE!	#VALUE!	#VALUE!
SG-16	2	15.9	27	7.6	0.35	0.000	17.54%

CETIS QC Plot

Report Date: 13 Mar-18 15:37 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Total Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	144.7	**Count:**	20	**-1s Warning Limit:**	101.5	**-2s Action Limit:**	71.17
Sigma:	n/a	**CV:**	36.60%	**+1s Warning Limit:**	206.4	**+2s Action Limit:**	294.4

Quality Control Data

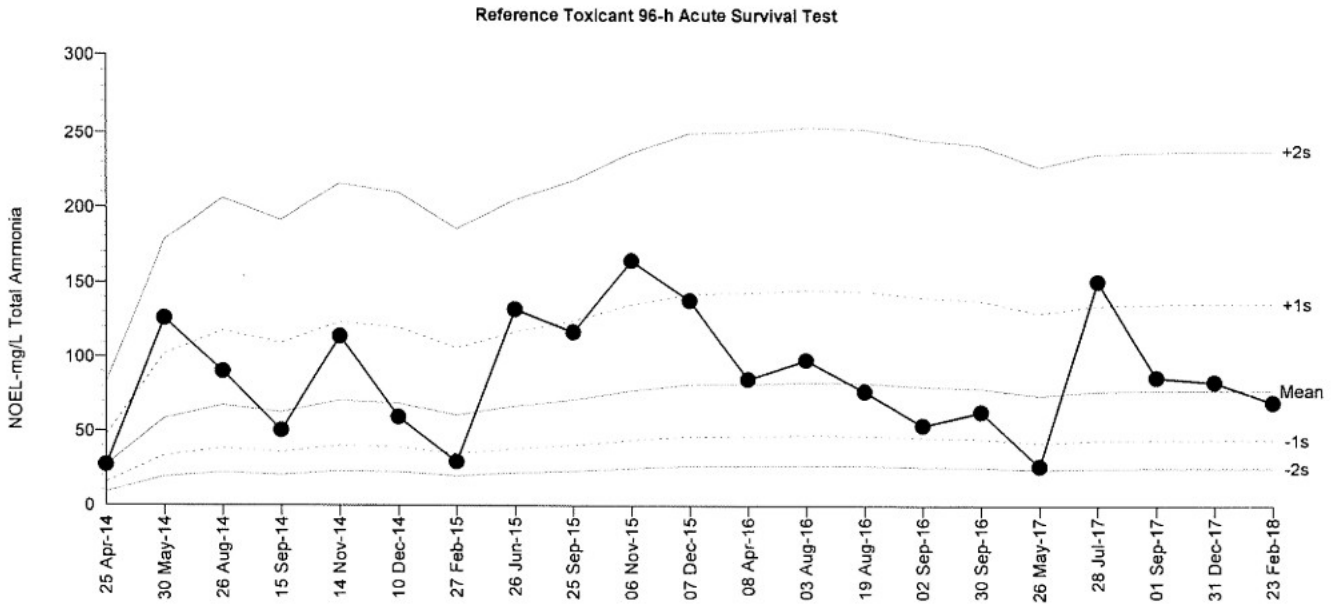
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	65.78	-78.97	-2.222	(-)	(-)	11-2394-9115	16-6351-0798	Port Gamble Environment
2		May	30	15:30	193.9	49.17	0.8238			11-1744-7543	02-6036-0984	ENVIRON
3		Aug	26	15:45	113.3	-31.43	-0.6895			15-5557-5937	00-0529-4993	ENVIRON
4		Sep	15	15:10	106.3	-38.4	-0.8685			07-1282-2061	01-5984-9612	ENVIRON
5		Nov	14	14:25	168	23.25	0.4195			09-0717-5355	19-7840-9499	ENVIRON
6		Dec	10	15:50	168.3	23.56	0.4247			19-3485-9112	05-9978-3434	ENVIRON
7	2015	Feb	27	12:35	108.8	-35.95	-0.8042			19-3876-5860	21-0291-4043	ENVIRON
8		Jun	26	13:20	197.1	52.34	0.8694			00-5720-1886	11-7391-9309	ENVIRON
9		Sep	25	17:30	157.8	13.07	0.2435			05-7835-3625	14-8488-2762	ENVIRON
10		Nov	6	15:30	240.8	96.07	1.434	(+)		07-0462-4762	05-5994-4603	ENVIRON
11		Dec	7	15:58	180.1	35.33	0.6152			18-5380-2632	01-5604-1684	ENVIRON
12	2016	Apr	8	14:40	178.3	33.58	0.5877			20-3339-4511	20-5786-8614	ENVIRON
13		Aug	3	16:55	155	10.29	0.1934			15-5854-7986	14-0317-8212	ENVIRON
14			19	14:25	177	32.21	0.566			10-0746-9736	13-2092-5186	ENVIRON
15		Sep	2	16:25	80.2	-64.55	-1.663	(-)		06-2389-4542	16-8119-8926	ENVIRON
16			30	15:00	152.6	7.899	0.1497			16-2341-4864	11-2277-7148	ENVIRON
17	2017	May	26	13:00	97.99	-46.76	-1.099	(-)		06-2743-8362	04-6967-6524	EcoAnalysts
18		Jul	28	14:20	196.9	52.11	0.8661			14-8451-4586	00-9100-0373	EcoAnalysts
19		Sep	1	15:45	100.5	-44.28	-1.028	(-)		02-8963-0820	06-1020-6763	EcoAnalysts
20		Dec	31	15:47	220.3	75.56	1.183	(+)		09-7306-1854	08-4856-6308	EcoAnalysts
21	2018	Feb	23	13:35	144.3	-0.4306	-0.008393			21-0530-3984	12-8139-0101	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:37 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Total Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	77.94	**Count:**	20	**-1s Warning Limit:**	44.62	**-2s Action Limit:**	25.54
Sigma:	n/a	**CV:**	60.50%	**+1s Warning Limit:**	136.2	**+2s Action Limit:**	238

Quality Control Data

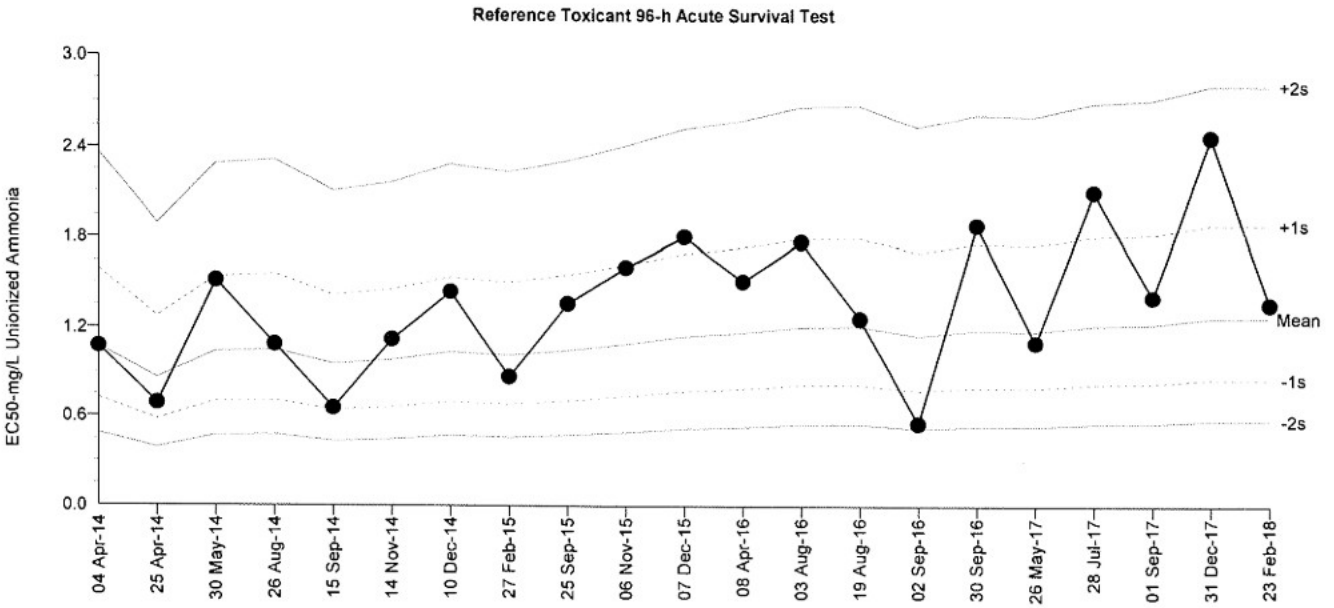
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	27	-50.94	-1.9	(-)		11-2394-9115	19-2434-9439	Port Gamble Environment
2		May	30	15:30	126	48.06	0.8606			11-1744-7543	06-3985-7474	ENVIRON
3		Aug	26	15:45	90.1	12.16	0.2597			15-5557-5937	08-3094-4388	ENVIRON
4		Sep	15	15:10	50.5	-27.44	-0.7777			07-1282-2061	16-3885-0935	ENVIRON
5		Nov	14	14:25	114	36.06	0.6812			09-0717-5355	07-0500-8008	ENVIRON
6		Dec	10	15:50	59.4	-18.54	-0.4868			19-3485-9112	07-0579-1018	ENVIRON
7	2015	Feb	27	12:35	29.3	-48.64	-1.753	(-)		19-3876-5860	19-7961-3594	ENVIRON
8		Jun	26	13:20	132	54.06	0.9439			00-5720-1886	15-3704-4199	ENVIRON
9		Sep	25	17:30	117	39.06	0.7278			05-7835-3625	21-0939-3919	ENVIRON
10		Nov	6	15:30	165	87.06	1.344	(+)		07-0462-4762	19-7906-3673	ENVIRON
11		Dec	7	15:58	138	60.06	1.024	(+)		18-5380-2632	00-7335-5231	ENVIRON
12	2016	Apr	8	14:40	85.2	7.255	0.1595			20-3339-4511	16-7438-0764	ENVIRON
13		Aug	3	16:55	98	20.06	0.4103			15-5854-7986	05-8855-9934	ENVIRON
14			19	14:25	76.9	-1.045	-0.02418			10-0746-9736	12-8850-4495	ENVIRON
15		Sep	2	16:25	54.1	-23.84	-0.6543			06-2389-4542	18-8647-7799	ENVIRON
16			30	15:00	63.2	-14.74	-0.3757			16-2341-4864	17-9345-6065	ENVIRON
17	2017	May	26	13:00	26.6	-51.34	-1.926	(-)		06-2743-8362	12-3565-7845	EcoAnalysts
18		Jul	28	14:20	151	73.06	1.185	(+)		14-8451-4586	09-8418-8824	EcoAnalysts
19		Sep	1	15:45	86.5	8.555	0.1866			02-8963-0820	17-0422-4621	EcoAnalysts
20		Dec	31	15:47	83.6	5.655	0.1255			09-7306-1854	06-1883-5465	EcoAnalysts
21	2018	Feb	23	13:35	69.7	-8.245	-0.2003			21-0530-3984	16-8514-1800	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:43 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Unionized Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	1.273	**Count:**	20	**-1s Warning Limit:**	0.8574	**-2s Action Limit:**	0.5774
Sigma:	n/a	**CV:**	41.10%	**+1s Warning Limit:**	1.89	**+2s Action Limit:**	2.807

Quality Control Data

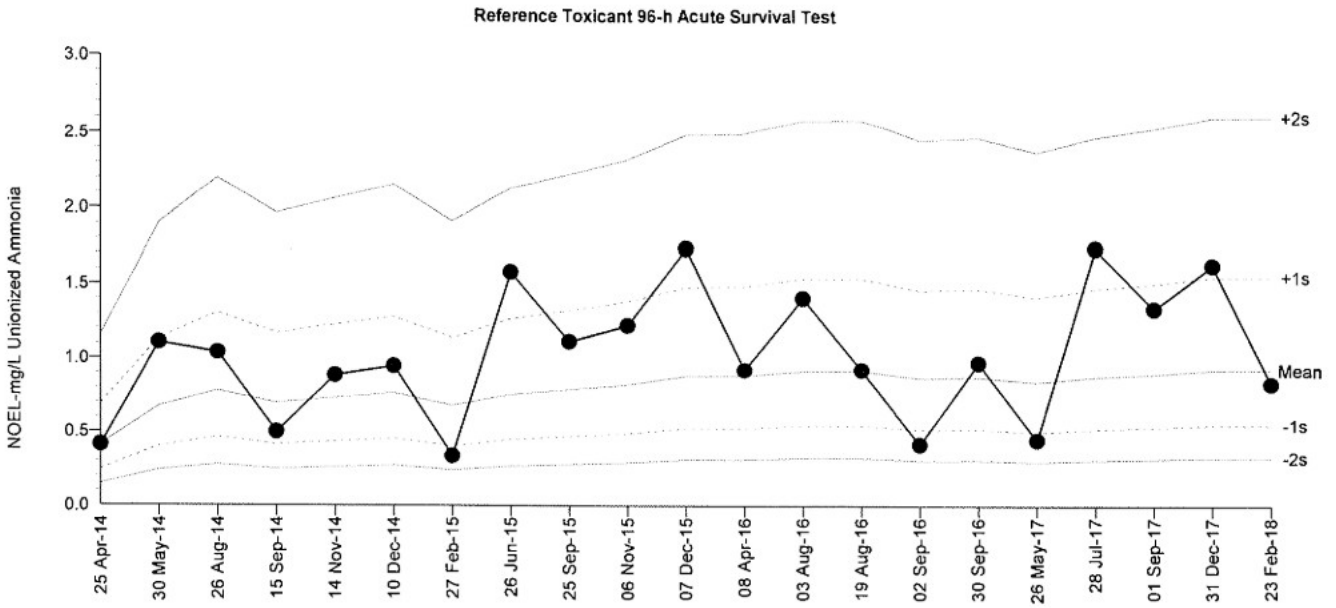
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	4	19:15	1.072	-0.2014	-0.4356			02-4910-1045	07-9486-3041	NewFields
2			25	13:00	0.6871	-0.5859	-1.56	(-)		05-3931-3196	11-2528-6540	Port Gamble Environment
3		May	30	15:30	1.517	0.2436	0.4429			03-2348-8477	19-6287-3473	ENVIRON
4		Aug	26	15:45	1.087	-0.186	-0.3995			16-9917-4183	13-7453-5343	ENVIRON
5		Sep	15	15:10	0.6543	-0.6187	-1.684	(-)		04-2286-3837	03-1229-8693	ENVIRON
6		Nov	14	14:25	1.119	-0.1539	-0.326			07-5753-6828	00-1415-6148	ENVIRON
7		Dec	10	15:50	1.441	0.1675	0.3128			04-0714-3304	08-0742-5225	ENVIRON
8	2015	Feb	27	12:35	0.8668	-0.4062	-0.9722			10-1977-7129	06-3048-0232	ENVIRON
9		Sep	25	17:30	1.361	0.08776	0.1687			00-7510-8480	16-9779-9851	ENVIRON
10		Nov	6	15:30	1.605	0.3323	0.5867			14-1974-2437	14-7486-0204	ENVIRON
11		Dec	7	15:58	1.807	0.5336	0.8855			12-1918-7694	00-1085-2209	ENVIRON
12	2016	Apr	8	14:40	1.512	0.2386	0.4347			17-7738-6530	02-5159-2977	ENVIRON
13		Aug	3	16:55	1.775	0.5015	0.8402			15-5470-2613	20-0153-1348	ENVIRON
14			19	14:25	1.264	-0.009337	-0.01862			11-7594-3529	18-2266-1841	ENVIRON
15		Sep	2	16:25	0.5558	-0.7172	-2.096	(-)	(-)	20-2236-1025	01-7459-0032	ENVIRON
16			30	15:00	1.885	0.6118	0.9928			12-0597-8760	12-1436-9613	ENVIRON
17	2017	May	26	13:00	1.101	-0.1724	-0.3682			15-8049-8093	00-1911-6893	EcoAnalysts
18		Jul	28	14:20	2.103	0.8298	1.27	(+)		11-4327-6237	03-7130-7368	EcoAnalysts
19		Sep	1	15:45	1.407	0.1342	0.2536			18-6405-8290	07-0280-8863	EcoAnalysts
20		Dec	31	15:47	2.466	1.193	1.672	(+)		16-6781-4604	13-3844-2137	EcoAnalysts
21	2018	Feb	23	13:35	1.361	0.0878	0.1687			00-2027-3508	17-9124-7622	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:43 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — All Matching Labs

Test Type:	Survival	**Organism:**	Eohaustorius estuarius (Amphipod)	**Material:**	Unionized Ammonia
Protocol:	EPA/600/R-94/025 (1994)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	0.9206	**Count:**	20	**-1s Warning Limit:**	0.5475	**-2s Action Limit:**	0.3256
Sigma:	n/a	**CV:**	55.70%	**+1s Warning Limit:**	1.548	**+2s Action Limit:**	2.602

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	0.409	-0.5116	-1.561	(-)		05-3931-3196	00-2785-8568	Port Gamble Environment
2		May	30	15:30	1.105	0.1844	0.3514			03-2348-8477	17-7984-3461	ENVIRON
3		Aug	26	15:45	1.037	0.1164	0.2292			16-9917-4183	01-4278-7622	ENVIRON
4		Sep	15	15:10	0.497	-0.4236	-1.186	(-)		04-2286-3837	01-4675-9354	ENVIRON
5		Nov	14	14:25	0.881	-0.03957	-0.08456			07-5753-6828	01-5478-5022	ENVIRON
6		Dec	10	15:50	0.943	0.02243	0.04633			04-0714-3304	12-5251-7122	ENVIRON
7	2015	Feb	27	12:35	0.334	-0.5866	-1.951	(-)		10-1977-7129	04-0485-4050	ENVIRON
8		Jun	26	13:20	1.578	0.6574	1.037	(+)		13-7504-6588	11-4090-1553	ENVIRON
9		Sep	25	17:30	1.111	0.1904	0.3619			00-7510-8480	05-3466-1859	ENVIRON
10		Nov	6	15:30	1.22	0.2994	0.542			14-1974-2437	10-4251-0205	ENVIRON
11		Dec	7	15:58	1.733	0.8124	1.218	(+)		12-1918-7694	05-5204-9536	ENVIRON
12	2016	Apr	8	14:40	0.918	-0.002572	-0.005385			17-7738-6530	07-6987-7357	ENVIRON
13		Aug	3	16:55	1.404	0.4834	0.8123			15-5470-2613	11-2111-0216	ENVIRON
14			19	14:25	0.919	-0.001572	-0.003289			11-7594-3529	06-9525-3086	ENVIRON
15		Sep	2	16:25	0.415	-0.5056	-1.533	(-)		20-2236-1025	20-1525-6837	ENVIRON
16			30	15:00	0.967	0.04643	0.09469			12-0597-8760	06-8089-0740	ENVIRON
17	2017	May	26	13:00	0.445	-0.4756	-1.399	(-)		15-8049-8093	18-0229-5291	EcoAnalysts
18		Jul	28	14:20	1.738	0.8174	1.223	(+)		11-4327-6237	11-4496-1419	EcoAnalysts
19		Sep	1	15:45	1.334	0.4134	0.7139			18-6405-8290	16-4129-3608	EcoAnalysts
20		Dec	31	15:47	1.626	0.7054	1.095	(+)		16-6781-4604	02-2467-9837	EcoAnalysts
21	2018	Feb	23	13:35	0.825	-0.09557	-0.211			00-2027-3508	11-7925-6381	EcoAnalysts

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	03-3036-5909	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 13:35	**Protocol:**	EPA/600/R-94/025 (1994)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 11:40	**Species:**	Eohaustorius estuarius	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Malacostraca	**Source:**	Northwestern Aquatic Scien **Age:**
Sample ID:	19-1574-0154	**Code:**	722FDFFA	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	p170515.67
Sample Age:	284d 14h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
16-8514-1800	Proportion Survived	Fisher Exact Test		69.7	146	100.9		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
12-8139-0101	Proportion Survived	Spearman-Kärber		EC50	144.3	125.5	166		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
16		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
32.4		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
69.7		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
146		3	0.5333	0.3899	0.6768	0.5000	0.6000	0.0333	0.0577	10.83%	46.67%
293		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
16		1.0000	1.0000	1.0000
32.4		1.0000	1.0000	0.9000
69.7		1.0000	1.0000	1.0000
146		0.5000	0.5000	0.6000
293		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
16		10/10	10/10	10/10
32.4		10/10	10/10	9/10
69.7		10/10	10/10	10/10
146		5/10	5/10	6/10
293		0/10	0/10	0/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Start Date:	23 Feb-18 13:35	**Species:**	Eohaustorius estuarius	**Sample Code:**	722FDFFA
End Date:	27 Feb-18 11:40	**Protocol:**	EPA/600/R-94/025 (1994)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Sample Station:**	p170515.67

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	18	10	10	
0	D	2	17	10	10	
0	D	3	16	10	10	
16		1	13	10	10	
16		2	3	10	10	
16		3	14	10	10	
32.4		1	6	10	10	
32.4		2	7	10	10	
32.4		3	12	10	9	
69.7		1	11	10	10	
69.7		2	15	10	10	
69.7		3	8	10	10	
146		1	5	10	5	
146		2	4	10	5	
146		3	2	10	6	
293		1	10	10	0	
293		2	9	10	0	
293		3	1	10	0	

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Batch ID:	09-3914-4382	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 13:35	**Protocol:**	EPA/600/R-94/025 (1994)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 11:40	**Species:**	Eohaustorius estuarius	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Malacostraca	**Source:**	Northwestern Aquatic Scien **Age:**
Sample ID:	07-1989-8147	**Code:**	2AE8C623	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	p170515.67
Sample Age:	284d 14h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
11-7925-6381	Proportion Survived	Fisher Exact Test		0.825	1.377	1.066		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
17-9124-7622	Proportion Survived	Spearman-Kärber		EC50	1.361	1.234	1.5		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.24		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.482		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
0.825		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.377		3	0.5333	0.3899	0.6768	0.5000	0.6000	0.0333	0.0577	10.83%	46.67%
2.215		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
0.24		1.0000	1.0000	1.0000
0.482		1.0000	1.0000	0.9000
0.825		1.0000	1.0000	1.0000
1.377		0.5000	0.5000	0.6000
2.215		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
0.24		10/10	10/10	10/10
0.482		10/10	10/10	9/10
0.825		10/10	10/10	10/10
1.377		5/10	5/10	6/10
2.215		0/10	0/10	0/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Start Date:	23 Feb-18 13:35	**Species:**	Eohaustorius estuarius	**Sample Code:**	2AE8C623
End Date:	27 Feb-18 11:40	**Protocol:**	EPA/600/R-94/025 (1994)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Sample Station:**	p170515.67

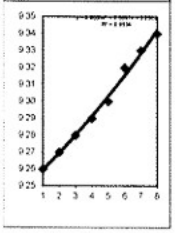
Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	12	10	10	
0	D	2	16	10	10	
0	D	3	9	10	10	
0.24		1	6	10	10	
0.24		2	14	10	10	
0.24		3	15	10	10	
0.482		1	17	10	10	
0.482		2	8	10	10	
0.482		3	11	10	9	
0.825		1	13	10	10	
0.825		2	10	10	10	
0.825		3	1	10	10	
1.377		1	18	10	5	
1.377		2	4	10	5	
1.377		3	7	10	6	
2.215		1	2	10	0	
2.215		2	3	10	0	
2.215		3	5	10	0	

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Reference Toxicant	Test Type:	*Eoh*
COMMENTS:	P170515.67		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	*NH3T (mg/L)*	*salinity (ppt)*	*pH*	*temp (C)*	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.6		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	0		0.499	28	7.9	15.6	288.76	9.3187		0.009
3	15		16.000	28	7.8	15.6	288.76	9.3187		0.240
4	30		32.400	28	7.8	15.5	288.66	9.3187		0.482
5	60		69.700	28	7.7	15.5	288.66	9.3187		0.825
6	120		146.000	28	7.6	15.5	288.66	9.3187		1.377
7	240		293.000	28	7.5	15.6	288.76	9.3187		2.215
8										
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WS

ECO ANALYSTS

Ammonia Reference Toxicant Test Water Quality Data Sheet

CLIENT	PROJECT		Laboratory	PROTOCOL
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble .	PSEP
TEST ID	**LOT #:**	**DILUTION PREP INITIALS:**		
P170515.67	2986C510	UB		
CHAMBER SIZE/TYPE	**EXPOSURE VOLUME**	**TEST START DATE** / **INITIALS** / **TIME**	**TEST END DATE**	**TIME**
Glass pint jar	250 mL	23Feb18 / 1335 / JL, UB	27Feb18	1140

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L)		TEMP(C)		SAL (ppt)		pH		TECHNICIAN	AMMONIA					
					> 4.6		15 ± 1		28 ± 1		7.8 ± 0.5								
SAMPLE ID	CONCENTRATION value	CONCENTRATION units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WQ TECH/ DATE	AMMONIA METER	AMMONIA mg/L	Tech			
Ref.Tox.-ammonia	0	mg/L	0	Stock	9	8.6	9	15.6	9	28	9	7.9	UB 2/23	10	0.499	UB			
			4	1	9	7.2	9	15.7	9	27	9	7.5	UB 2/27						
Ref.Tox.-ammonia	15	mg/L	0	Stock	9	8.8	9	15.6	9	28	9	7.8	UB 2/23	10	16.0	UB			
			4	1	9	7.5	9	15.8	9	28	9	7.8	UB 2/27						
Ref.Tox.-ammonia	30	mg/L	0	Stock	9	8.8	9	15.5	9	28	9	7.8	UB 2/23	10	32.4	UB			
			4	1	9	7.8	9	16.0	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	60	mg/L	0	Stock	9	8.8	9	15.5	9	28	9	7.7	UB 2/23	10	69.7	UB			
			4	1	9	7.8	9	15.8	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	120	mg/L	0	Stock	9	8.7	9	15.5	9	28	9	7.6	UB 2/23	10	146	UB			
			4	1	9	7.8	9	16.0	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	240	mg/L	0	Stock	9	8.7	9	15.6	9	28	9	7.5	UB 2/23	10	293	UB			
			4	1	9	—	9	—	9	—	9	—	~~UB 2/27~~						

EcoAnalysts Ammonia Reference Toxicant Test Water Quality Data Sheet

CLIENT	PROJECT	SPECIES		
		Eohaustorius estuarius		
Landau	Blair Waterway	PROJECT MANAGER: B. Hester	LABORATORY: Port Gamble .	PROTOCOL: PSEP

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

SAMPLE ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 DATE: 2/24/18 TECHNICIAN: UB			DAY 2 DATE: 2/25/18 TECHNICIAN: UB			DAY 3 DATE: 2/26/18 TECHNICIAN: BH			DAY 4 DATE: 2/27 TECHNICIAN: UB		
					#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	10	0	3F	10	0	1F	10	0	3F	10	0	5F
			2	↓	10	0	10F	10	0	6F	10	0	N	10	0	1F
			3	↓	10	0	2F	10	0	2F	10	0	4F	10	0	1F
Ref.Tox.- Ammonia	15	mg/L	1	10	10	0	5F	10	0	2F	10	0	4F	10	0	1F
			2	↓	10	0	1F	10	0	2F	10	0	1F	10	0	N
			3	↓	10	0	2F	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	30	mg/L	1	10	10	0	4F	10	0	3F	10	0	N	10	0	N
			2	↓	10	0	5F	10	0	2F 4F (1)	10	0	4F	10	0	1F
			3	↓	9	1	3F	9 10 (3)	0	4F (2) 8F	9	0	1F	9	0	2F
Ref.Tox.- Ammonia	60	mg/L	1	10	10	0	7F	10	0	3F	10	0	2F	10	0	4F
			2	↓	10	0	5F	10	0	4F	10	0	3F	10	0	5F
			3	↓	10	0	6F	10	0	8F	10	0	8F	10	0	2F
Ref.Tox.- Ammonia	120	mg/L	1	10	0 8	2	2F	8	0	2F	6	2	1F	5	1	1F,Q
			2	↓	9	1	5F	9	0	2F	8	1	2F/Q	5	3	2F,Q
			3	↓	10	0	5F	9	1	4F	7	2	4F/Q	6	1	4F,Q
Ref.Tox.- Ammonia	240	mg/L	1	10	5	5	2F	0	5	—	—	—	—			
			2	↓	6	4	4F	3	3	Q DC	0	3	—			
			3	↓	6	4	5F	1	5	Q DC	0	1	—			

(1) 1B, 8 alive UB 2/24
(2) WC 2F, UB 2/25
(3) WC 4F UB 2/25
9 alive

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170515.67
Date Prepared: 2/23/18
Technician Initials: VB

Amp/Eoh NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 1/23/2018
Measurement: 9676.66

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			[redacted]	SALT WATER
293	**240**	750	[redacted]	**27.902**
146	**120**	750	[redacted]	**13.951**
69.7	**60**	750	[redacted]	**6.976**
32.4	**30**	750	[redacted]	**3.488**
16.0	**15**	750	[redacted]	**1.744**
0.499	**0**	750	[redacted]	**0.000**
			[redacted]	
			[redacted]	

ORGANISM RECEIPT LOG

Date: 2/22/18	Time: 1400	Batch No. NAS022218
Organism: Eohaustorius estuarius		
Source / Supplier: Northwestern Aquatic Sciences		
No. Ordered: 860 / 900	**No. Received:** 860 + 10 L / 900 + 10 L	**Source Batch:** Collection date, hatch date, etc.): 2/19/18
Condition of Organisms: Good	**Approximate Size or Age:** (Days from hatch, life stage, size class, etc.): 3-5 mm	
Shipper: FedEx	**B of L (Tracking No.)** 0215 8112 7869 9780	
Condition of Container: Good	**Received By:** JL	

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
①							JL

*if >10% contact lab manager

Notes: ① Received Dry

Northwestern Aquatic Sciences
3814 Yaquina Bay Rd., P.O. Box 1437, Newport, OR 97365
Tel: 541-265-7225, Fax: 541-265-2799, www.nwaquatic.com

SUBJECT: Animal Collection Data Sheet (shipping)

SOLD TO: EcoAnalysts
4770 NE View Dr.
P.O. Box 216
Port Gamble WA 98364

Brian Hester/Collin Ray/Hillary Eicholer
360.297.6040
Julia Baum
360.509.4141

FedEx# 1817-5747-7

P.O. # 1398 PGL

DATE OF SHIPMENT: 2-21-18

ANIMAL HISTORY

Species	Age/Size	Number Shipped
Eohaustorius estuarius	3-5mm	860 + 10%

WATER QUALITY AT TIME OF SHIPMENT

Temperature (°C): 15.2	pH: 8.1	Salinity (ppt): 30.5	D.O. (mg/L): 8.3
Other:			

PACKAGED BY: Yves Nalcheme **DATE:** 2-21-18

FIELD COLLECTION/CULTURE NOTES

Collected 2-19-18 from Yaquina Bay, OR.
Interstitial WQ: Temp: 0.0 °C, Salinity 27.0 ppt.; salinity was adjusted down or up ~ 5ppt as needed.
Held at 15°C in aerated water.

ADDITIONAL COMMENTS

P.O. # 1398 PGL

2-liters of 0.5 mm sieved home sediment included.

PLEASE RETURN ALL SHIPPING MATERIALS

If you have any questions, Please call Gary Buhler or Gerald Irissarri at (541) 265-7225. Thank You.

MAINTENANCE LOG FOR CULTURES

ORGANISM: *Eohaustorius estuarius*
LOCATION: bath 5

Feed: tetramin slurry

Batch Number: ~~NAS0221~~ ① NAS022218	Date Received: 2/22/18	Initial # of Organisms: ~1936

Date	Feed AM/PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal ppt	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/23/18	② ✓	1	8.3	15.4	29	7.9	N	Y	0	—	UB	
↓	② ✓	2	8.5	15.3	29	8.0	N	Y	0	—	UB	
2/24/18	—	1	7.7	16.1	29	8.0	Y	Y	1	<1%.	UB	
↓	—	2	8.1	15.9	28	8.0	Y	Y	1	<1%.	UB	
2/25/18	✓	1	7.7	16.1	29	7.7	N	Y	30	~1.5%.	UB	
↓	✓	2	8.0	15.9	28	7.8	N	Y	14	<1%.	UB	
2/26/18	✓	1	8.0	16.0	29	7.8	③ ~~N~~ Y	Y	1	<1%	BG	
↓	✓	2	8.1	15.9	28	7.8	③ ~~N~~ Y	Y	3	<1%	BG	
2/27	—	1	7.4	16.1	28	7.6	Y	Y	5	<1%.	UB	
↓	—	2	7.9	16.0	28	7.8	Y	Y	3	<1%.	UB	
2/28	✓	1	7.8	16.1	29	7.8	N	Y	5	<1%.	UB	
↓	✓	2	8.0	16.0	29	7.8	N	Y	0	—	UB	
3/1	—	1	7.8	16.1	29	7.9	~~N~~ Y ④	Y	2	<1%.	UB	
↓	—	2	7.8	16.0	29	7.9	~~N~~ Y ④	Y	1	<1%.	UB	
3/2	—	1	7.7	16.3	30	7.9	NA	Y	0	—	UB	
↓	—	2	7.8	16.2	30	7.9	NA	Y	0	—	UB	
3/5	—	1	7.7	15.9	31	7.8	NA	Y	0	—	BG	
↓	—	2	7.9	16.1	31	7.8	NA	Y	0	—	BG	

FT = Flow-through
*if >10% notify lab manager

① IG, UB 2/23 ② Fed in PM, UB 2/23 ③ H_2O was changed but not recorded UB 2/28
④ Increase sal to 30 ppt, UB 3/1

END OF CULTURE 3/5/18 BG

2. *Neanthes arenaceodentata* 20-Day Test

ECO ANALYSTS

20-DAY CHRONIC TEST
INTERACTIVE DATA SETUP

GENERAL

CLIENT:	Landau
PROJECT:	Blair Waterway
JOB NUMBER:	PG1103
PROJECT MANAGER:	Brian Hester
TEST SPECIES:	*Neanthes arenaceodentata*
ORGANISM BATCH:	NAS022218
TEST PROTOCOL:	PSEP 1995
LABORATORY:	Port Gamble
TEST LOCATION:	Bath 7
TEST START DATE:	23Feb18
TEMP. RECORDER#:	NA
DILUTION WATER BATCH:	FSW022118.01
FEEDING INFORMATION:	40 mg/test chamber every other day
WATER RENEWAL INFO:	1/3 of total volume every third day

TEST START TIME: 1445 JL, UB
TEST START TIME: 0900 UB JL

FIELD SAMPLE

DATE RCVD AT PORT GAMBLE:	
SAMPLE STORAGE:	4 Degrees Celsius - dark
SAMPLE TREATMENT:	none
TEST CHAMBER:	1 L glass mason jar
EXPOSURE VOLUME:	2 cm sediment/water to 950 mL
REFERENCE TOXICANT #1:	ammonia - TAN
REF. TOX. MATERIAL #1:	ammonium chloride

NH3 REFTOX CONC (mg/ L)

0
15
30
60
120
240

	CLIENT SAMPLE ID	SAMPLE ID
1	Carr Reference	
2	G-5	
3	SG-14	
4	SG-16	

CONTROL ID: Control

CONTROL ID: Eoh Sand

DAILY DATA QA CHECKS: (Date/Initials)

2/23/18	JL 2/23
2/24/18	UB 2/24
2/25/18	UB 2/25
2/26/18	JL 2/26
2/27/18	UB 2/27
2/28/18	JL 3/12 ↓
3/1/18	JL
3/2/18	JL 3/02
3/3/18	UB 3/3
3/4/18	JL 3/12
3/5/18	JL
3/6/18	JL
3/7/18	JL
3/8/18	JL
3/9/18	JL ↓
3/10/18	UB 3/10
3/11/18	JL 3/12
3/12/18	↓
3/13/18	JL 3/15
3/14/18	↓
3/15/18	

TEST PARAMETERS	TARGET	ACCEPTABLE RANGE / COMMENTS
DO: (mg/L)	>4.6	60% Sat @ 20°C, 28ppt
Temp: (°C)	20 ± 1	Optimal
Sal: (ppt)	28 ± 2	Optimal
pH:	7 - 9	Optimal

EcoAnalysts

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 7	PSEP 1995	*Neanthes arenaceodentata*

ENDPOINT DATA & OBSERVATIONS

N = Normal
#E = Emergence
#M = Mortality
G = Growth (fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

CLIENT/ ENVISION ID	REP	JAR	INITIAL # (if differs)	Date and Initials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
				2/24 US	2/25/18 US	2/24/18 US	2/27 US	2/28 US	3/1 US	3/2 JL	3/3 US	3/4 US	3/5 JL	3/6 US	3/7 US	3/8 US	3/9 US	3/10 US	3/11 JL	3/12 JL	3/13 US	3/14 US	3/15 US					
Control / Eoh Sand	1		5	U	N	N	N	N	N	N	N	N	N	N	G	G	G	G	G	G	G	G	G	G	5	1 214.47	284.50	242.63
	2		5											G	G	G	G				G,IE		IE G		5	2 201.10	299.32	245.35
	3		5											N	N	N	N				G		G		5	3 177.77	236.85	196.88
	4		5											G	G	G	G		G,IE				G		5	4 189.46	26286	220.32
	5		5											G	G	G	G		G				IE G		5	5 188.45	282.29	229.64
Carr Reference /	1		5	U	N	N	N	N	N	N		N		G	G	G	G	G	G			G	G	G	5	6 182.49	267.38	212.08
	2		5											G											5	7 193.23	255.53	208.51
	3		5								G	G		G											5	8 180.59	~~266.80~~ (3)	206.58
	4		5							G	G	G		G							G,IE				5	9 197.25	266.80	219.15
	5		5							N	G	G		G							G				5	10 213.64	276.26	232.60
G-5 /	1		5	U	N	N	N	N	N	N	N	N		G	G	G	G	G	G			G	G	G	5	11 188.59	~~268.17~~ (3)	201.84
	2		5											G											5	12 187.22	268.17	206.47
	3		5											G											5	13 209.65	277.10	226.14
	4		5				F	TC (1) G	G	G	G,3E	G		G											5	14 170.20	241.29	184.75
	5		5				N	N	N	N	N	G		G											5	15 191.58	251.38	207.20

Initial Biomass	Rep	Number	Tare Weight (mg)	Dry Weight (mg)	Ashed Weight (mg)
	1	5 21	50.60	53.1	51.08
	2	5 26	50.47	52.7	~~50.84~~ (2) 50.86
	3	5 27	50.34	52.2	50.63

→oven 2/22/18 0740 JL; → oven 1615 2/23/18 104°; → desic 0845 2/25/18 104°

(1) Wrong notation, Growth, US 2/28

(2) MR, 50.86 US 3/1

(3) WL. 8 250.99 mg. JL 3/16/18.
11 244.83 mg

ECO ANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 7	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	SAS	INITIAL # (if differs)	Date and Initials	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
SG-14 /	1		5	2/24 UB	U	N	N	N	N	N	N	N	N	N	N	G	G	G	G	G	G	G	G	G	5	16 196.54	275.53	222.37
	2		5	2/25 UB											N	N					G,IE				5	17 199.70	287.32	228.06
	3		5	2/26 BG					N						N	G					G				5	18 194.81	274.56	217.56
	4		5	2/27 UB					N						G										5	19 192.12	273.07	218.44
	5		5	2/28 UB					N						G										6	20 185.94	263.89	211.96
SG-16 /	1		5	3/1 UB	U	N	N	N	N	N	N	N		G	G	G	G	G	G	IE,G		G	G	G	5	21 220.99	294.28	241.91
	2		5	3/3 UB					G					N	N	N				G					5	22 213.38	300.38	241.62
	3		5	3/3 UB					G						N	G									5	23 202.65	280.15	227.18
	4		5	3/3 UB					N						N	N									5	24 196.49	274.44	220.51
	5		5	3/4 JL					N						N	G					G,IE				5	25 197.04	265.03	218.12

① IE, Normal, UB 2/28

② WC UB 3/3 JL 3/2

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
Control / Eoh Sand	0	Surr	2	9	7.8	9	19.7	9	28	9	7.7		JL	2.23.18 BH
Control / Eoh Sand	1	Surr		8	7.4	8	18.9	8	28	8	7.8			UB 2/24
Control / Eoh Sand	2	Surr		8	7.5	8	19.1	8	28	8	8.0		UB	UB 2/25
Control / Eoh Sand	3	Surr		9	7.7	9	19.1	9	28	9	7.9	BG		BG 2/26/18
Control / Eoh Sand	4	Surr		9	7.5	9	19.0	9	28	9	8.0		UB	UB 2/27
Control / Eoh Sand	5	Surr		9	7.3	9	19.5	9	28	9	7.9			UB 2/28
Control / Eoh Sand	6	Surr		9	7.2	9	20.1	9	28	9	7.8	UB/JL	UB	JL 3/01
Control / Eoh Sand	7	Surr		9	7.1	9	20.3	9	28	9	7.9			JL 3/02
Control / Eoh Sand	8	Surr		9	7.3	9	20.5	9	28	9	8.0		UB	UB 3/3
Control / Eoh Sand	9	Surr		9	7.2	9	20.9	9	28	9	7.7	GR		GR 3/4
Control / Eoh Sand	10	Surr		8	7.5	8	20.1	8	28	8	7.9		JL	JL 3/05
Control / Eoh Sand	11	Surr		8	7.2	8	20.3	8	28	8	7.9			UB 3/6
Control / Eoh Sand	12	Surr		8	7.3	8	20.4	8	28	8	8.0	UB	UB	UB 3/7
Control / Eoh Sand	13	Surr		8	7.1	8	20.6	8	28	8	7.9			UB 3/8
Control / Eoh Sand	14	Surr		8	7.3	8	20.5	8	28	8	7.9		UB	UB 3/9
Control / Eoh Sand	15	Surr		8	7.3	8	20.5	8	28	8	7.9	UB		UB 3/10
Control / Eoh Sand	16	Surr		8	7.4	8	20.7	8	28	8	7.8		JL	JL 3/11
Control / Eoh Sand	17	Surr		8	7.4	8	20.7	8	28	8	7.9			JL 3/12
Control / Eoh Sand	18	Surr		8	7.2	8	21.0	8	28	8	7.9	UB	UB	UB 3/13
Control / Eoh Sand	19	Surr		8	7.3	8	20.7	8	28	8	7.8			UB 3/14
Control / Eoh Sand	20	Surr	↓	8	7.4	8	20.4	8	28	8	7.9			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
Carr Reference /	0	Surr	5	9	7.9	9	19.7	9	28	9	7.8		JL	2.23.18 BH
Carr Reference /	1	Surr		8	7.5	8	18.9	8	28	8	7.9			UB 2/24
Carr Reference /	2	Surr		8	7.5	8	19.1	8	28	8	8.0		UB	UB 2/25
Carr Reference /	3	Surr		9	7.5	9	19.0	9	28	9	7.9	BH		BH 2/26
Carr Reference /	4	Surr		9	7.5	9	19.1	9	28	9	8.0		UB	UB 2/27
Carr Reference /	5	Surr		9	7.4	9	19.4	9	28	9	7.9			UB 2/28
Carr Reference /	6	Surr		9	7.3	9	20.0	9	28	9	7.9	UB/JL	UB	JL 3/01
Carr Reference /	7	Surr		9	7.1	9	20.4	9	28	9	7.9			JL 3/02
Carr Reference /	8	Surr		9	7.2	9	20.4	9	28	9	8.0		UB	UB 3/3
Carr Reference /	9	Surr		9	7.3	9	20.8	9	28	9	7.7	CR		CR 3/4
Carr Reference /	10	Surr		8	7.5	8	19.9	8	28	8	7.9		JL	JL 3/05
Carr Reference /	11	Surr		8	7.4	8	20.2	8	28	8	8.0			UB 3/6
Carr Reference /	12	Surr		8	7.4	8	20.3	8	28	8	8.1	UB	UB	UB 3/7
Carr Reference /	13	Surr		8	7.2	8	20.4	8	28	8	8.0			UB 3/8
Carr Reference /	14	Surr		8	7.5	8	20.4	8	28	8	8.1		UB	UB 3/9
Carr Reference /	15	Surr		8	7.4	8	20.4	8	28	8	8.0	UB		UB 3/10
Carr Reference /	16	Surr		8	7.5	8	20.5	8	28	8	8.0		JL	JL 3/11
Carr Reference /	17	Surr		8	7.5	8	20.5	8	28	8	8.0			JL 3/12
Carr Reference /	18	Surr		8	7.4	8	20.9	8	28	8	8.1	UB	UB	UB 3/13
Carr Reference /	19	Surr		8	7.5	8	20.4	8	28	8	8.0			UB 3/14
Carr Reference /	20	Surr		8	7.6	8	20.4	8	28	8	8.1			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
G-5 /	0	Surr	29	9	7.8	9	19.8	9	28	9	7.8		JL	2.23.18 BH
G-5 /	1	Surr		8	7.2	8	18.9	8	28	8	7.8			UB 2/24
G-5 /	2	Surr		8	7.6	8	18.9	8	28	8	8.0		UB	UB 2/25
G-5 /	3	Surr		9	7.4	9	18.7	9	28	9	7.9	HA		BH 2/26/18
G-5 /	4	Surr		9	7.5	9	18.8	9	28	9	8.1		UB	UB 2/27
G-5 /	5	Surr		9	7.4	9	19.2	9	28	9	8.0			UB 2/28
G-5 /	6	Surr		9	7.2	9	19.9	9	28	9	8.0	UB/JL	UB	JL 3/01
G-5 /	7	Surr		9	7.2	9	20.0	9	28	9	8.1			JL 3/02
G-5 /	8	Surr		9	7.3	9	19.9	9	28	9	8.1		UB	UB 3/3
G-5 /	9	Surr		9	7.3	9	20.1	9	28	9	7.9	CR		CR 3/4
G-5 /	10	Surr		8	7.5	8	19.9	8	28	8	8.0		JL	JL 3/05
G-5 /	11	Surr		8	7.4	8	20.0	8	28	8	8.1			UB 3/6
G-5 /	12	Surr		8	7.3	8	19.9	8	28	8	8.1	UB	UB	UB 3/7
G-5 /	13	Surr		8	7.1	8	20.1	8	28	8	8.1			UB 3/8
G-5 /	14	Surr		8	7.3	8	20.1	8	28	8	8.1		UB	UB 3/9
G-5 /	15	Surr		8	7.1	8	19.9	8	28	8	7.9	UB		UB 3/10
G-5 /	16	Surr		8	7.4	8	20.1	8	28	8	8.0		JL	JL 3/11
G-5 /	17	Surr		8	7.3	8	20.1	8	28	8	8.0			JL 3/12
G-5 /	18	Surr		8	7.3	8	20.3	8	28	8	8.1	UB	UB	UB 3/13
G-5 /	19	Surr		8	7.3	8	20.2	8	28	8	8.0			UB 3/14
G-5 /	20	Surr		8	7.5	8	19.9	8	28	8	8.0			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
SG-14 /	0	Surr	B	9	7.9	9	19.5	9	28	9	7.9		JL	2.23.18 BH
SG-14 /	1	Surr		8	7.5	8	18.8	8	28	8	7.9			UB 2/24
SG-14 /	2	Surr		8	7.6	8	19.0	8	28	8	8.0		UB	UB 2/25
SG-14 /	3	Surr		9	7.5	9	18.7	9	28	9	7.9	BH		BH 2/26/18
SG-14 /	4	Surr		9	7.5	9	18.9	9	28	9	8.1		UB	UB 2/27
SG-14 /	5	Surr		9	7.5	9	19.3	9	28	9	8.0			UB 2/28
SG-14 /	6	Surr		9	7.3	9	19.9	9	28	9	8.0	UB/JL	UB	JL 3/01
SG-14 /	7	Surr		9	7.2	9	20.2	9	28	9	8.0			JL 3/02
SG-14 /	8	Surr		9	7.3	9	20.2	9	28	9	8.1		UB	UB 3/3
SG-14 /	9	Surr		9	7.2	9	20.6	9	28	9	7.9	CR		CR 3/4
SG-14 /	10	Surr		8	7.5	8	19.9	8	28	8	8.0		JL	JL 3/05
SG-14 /	11	Surr		8	7.4	8	20.2	8	28	8	8.0			UB 3/6
SG-14 /	12	Surr		8	7.4	8	20.3	8	29	8	8.1	UB	UB	UB 3/7
SG-14 /	13	Surr		8	7.2	8	20.4	8	28	8	8.0			UB 3/8
SG-14 /	14	Surr		8	7.4	8	20.5	8	28	8	8.1		UB	UB 3/9
SG-14 /	15	Surr		8	7.4	8	20.3	8	28	8	8.0	UB		UB 3/10
SG-14 /	16	Surr		8	7.5	8	20.5	8	28	8	8.0		JL	JL 3/11
SG-14 /	17	Surr		8	7.4	8	20.5	8	28	8	8.0			JL 3/12
SG-14 /	18	Surr		8	7.4	8	20.8	8	28	8	8.0	UB	UB	UB 3/13
SG-14 /	19	Surr		8	7.3	8	20.4	8	28	8	8.0			UB 3/14
SG-14 /	20	Surr	↓	8	7.4	8	20.4	8	28	8	8.1			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
				D.O.		TEMP		SALINITY		pH		WATER		
SAMPLE ID	DAY	REP	JAR	meter	mg/L	meter	°C	meter	ppt	meter	unit	RENEWAL	Feeding	TECH/DATE
SG-16 /	0	Surr	30	9	7.8	9	①~~2~~19.9	9	28	9	7.8		JV	2.23.18 BH
SG-16 /	1	Surr		8	7.2	8	19.0	8	28	8	7.7			UB 2/24
SG-16 /	2	Surr		8	7.5	8	19.1	8	28	8	8.0		UB	UB 2/25
SG-16 /	3	Surr		9	7.0	9	18.9	9	②+28	9	7.9	BH		BH 2/26/18
SG-16 /	4	Surr		9	7.2	9	19.1	9	28	9	8.0		UB	UB 2/27
SG-16 /	5	Surr		9	7.3	9	19.4	9	28	9	7.9			UB 2/28
SG-16 /	6	Surr		9	7.0	9	19.9	9	28	9	7.9	UB/JL	UB	JL 3/01
SG-16 /	7	Surr		9	6.8	9	20.0	9	28	9	7.9			JL 3/02
SG-16 /	8	Surr		9	6.8	9	19.9	9	28	9	7.9		UB	UB 3/3
SG-16 /	9	Surr		9	6.7	9	20.1	9	28	9	7.8	CR		CR 3/4
SG-16 /	10	Surr		8	7.1	8	19.9	8	28	8	7.8		JL	JL 3/05
SG-16 /	11	Surr		8	7.4	8	19.9	8	28	8	7.9			UB 3/6
SG-16 /	12	Surr		8	7.1	8	19.8	8	28	8	7.9	UB	UB	UB 3/7
SG-16 /	13	Surr		8	7.2	8	20.1	8	28	8	7.8			UB 3/8
SG-16 /	14	Surr		8	7.1	8	20.0	8	28	8	8.0		UB	UB 3/9
SG-16 /	15	Surr		8	7.3	8	19.9	8	28	8	7.8	UB		UB 3/10
SG-16 /	16	Surr		8	7.0	8	20.1	8	28	8	7.9		JL	JL 3/11
SG-16 /	17	Surr		8	6.7	8	20.0	8	28	8	7.8			JL 3/12
SG-16 /	18	Surr		8	6.9	8	20.2	8	28	8	8.0	UB	UB	UB 3/13
SG-16 /	19	Surr		8	6.9 ~~7.2~~③	8	20.2	8	28	8	7.9			UB 3/14
SG-16 /	20	Surr		8	7.0	8	19.9	8	28	8	8.0			UB 3/15

① IE 2.23.18 BH

② UB 2/26/18 BH

③ MR, 6.9 UB 3/14

Ammonia and Sulfide Analysis Record

Client/Project:	Organism:	Test Duration (days):
Landau/Blair Waterway	Neanthes	20

PRETEST / (INITIAL) / FINAL / OTHER (circle one)

(OVERLYING (OV)) / (POREWATER (PW)) (circle one) / Comments: _____

DAY of TEST: 0

Calibration Standards Temperature	
Date:	Temperature:
2/23/18	20.7°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV 0	Surf.	2/23/18 JL	0.102	TAp	20.7	2/23/18 JL/LB	N			10	0.003		
Ref.			0.239								0.002		
G.S			1.09								0.000		
SG.14			0.828								0.000		
SG.16			0.746								0.000		
SG.17			0.327	↓	↓						0.000		
①													
PW 0+0			②	TAp	19.7								
Ref			5.22					7.7	29	5	0.00	2	
G.S			10.4					7.8	7.8① 29		0.002		0.004
SG.14			8.46					7.8	29		0.00		
SG.16			5.58					7.8	30 24①		0.00		
SG.17			7.12	↓	↓	↓	↓	7.8	29 30①	↓	0.00	↓	

① IG.JL 2/23/18. ②

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway	Organism: Neanthes	Test Duration (days): 20

PRETEST / INITIAL / ~~FINAL~~ / OTHER (circle one)

~~OVERLYING (OV)~~ / ~~POREWATER (PW)~~ (circle one) / Comments: _____

DAY of TEST: 20

Calibration Standards Temperature		
Date: 3/15/18	Temperature: 20.8 °C	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

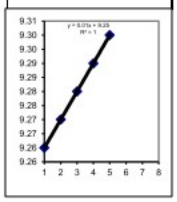
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV. Ø	Surr	3/15/18 JV	0.614	TAP	19.8	3/15/18 JV	N			10	0.006		
CARP REF.			0.196								ND		
G·5			0.136								0.001		
S6·14			0.116								0.00		
S6·16			0.143								ND		
S6·17			0.132	↓	↓					↓	ND		
PW Ø			1.25	TAP	20.8			7.5	29	2	0.00	5	0.00
CARP REF.			0.350		21.1			7.2	27	5	ND	2	—
G·5			1.36		21.8			7.2	28		0.00		0.00
S6·14			0.964		21.1			7.3	27		0.004		0.008
S6·16			1.81		21.6			7.0	27		ND		←
S6·17			0.359	↓	21.2			7.1	27		0.011	↓	0.022

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Neanthes arenaceodentata*
COMMENTS:	Porewater calculations performed with porewater WQ parameters		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30

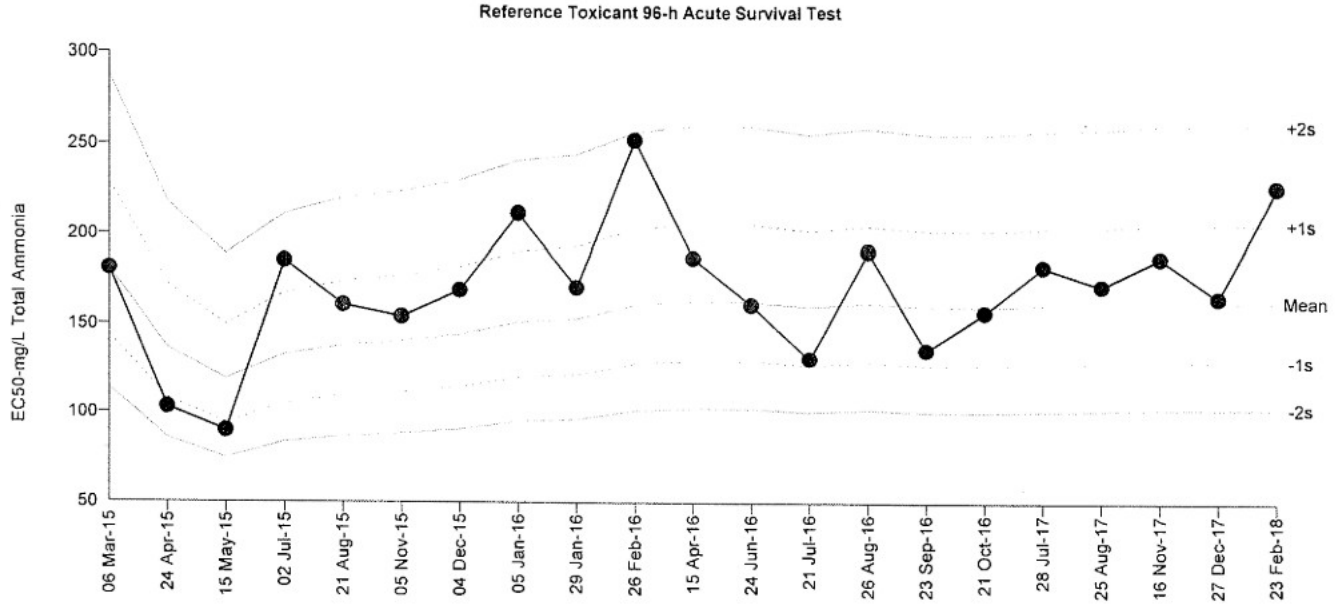


Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
Day 0 OV									
Control		0.102	28	7.7	19.7	292.86	9.3187		0.002
Carr Reference		0.239	28	7.8	19.7	292.86	9.3187		0.005
G-5		1.090	28	7.8	19.8	292.96	9.3187		0.022
SG-14		0.828	28	7.9	19.5	292.66	9.3187		0.021
SG-16		0.746	28	7.8	19.9	293.06	9.3187		0.015
Day 0 PW									
Control		NM				273.16	9.2548		#VALUE!
Carr Reference		5.220	29	7.7	19.7	292.86	9.3214		0.084
G-5		10.400	29	7.8	19.8	292.96	9.3214		0.211
SG-14		8.460	29	7.8	19.5	292.66	9.3214		0.168
SG-16		5.580	30	7.8	19.9	293.06	9.3242		0.113
Day 20 OV									
Control		0.614	28	7.9	20.4	293.56	9.3187		0.016
Carr Reference		0.196	28	8.1	20.4	293.56	9.3187		0.008
G-5		0.136	28	8.0	19.9	293.06	9.3187		0.004
SG-14		0.116	28	8.1	20.4	293.56	9.3187		0.005
SG-16		0.143	28	8.0	19.9	293.06	9.3187		0.005
Day 20 PW									
Control		1.250	29	7.5	20.4	293.56	9.3214		0.013
Carr Reference		0.350	27	7.2	20.4	293.56	9.3160		0.002
G-5		1.360	28	7.2	19.9	293.06	9.3187		0.007
SG-14		0.964	27	7.3	20.4	293.56	9.3160		0.007
SG-16		1.810	27	7.0	19.9	293.06	9.3160		0.006

	Input				Output		
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	3	19.7	28	7.7	0.38	0.000	12.70%
Carr Reference	2	19.7	28	7.8	0.21	0.000	10.34%
G-5	0	19.8	28	7.8	0.00	0.000	#DIV/0!
SG-14	0	19.5	28	7.9	0.00	0.000	#DIV/0!
SG-16	0	19.9	28	7.8	0.00	0.000	#DIV/0!
Day 0 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	0.0	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	0	19.7	29	7.7	0.00	0.000	#DIV/0!
G-5	4	19.8	29	7.8	0.41	0.000	10.26%
SG-14	0	19.5	29	7.8	0.00	0.000	#DIV/0!
SG-16	0	19.9	30	7.8	0.00	0.000	#DIV/0!
Day 20 OV					0.00	0.000	#DIV/0!
Control	6	20.4	28	7.9	0.49	0.000	8.19%
Carr Reference	#VALUE!	20.4	28	8.1	#VALUE!	#VALUE!	#VALUE!
G-5	1	19.9	28	8.0	0.07	0.000	6.72%
SG-14	0	20.4	28	8.1	0.00	0.000	#DIV/0!
SG-16	#VALUE!	19.9	28	8.0	#VALUE!	#VALUE!	#VALUE!
Day 20 PW					0.00	0.000	#DIV/0!
Control	0	20.4			0.00	0.000	#DIV/0!
Carr Reference	#VALUE!	20.4	27	7.2	#VALUE!	#VALUE!	#VALUE!
G-5	0	19.9			0.00	0.000	#DIV/0!
SG-14	8	20.4	27	7.3	2.13	0.002	26.62%
SG-16	#VALUE!	19.9	27	7	#VALUE!	#VALUE!	#VALUE!

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Total Ammonia
Protocol:	PSEP (1995)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	163.7	**Count:**	20	**-1s Warning Limit:**	129.8	**-2s Action Limit:**	102.9
Sigma:	n/a	**CV:**	23.50%	**+1s Warning Limit:**	206.4	**+2s Action Limit:**	260.3

Quality Control Data

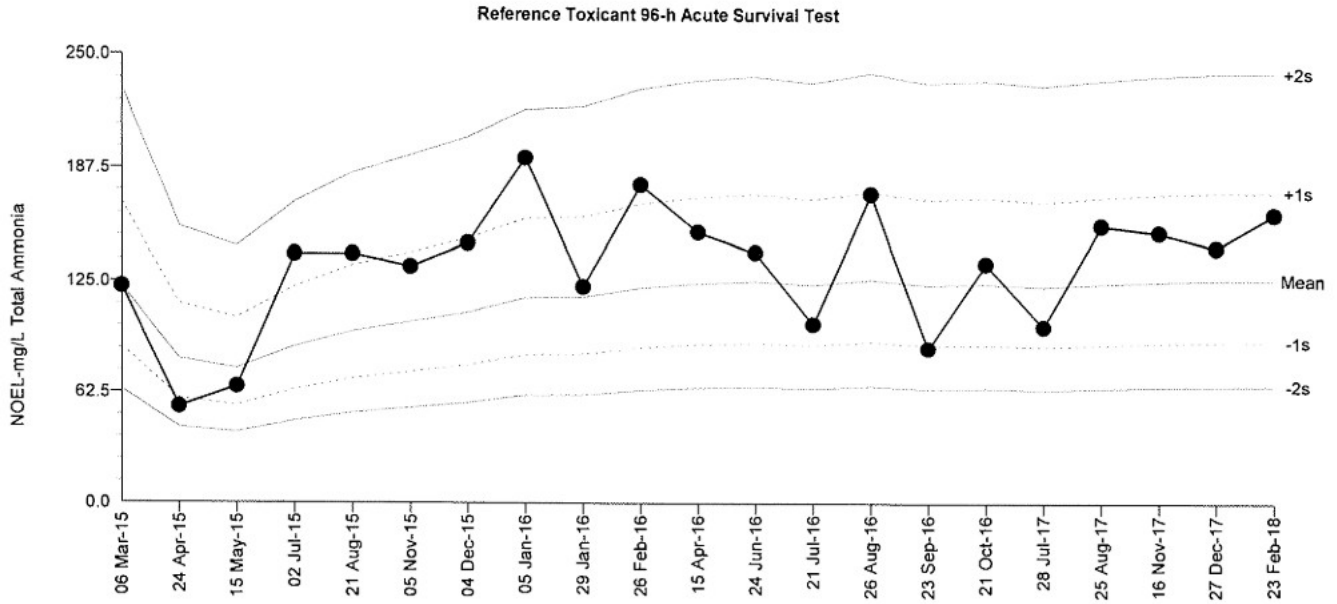
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Mar	6	11:50	181.2	17.46	0.4369			09-2159-7453	09-1672-5355	ENVIRON
2		Apr	24	12:50	103.1	-60.61	-1.993	(-)		01-6315-9057	02-6990-5019	ENVIRON
3		May	15	14:00	89.83	-73.87	-2.587	(-)	(-)	15-1184-2734	08-8902-1629	ENVIRON
4		Jul	2	14:15	185.6	21.89	0.5409			18-8075-0902	16-6019-0259	ENVIRON
5		Aug	21	16:33	161	-2.709	-0.07194			18-5704-8732	08-2852-0434	ENVIRON
6		Nov	5	16:00	154.3	-9.358	-0.2537			15-0871-2744	12-3779-6972	ENVIRON
7		Dec	4	15:55	169.2	5.529	0.1432			15-8650-5167	03-4063-5051	ENVIRON
8	2016	Jan	5	15:40	211.6	47.91	1.107	(+)		08-2089-5605	19-0377-2050	ENVIRON
9			29	10:55	170.9	7.215	0.1859			17-5198-4435	10-4316-4458	ENVIRON
10		Feb	26	13:05	251.9	88.21	1.858	(+)		12-4659-9912	05-2938-3515	ENVIRON
11		Apr	15	11:20	187.5	23.79	0.5848			14-5662-2397	01-2817-7421	ENVIRON
12		Jun	24	14:10	161.5	-2.186	-0.05794			18-4503-3329	10-8210-8087	ENVIRON
13		Jul	21	14:00	130.8	-32.86	-0.9658			03-2252-3368	14-5043-4569	ENVIRON
14		Aug	26	17:00	191.5	27.82	0.6765			03-0001-3671	08-4097-9552	ENVIRON
15		Sep	23	14:00	135.9	-27.83	-0.8032			11-8849-2684	05-6423-6975	ENVIRON
16		Oct	21	12:20	157.3	-6.356	-0.1707			07-3517-7142	10-6382-3344	ENVIRON
17	2017	Jul	28	10:45	183.1	19.39	0.4825			04-6413-3650	06-5419-2075	EcoAnalysts
18		Aug	25	10:40	172.2	8.538	0.2191			03-6651-4426	03-4165-4995	EcoAnalysts
19		Nov	16	13:40	188.2	24.52	0.6016			03-0415-6136	04-9955-5124	EcoAnalysts
20		Dec	27	15:35	165.8	2.149	0.05622			01-8821-8905	08-9204-3617	EcoAnalysts
21	2018	Feb	23	16:20	226.4	62.72	1.398	(+)		13-7905-8989	13-7098-6720	EcoAnalysts

CETIS QC Plot

Report Date: 21 Mar-18 12:07 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Total Ammonia
Protocol:	PSEP (1995)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	126.2	**Count:**	20	**-1s Warning Limit:**	91.44	**-2s Action Limit:**	66.26
Sigma:	n/a	**CV:**	33.10%	**+1s Warning Limit:**	174.1	**+2s Action Limit:**	240.3

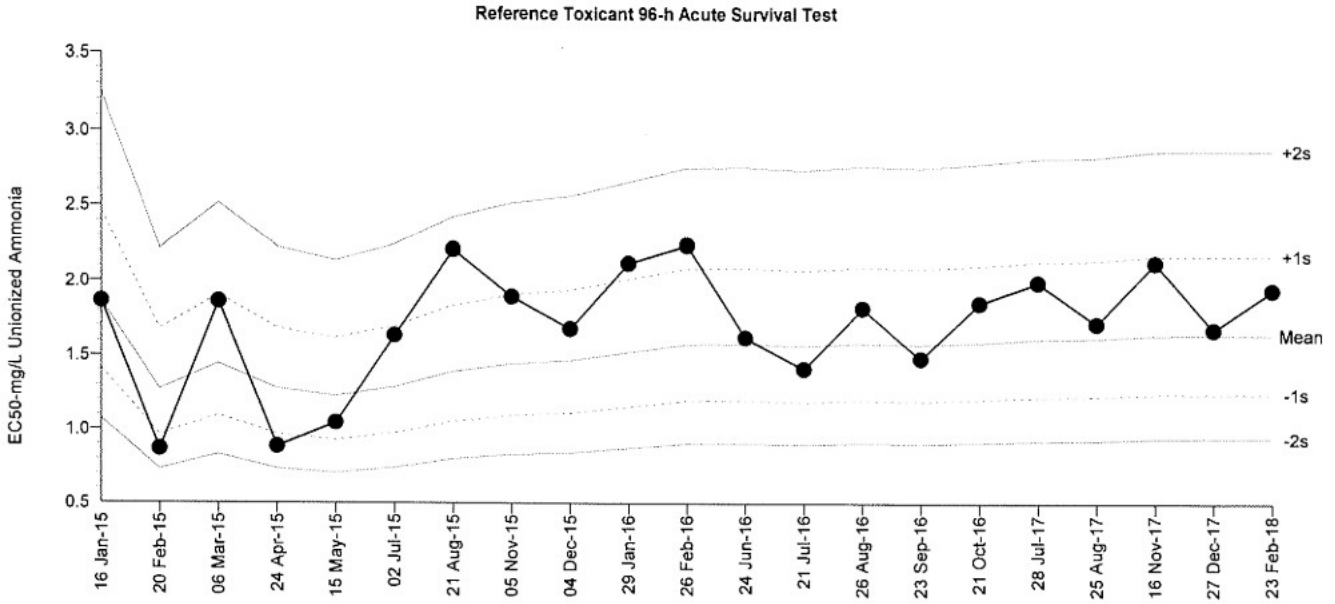
Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Mar	6	11:50	122	-4.217	-0.1055			09-2159-7453	06-6960-4147	ENVIRON
2		Apr	24	12:50	54.3	-71.92	-2.619	(-)	(-)	01-6315-9057	00-4642-5370	ENVIRON
3		May	15	14:00	65.6	-60.62	-2.032	(-)	(-)	15-1184-2734	09-3943-6020	ENVIRON
4		Jul	2	14:15	140	13.78	0.3218			18-8075-0902	00-0324-0641	ENVIRON
5		Aug	21	16:33	140	13.78	0.3218			18-5704-8732	12-5806-5521	ENVIRON
6		Nov	5	16:00	133	6.783	0.1625			15-0871-2744	05-8415-3689	ENVIRON
7		Dec	4	15:55	146	19.78	0.4521			15-8650-5167	03-6544-2607	ENVIRON
8	2016	Jan	5	15:40	193	66.78	1.319	(+)		08-2089-5605	14-5672-8302	ENVIRON
9			29	10:55	122	-4.217	-0.1055			17-5198-4435	20-2746-8183	ENVIRON
10		Feb	26	13:05	178	51.78	1.067	(+)		12-4659-9912	04-9112-4627	ENVIRON
11		Apr	15	11:20	152	25.78	0.5771			14-5662-2397	08-8399-3634	ENVIRON
12		Jun	24	14:10	141	14.78	0.3439			18-4503-3329	05-9137-4303	ENVIRON
13		Jul	21	14:00	101	-25.22	-0.692			03-2252-3368	05-6001-6512	ENVIRON
14		Aug	26	17:00	173	46.78	0.9789			03-0001-3671	13-0809-8319	ENVIRON
15		Sep	23	14:00	87.6	-38.62	-1.134	(-)		11-8849-2684	14-0354-7159	ENVIRON
16		Oct	21	12:20	135	8.783	0.2089			07-3517-7142	04-1673-2094	ENVIRON
17	2017	Jul	28	10:45	99.9	-26.32	-0.726			04-6413-3650	18-1225-7941	EcoAnalysts
18		Aug	25	10:40	156	29.78	0.6577			03-6651-4426	09-2206-9228	EcoAnalysts
19		Nov	16	13:40	152	25.78	0.5771			03-0415-6136	18-4343-4696	EcoAnalysts
20		Dec	27	15:35	144	17.78	0.4092			01-8821-8905	01-3003-6293	EcoAnalysts
21	2018	Feb	23	16:20	162	35.78	0.7749			13-7905-8989	16-4206-5191	EcoAnalysts

Analyst: LB QA: JL

Reference Toxicant 96-h Acute Survival Test All Matching Labs

Test Type: Survival **Organism:** Neanthes arenaceodentata (Polycha **Material:** Unionized Ammonia
Protocol: PSEP (1995) **Endpoint:** Proportion Survived **Source:** Reference Toxicant-REF



Mean:	1.644	**Count:**	20	**-1s Warning Limit:**	1.246	**-2s Action Limit:**	0.9438
Sigma:	n/a	**CV:**	28.30%	**+1s Warning Limit:**	2.17	**+2s Action Limit:**	2.864

Quality Control Data

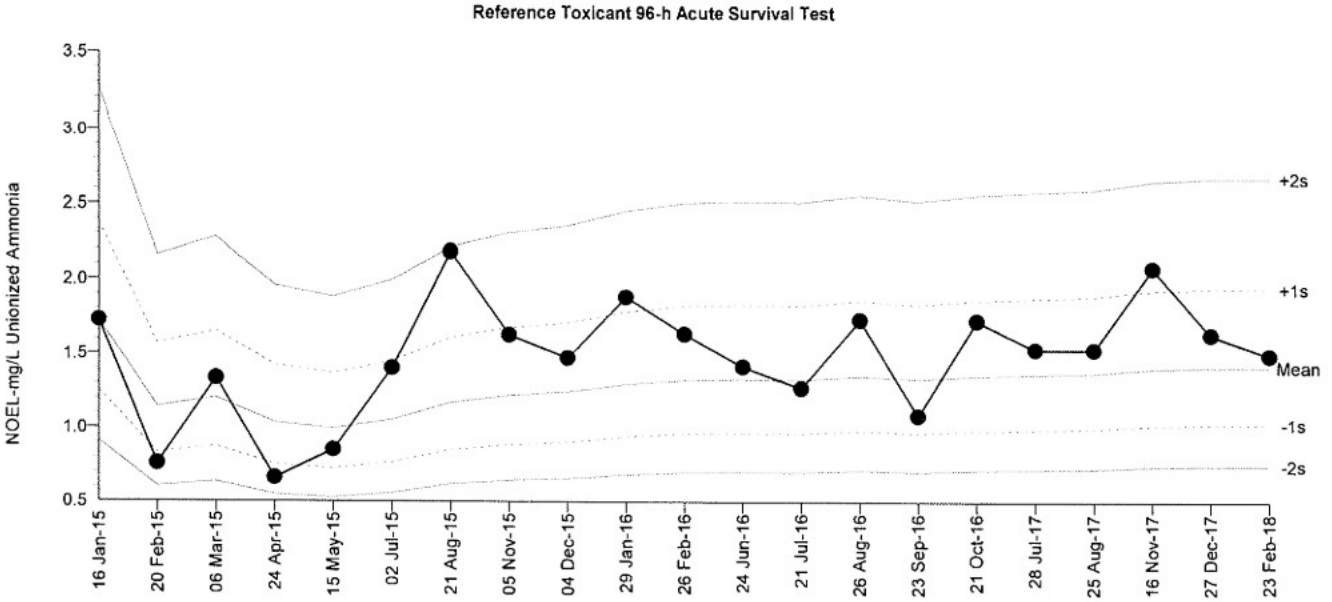
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.864	0.22	0.4527			18-9719-6747	15-5803-7088	ENVIRON
2		Feb	20	14:50	0.866	-0.7779	-2.31	(-)	(-)	15-6687-7653	15-3894-5718	ENVIRON
3		Mar	6	11:50	1.861	0.2174	0.4475			11-3697-1780	11-9165-3524	ENVIRON
4		Apr	24	12:50	0.8832	-0.7607	-2.239	(-)	(-)	01-0867-6874	09-2102-1717	ENVIRON
5		May	15	14:00	1.043	-0.6013	-1.641	(-)		09-1275-9559	04-5482-9783	ENVIRON
6		Jul	2	14:15	1.633	-0.0114	-0.02508			12-0891-3679	07-1814-7730	ENVIRON
7		Aug	21	16:33	2.206	0.5617	1.059	(+)		12-1645-6634	17-4166-4421	ENVIRON
8		Nov	5	16:00	1.894	0.2498	0.5097			13-9158-6969	12-9319-1772	ENVIRON
9		Dec	4	15:55	1.68	0.03569	0.0774			05-0232-3049	00-1680-9936	ENVIRON
10	2016	Jan	29	10:55	2.116	0.4725	0.9104			02-3774-6836	17-0304-9971	ENVIRON
11		Feb	26	13:05	2.236	0.5918	1.108	(+)		18-2733-1978	16-1252-1654	ENVIRON
12		Jun	24	14:10	1.621	-0.02294	-0.05065			14-5937-9292	12-2632-5647	ENVIRON
13		Jul	21	14:00	1.412	-0.2319	-0.548			13-0851-4355	08-2460-4906	ENVIRON
14		Aug	26	17:00	1.818	0.1739	0.3624			18-0730-6378	20-7585-3701	ENVIRON
15		Sep	23	14:00	1.482	-0.1623	-0.3746			16-0277-5330	13-3150-6775	ENVIRON
16		Oct	21	12:20	1.851	0.2074	0.4282			15-4953-5653	13-6771-5656	ENVIRON
17	2017	Jul	28	10:45	1.989	0.3452	0.6868			11-9488-2902	14-7043-7154	EcoAnalysts
18		Aug	25	10:40	1.716	0.07165	0.1537			04-3451-1040	00-3615-6317	EcoAnalysts
19		Nov	16	13:40	2.122	0.4781	0.9199			21-2485-6236	15-8866-6943	EcoAnalysts
20		Dec	27	15:35	1.678	0.03394	0.07363			14-3251-3795	10-3688-8341	EcoAnalysts
21	2018	Feb	23	16:20	1.939	0.2946	0.594			08-4313-9079	15-8743-9749	EcoAnalysts

CETIS QC Plot

Report Date: 21 Mar-18 13:07 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Neanthes arenaceodentata (Polycha | **Material:** Unionized Ammonia
Protocol: PSEP (1995) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	1.414	**Count:**	20	**-1s Warning Limit:**	1.028	**-2s Action Limit:**	0.7469
Sigma:	n/a	**CV:**	32.70%	**+1s Warning Limit:**	1.945	**+2s Action Limit:**	2.677

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.723	0.3092	0.6198			18-9719-6747	13-2446-7374	ENVIRON
2		Feb	20	14:50	0.756	-0.6578	-1.962	(-)		15-6687-7653	19-8246-2320	ENVIRON
3		Mar	6	11:50	1.333	-0.08083	-0.1845			11-3697-1780	05-2303-0535	ENVIRON
4		Apr	24	12:50	0.659	-0.7548	-2.392	(-)	(-)	01-0867-6874	18-8094-8803	ENVIRON
5		May	15	14:00	0.85	-0.5638	-1.595	(-)		09-1275-9559	12-8836-8785	ENVIRON
6		Jul	2	14:15	1.402	-0.01183	-0.02632			12-0891-3679	17-1059-5211	ENVIRON
7		Aug	21	16:33	2.184	0.7702	1.363	(+)		12-1645-6634	17-2823-4932	ENVIRON
8		Nov	5	16:00	1.627	0.2132	0.4401			13-9158-6969	18-5085-3785	ENVIRON
9		Dec	4	15:55	1.473	0.05917	0.1285			05-0232-3049	09-1115-6716	ENVIRON
10	2016	Jan	29	10:55	1.883	0.4692	0.898			02-3774-6836	16-2829-1192	ENVIRON
11		Feb	26	13:05	1.635	0.2212	0.4555			18-2733-1978	17-6331-1700	ENVIRON
12		Jun	24	14:10	1.415	0.001173	0.0026			14-5937-9292	10-8537-0051	ENVIRON
13		Jul	21	14:00	1.27	-0.1438	-0.3362			13-0851-4355	06-2505-9350	ENVIRON
14		Aug	26	17:00	1.732	0.3182	0.6361			18-0730-6378	04-2606-0638	ENVIRON
15		Sep	23	14:00	1.085	-0.3288	-0.8296			16-0277-5330	10-1484-1501	ENVIRON
16		Oct	21	12:20	1.725	0.3112	0.6234			15-4953-5653	10-3980-3312	ENVIRON
17	2017	Jul	28	10:45	1.532	0.1182	0.2516			11-9488-2902	00-8692-4177	EcoAnalysts
18		Aug	25	10:40	1.53	0.1162	0.2475			04-3451-1040	07-6966-4955	EcoAnalysts
19		Nov	16	13:40	2.079	0.6652	1.208	(+)		21-2485-6236	00-9775-4668	EcoAnalysts
20		Dec	27	15:35	1.633	0.2192	0.4516			14-3251-3795	04-4998-7500	EcoAnalysts
21	2018	Feb	23	16:20	1.491	0.07717	0.1666			08-4313-9079	12-5767-7210	EcoAnalysts

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	05-8775-6843	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 16:20	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 14:35	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Polychaeta	**Source:**	Aquatic Toxicology Support **Age:**
Sample ID:	08-9579-7944	**Code:**	3564CAB8	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.68
Sample Age:	284d 16h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
16-4206-5191	Proportion Survived	Fisher Exact Test		162	192	176.4		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
13-7098-6720	Proportion Survived	Trimmed Spearman-Kärber		EC50	226.4	205.4	249.6		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
69.9		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
118		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
162		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
192		3	0.7000	0.0000	1.0000	0.2000	1.0000	0.2517	0.4359	62.27%	30.00%
267		3	0.3000	0.0000	1.0000	0.0000	0.6000	0.1732	0.3000	100.00%	70.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
69.9		1.0000	1.0000	1.0000
118		0.9000	1.0000	1.0000
162		1.0000	1.0000	1.0000
192		1.0000	0.9000	0.2000
267		0.6000	0.0000	0.3000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
69.9		10/10	10/10	10/10
118		9/10	10/10	10/10
162		10/10	10/10	10/10
192		10/10	9/10	2/10
267		6/10	0/10	3/10

CETIS Test Data Worksheet

Report Date: 10 Mar-18 12:23 (p 1 of 1)
Test Code/ID: 5232C52D / 13-7905-8989

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Start Date:	23 Feb-18 16:20	**Species:**	Neanthes arenaceodentata	**Sample Code:**	3564CAB8
End Date:	27 Feb-18 14:35	**Protocol:**	PSEP (1995)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Sample Station:**	P170515.68

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	10	10	10	
0	D	2	18	10	10	
0	D	3	3	10	10	
69.9		1	14	10	10	
69.9		2	8	10	10	
69.9		3	7	10	10	
118		1	13	10	9	
118		2	15	10	10	
118		3	12	10	10	
162		1	6	10	10	
162		2	1	10	10	
162		3	11	10	10	
192		1	5	10	10	
192		2	16	10	9	
192		3	17	10	2	
267		1	2	10	6	
267		2	4	10	0	
267		3	9	10	3	

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	05-8775-6843	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 16:20	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 14:35	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Polychaeta	**Source:**	Aquatic Toxicology Support **Age:**
Sample ID:	08-8524-5379	**Code:**	34C3C5C3	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.68
Sample Age:	284d 16h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
12-5767-7210	Proportion Survived	Fisher Exact Test		1.491	1.727	1.605		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
15-8743-9749	Proportion Survived	Trimmed Spearman-Kärber		EC50	1.939	1.81	2.076		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.853		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.226		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
1.491		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.727		3	0.7000	0.0000	1.0000	0.2000	1.0000	0.2517	0.4359	62.27%	30.00%
2.176		3	0.3000	0.0000	1.0000	0.0000	0.6000	0.1732	0.3000	100.00%	70.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
0.853		1.0000	1.0000	1.0000
1.226		0.9000	1.0000	1.0000
1.491		1.0000	1.0000	1.0000
1.727		1.0000	0.9000	0.2000
2.176		0.6000	0.0000	0.3000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
0.853		10/10	10/10	10/10
1.226		9/10	10/10	10/10
1.491		10/10	10/10	10/10
1.727		10/10	9/10	2/10
2.176		6/10	0/10	3/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Start Date:	23 Feb-18 16:20	**Species:**	Neanthes arenaceodentata	**Sample Code:**	34C3C5C3
End Date:	27 Feb-18 14:35	**Protocol:**	PSEP (1995)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Sample Station:**	P170515.68

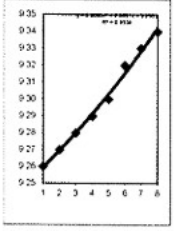
Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	14	10	10	
0	D	2	10	10	10	
0	D	3	7	10	10	
0.853		1	4	10	10	
0.853		2	6	10	10	
0.853		3	15	10	10	
1.226		1	18	10	9	
1.226		2	11	10	10	
1.226		3	16	10	10	
1.491		1	2	10	10	
1.491		2	3	10	10	
1.491		3	1	10	10	
1.727		1	17	10	10	
1.727		2	8	10	9	
1.727		3	13	10	2	
2.176		1	5	10	6	
2.176		2	12	10	0	
2.176		3	9	10	3	

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Reference Toxicant	Test Type:	*Neanthes*
COMMENTS:	P170515.68		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	0		0.000	27	7.7	19.0	292.16	9.3160		
3	60		69.900	28	7.6	19.0	292.16	9.3187		0.853
4	100		118.000	28	7.5	19.9	293.06	9.3187		1.226
5	140		162.000	28	7.5	19.8	292.96	9.3187		1.491
6	180		192.000	28	7.4	19.8	292.96	9.3187		1.727
7	220		267.000	28	7.4	19.7	292.86	9.3187		2.176
8										
9										
10										
11										
12										
13										
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Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT	PROJECT	SPECIES		LABORATORY	PROTOCOL
Landau	Blair Waterway	*Neanthes arenaceodentata*		Port Gamble .	PSEP
TEST ID	**LOT #:**	**TEST START DATE**	**TIME**	**4-DAY END DATE**	**TIME**
P170515.68	2986CS10	23Feb18	1620	27Feb18	1435
CHAMBER SIZE/TYPE	**EXPOSURE VOLUME**				
Glass pint jar	250mL				

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L)		TEMP(C)		SAL (ppt)		pH		TECHNICIAN	AMMONIA			SULFIDES		
					> 4.6		20 ± 1		28 ± 2		7.8 ± 0.5								
CLIENT/ENVIRON ID	CONCENTRATION		DAY	REP	D.O.		TEMP.		SALINITY		pH		WQ TECH/ DATE	AMMONIA		Tech	SULFIDES		Tech
	value	units			meter	mg/L	meter	°C	meter	ppt	meter	unit		METER	mg/L		meter	mg/L	
Ref.Tox.-ammonia	0	mg/L	0	Stock	B	8.8	B	19.0	B	27	B	7.7	JL 2/23/18	10	0.00				LB
			4	1	9	7.0	9	19.3	9	27	9	7.8	LB 2/27						
Ref.Tox.-ammonia	60	mg/L	0	Stock	B	8.9	B	19.0	B	28	B	7.6	JL 2/23	10	69.9				LB
			4	1	9	7.0	9	19.3	9	28	9	7.9	LB 2/27						
Ref.Tox.-ammonia	100	mg/L	0	Stock	B	8.8	B	19.9	B	28	B	7.5	JL 2/23	10	118				LB
			4	1	9	7.0	9	19.2	9	28	9	7.9	LB 2/27						
Ref.Tox.-ammonia	140	mg/L	0	Stock	B	8.7	B	19.8	B	28	B	7.5	JL 2/23	10	162				LB
			4	1	9	7.0	9	19.3	9	28	9	7.8	LB 2/27						
Ref.Tox.-ammonia	180	mg/L	0	Stock	B	8.7	B	19.8	B	28	B	7.4	JL 2/23	10	192				LB
			4	1	9	7.0	9	19.3	9	28	9	7.8	LB 2/27						
Ref.Tox.-ammonia	220	mg/L	0	Stock	B	8.6	B	19.7	B	28	B	7.4	JL 2/23	10	267				LB
			4	1	9	6.5	9	19.3	9	28	9	7.7	LB 2/27						

Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT	PROJECT	JOB NO.	SPECIES		
			Neanthes arenaceodentata		
			PROJECT MANAGER	LABORATORY	PROTOCOL
Landau	Blair Waterway	PG1103	B. Hester	Port Gamble .	PSEP

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

CLIENT/ENVIRON ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 DATE: 2/24/18 TECHNICIAN: UB			DAY 2 DATE: 2/25/18 TECHNICIAN: UB			DAY 3 DATE: 2/26/18 TECHNICIAN: BG			DAY 4 DATE: 2/27 TECHNICIAN: UB		
					#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	10	0	N	10	0	N	10	0	N	10	0	N
			2	↓	10	0	N	10	0	N	10	0	N	10	0	N
			3	↓	10	0	N	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	60	mg/L	1	10	10	0	N	10	0	N	10	0	N	10	0	N
			2	↓	10	0	N	10	0	N	10	0	N	10	0	N
			3	↓	10	0	N	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	100	mg/L	1	10	9	1	N	9	0	N	9	0	N	9	0	Q
			2	↓	10	0	N	10	0	N	10	0	N	10	0	Q
			3	↓	10	0	N	10	0	N	10	0	N	10	0	Q
Ref.Tox.- Ammonia	140	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			3	↓	10	0	Q	10	0	Q	10	0	Q	10	0	Q
Ref.Tox.- Ammonia	180	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	9	1	Q
			3	↓	10	0	Q	10	0	Q	10	0	Q	2	8	Q
Ref.Tox.- Ammonia	220	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	6	4	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	0	10	—
			3	↓	10	0	Q	10	0	Q	10	0	Q	3	7	Q

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170505-6B
Date Prepared: 2/23/18
Technician Initials: VB

Neanthes NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 1/23/2018
Measurement: 9676.66

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			FRESH WATER (mL)	SALT WATER (mL)
69.9	**60**	750	[redacted]	6.98
118	**100**	750		11.63
162	**140**	750		16.28
192	**180**	750		20.93
267	**220**	750		25.58

ORGANISM RECEIPT LOG

Date:	Time:	Batch No.
2/22/18	0915	ATS 022218

Organism: Neanthes

Source / Supplier: Aquatic Tox. Support

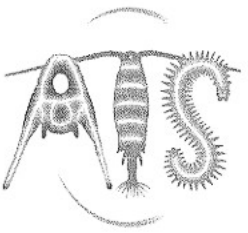
No. Ordered:	No. Received:	Source Batch: Collection date, hatch date, etc.):
345	345 + 10 ↑	Emerged 2/5/18

Condition of Organisms:	Approximate Size or Age: (Days from hatch, life stage, size class, etc.):
Good	17 days
Shipper: Courier	**B of L (Tracking No.)** NA
Condition of Container: Good	**Received By:** UL

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
1	17.1	21.0	30 ppt	7.4	0	—	UL

*if >10% contact lab manager

Notes:



Aquatic Toxicology Support
1849 Charleston Beach Road West
Bremerton, Washington 98312
(360) 813-1202

Order Summary

Species: *Neanthes arenaceodentata**	Emerge Date: 5 Feb '18
Number Ordered: 345	Number Shipped: 345 + 10%
Date Shipped: 21 Feb '18	Salinity (ppt): 30

*Smith 1964. CSU Long Beach strain. Feed upon arrival.

MAINTENANCE LOG FOR CULTURES

ORGANISM: Neanthes
LOCATION: Batch 6

Batch Number: ATS022218	Date Received: 2/22/18	Initial # of Organisms: 345 + 16 Y.

Date	Feed AM/PM	Tub No.	D.O.	Temp (°C)	Cond/ (Sal)	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/23/18	—	1	7.4	18.2	30 ppt	7.8	N	Y	0	—	JL	
2/24/18		1	7.4	19.0	35	7.9	N	N/A ①	-①	-①	BG	
↓		2					N	N/A ①	-①	-①	BG	②
2/24/18		1	7.6	18.9	31	7.9	N	Y	0	0	BG	

FT = Flow-through
if >10% notify lab manager

① too dark to see BG 2/26/18
② wrong culture BG 2/26/18

3. *Mytilus galloprovincialis* Bivalve Larval Test

ECO ANALYSTS

CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	LABORATORY	PROTOCOL
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble Bath 4	PSEP (1995)

TEST ORGANISM SPAWNING DATA

SPECIES			
Mytilus sp			
SUPPLIER		ORGANISM BATCH	
Taylor Shellfish		TS2589	
SPAWNING METHOD			
Heat Shock 1147 (fed 1026)			
MALES	FEMALES	SPERM VIABILITY	EGG CONDITION
9	6	✓	>90% div
INITIAL SPAWNING TIME	BEGIN FERTILIZATION	CONDITION OF EMBRYOS	
1156	1340	Good	

feed 1026
heat shock 1147 BH, LB

SAMPLE STORAGE
4 Degrees Celsius - dark
SEDIMENT TREATMENT
none
TEST CHAMBERS
1 L Mason Jars
EXPOSURE VOLUME
900mL seawater / 18g Sediment
TIME OF SHAKE
1045 LB, JB
TIME OF INITIATION
1645 LB, BH

SPECIAL CONDITIONS

UV LIGHT EXPOSURE (YES/NO)	AERATION FROM TEST INITIATION (YES/NO)
NO	NO
SCREEN TUBE TEST (YES/NO)	**OTHER (EXPLAIN)**
NO	

EMBRYO DENSITY CALCULATIONS

51, 78, 61 = 190/3 = 63

egg density

63 · 100 = 6300 eggs/mL

Sed Test

$\frac{27{,}000 \text{ target}}{6300 \text{ actual}} = 4.285 \text{ mL}$

Add 4.29 ess stock per jar

RT to make Adj stock

$\frac{2700}{6300} = 0.4285$

40mL · 0.4285

17mL ess stock

~~33~~ 23 mL dilution water

Deliver 0.100mL/vial of Adj stock

Calc ✓ BH, LB

ECO ANALYSTS

SPECIES					
Mytilus sp					
CLIENT	**PROJECT**	**JOB NUMBER**	**PROJECT MANAGER**	**LAB / LOCATION**	**PROTOCOL**
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 4	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER	DATE	TECHNICIAN	COMMENTS
STOCKING DENSITY	1		357	2/27/18	UB	
	2		348	↓	↓	
	3		320			
	4		346			
	5		356			
Control /	1	328	5	2/24	UB	
	2	314	13			
	3	344	14			
	4	317	11			
	5	319	12			
Sediment Control /	1	277	8			
	2	272	8			
	3	284	6			
	4	314	6			
	5	289	6	↓		
Carr Reference /	1	300	14	2/25		
	2	282	5			
	3	265	3			
	4	304	0			
	5	287	4			
G-5 /	1	279	3			
	2	269	4			
	3	①~~590~~ 325	3			
	4	232	7			
	5	266	11	↓	↓	

①E, UB 2/27

ECO ANALYSTS

SPECIES					
Mytilus sp					
CLIENT	**PROJECT**	**JOB NUMBER**	**PROJECT MANAGER**	**LAB / LOCATION**	**PROTOCOL**
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 4	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER	DATE	TECHNICIAN	COMMENTS
SG-14 /	1	266	6	2/25	MB	
	2	243	5			
	3	226	4			
	4	253	2			
	5	258	5			
SG-16 /	1	175	3			
	2	257	2			
	3	239	3			
	4	233	2			
	5	249	4			

QA Count Checks:			
#1 conc/rep Ø/3 # normal 290 # abnormal 7	#2 conc/rep SG14/1 # normal 219 # abnormal 8	#3 conc/rep G5/3 # normal 320 # abnormal 5	#4 conc/rep REF/5 # normal 282 # abnormal 6
Tech. Init. BG	Tech. Init. BG	Tech. Init. BG	Tech. Init. BG
Calc. $\frac{7}{297}=2.4\%$ $\frac{14}{358}=3.9\%$ <5%	$\frac{8}{227}=3.5\%$ $\frac{6}{272}=2.2\%$ <5%	$\frac{5}{325}=1.5\%$ $\frac{3}{328}=0.9\%$ <5%	$\frac{6}{288}=2.1\%$ $\frac{4}{291}=1.4\%$ <5%

QA Check Acceptability: ☑ <5% difference in means of QA & orig. counts

ECO ANALYSTS

CLIENT	PROJECT	SPECIES		LAB / LOCATION	PROTOCOL
Landau	Blair Waterway	*Mytilus sp*		Port Gamble / Bath 4	PSEP (1995)
JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE**	**TIME**	**TEST END DATE**	**TIME**
PG1103	Brian Hester	21Feb18	1645	23 Feb 18	1700

* Day 3&4 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

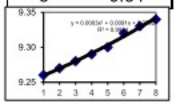
TEST CONDITIONS				DO (mg/L) >5.0		Temp (°C) 16 ± 1		Sal (ppt) 28 ± 1		pH 7 - 9		Ammonia NA		Sulfide NA		TECH	DATE
SAMPLE ID	DAY	Random #	REP	D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
				meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	mg/L (Total		
Control /	0	7	WQ Surr	9	8.6	9	16.5	9	28	9	7.7	UB	0.0076	JL	0.001	BH	2/21/18
Control /	1	↓	WQ Surr	9	8.1	9	16.7	9	28	9	7.6					JL	2/22
Control /	2	↓	WQ Surr	9	7.7	9	16.4	9	28	9	7.8	JL	0.110	JL	0.003	JL	2/23
Sediment Control /	0	31	WQ Surr	9	8.8	9	16.6	9	28	9	7.7	UB	0.00	JL	0.001	BH	2/21
Sediment Control /	1	↓	WQ Surr	9	7.9	9	17.0	9	28	9	7.7					JL	2/22
Sediment Control /	2	↓	WQ Surr	9	6.7	9	17.0	9	28	9	7.8	JL	0.0889	JL	0.007	JL	2/23
Carr Reference /	0	16	WQ Surr	9	8.0	9	16.9	9	28	9	7.6	UB	0.00	JL	0.004	BH	2/21
Carr Reference /	1	↓	WQ Surr	9	7.2	9	16.9	9	28	9	7.7					JL	2/22
Carr Reference /	2	↓	WQ Surr	9	6.7	9	17.0	9	28	9	7.8	JL	0.0849	JL	0.000	JL	2/23
G-5 /	0	24	WQ Surr	9	8.0	9	16.8	9	28	9	7.6	UB	0.0038	JL	0.003	BH	2/21
G-5 /	1	↓	WQ Surr	9	5.9	9	16.4	9	28	9	7.7					JL	2/22
G-5 /	2	↓	WQ Surr	9	6.0	9	16.4	9	28	9	7.8	JL	0.136	JL	0.004	JL	2/23
SG-14 /	0	17	WQ Surr	9	8.4	9	16.9	9	28	9	7.7	UB	0.00	JL	0.006	BH	2/21
SG-14 /	1	↓	WQ Surr	9	7.3	9	17.0	9	28	9	7.7					JL	2/22
SG-14 /	2	↓	WQ Surr	9	7.2	9	16.6	9	28	9	7.8	JL	0.142	JL	0.003	JL	2/23
SG-16 /	0	15	WQ Surr	9	8.1	9	16.6	9	28	9	7.7	UB	0.00	JL	0.004	BH	2/21
SG-16 /	1	↓	WQ Surr	9	7.1	9	17.0	9	28	9	7.7					JL	2/22
SG-16 /	2	↓	WQ Surr	9	7.1	9	16.7	9	28	9	7.8	JL	0.140	JL	0.002	JL	2/23

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	21-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Mytilus sp*
COMMENTS:			

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1	**Day 0**									
2	Control		0.008	28	7.7	16.5	289.66	9.3187		0.000
3	Sediment Control		0.000	28	7.7	16.6	289.76	9.3187		
4	Carr Reference		0.000	28	7.6	16.9	290.06	9.3187		
5	G-5		0.004	28	7.6	16.8	289.96	9.3187		0.000
6	SG-14		0.000	28	7.7	16.9	290.06	9.3187		
7	SG-16		0.000	28	7.7	16.6	289.76	9.3187		
8										
17	**Day 2**									
18	Control		0.110	28	7.8	16.4	289.56	9.3187		0.002
19	Sediment Control		0.089	28	7.8	17.0	290.16	9.3187		0.001
20	Carr Reference		0.085	28	7.8	17.0	290.16	9.3187		0.001
21	G-5		0.136	28	7.8	16.4	289.56	9.3187		0.002
22	SG-14		0.142	28	7.8	16.6	289.76	9.3187		0.002
23	SG-16		0.140	28	7.8	16.7	289.86	9.3187		0.002
24										
25										
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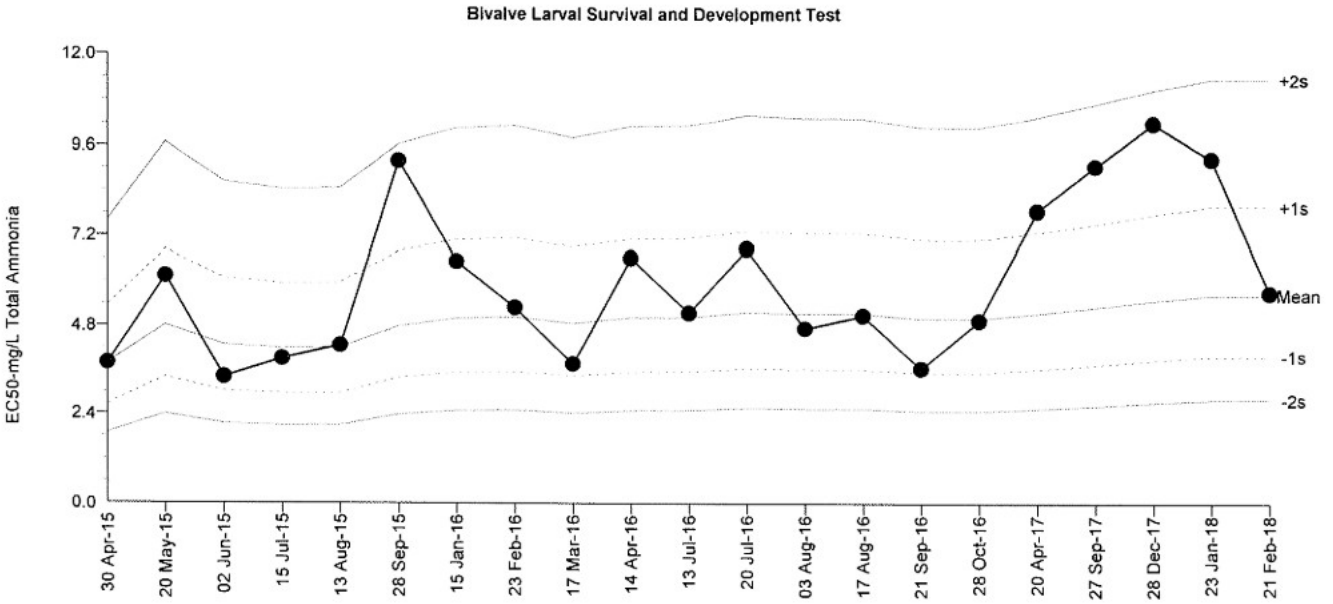
	Input					Output	
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	1	16.5	28	7.7	0.14	0.000	14.07%
Sediment Control	1	16.6	28	7.7	0.14	0.000	14.03%
Carr Reference	4	16.9	28	7.6	0.68	0.001	16.91%
G-5	3	16.8	28	7.6	0.51	0.001	16.97%
SG-14	6	16.9	28	7.7	0.83	0.001	13.89%
SG-16	4	16.6	28	7.7	0.56	0.001	14.03%
Day 2 OV					0.00	0.000	#DIV/0!
Control	3	16.4	28	7.8	0.35	0.000	11.53%
Sediment Control	7	17	28	7.8	0.79	0.001	11.30%
Carr Reference	0	17	28	7.8	0.00	0.000	#DIV/0!
G-5	4	16.4	28	7.8	0.46	0.000	11.53%
SG-14	3	16.6	28	7.8	0.34	0.000	11.45%
SG-16	2	16.7	28	7.8	0.23	0.000	11.41%

Bivalve Larval Survival and Development Test **All Matching Labs**

Test Type: Development-Survival **Organism:** Mytilus galloprovincialis (Bay Mussel) **Material:** Total Ammonia
Protocol: EPA/600/R-95/136 (1995) **Endpoint:** Combined Proportion Normal **Source:** Reference Toxicant-REF



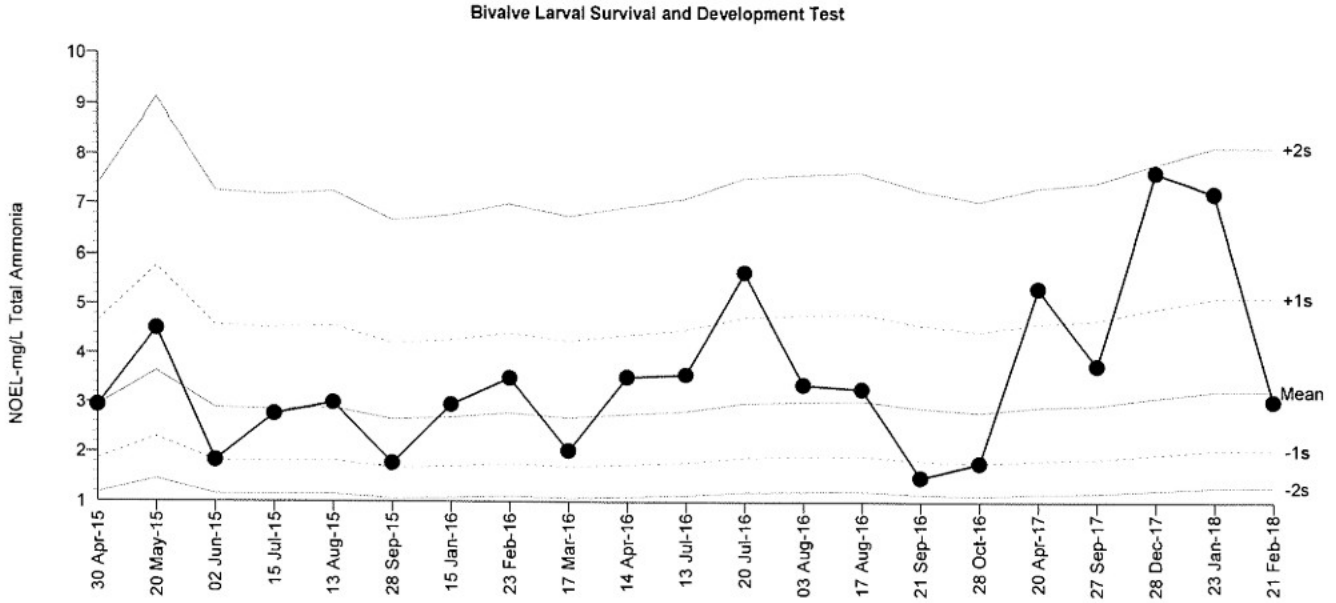
Mean:	5.641	**Count:**	20	**-1s Warning Limit:**	3.978	**-2s Action Limit:**	2.805
Sigma:	n/a	**CV:**	36.00%	**+1s Warning Limit:**	7.999	**+2s Action Limit:**	11.34

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	30	18:04	3.781	-1.86	-1.145	(-)		20-6119-4159	02-4196-3961	ENVIRON
2		May	20	17:25	6.135	0.4941	0.2404			09-2578-9028	09-4770-1274	ENVIRON
3		Jun	2	17:40	3.4	-2.241	-1.449	(-)		17-1514-2545	13-6694-9114	ENVIRON
4		Jul	15	17:28	3.896	-1.744	-1.059	(-)		03-2854-6295	19-5139-2675	ENVIRON
5		Aug	13	17:12	4.263	-1.378	-0.8017			11-0008-2350	17-0708-6345	ENVIRON
6		Sep	28	19:46	9.184	3.543	1.395	(+)		13-4113-2133	05-9076-7384	ENVIRON
7	2016	Jan	15	18:45	6.515	0.8739	0.4124			12-5434-0454	10-0079-7236	ENVIRON
8		Feb	23	17:50	5.292	-0.3488	-0.1828			18-1470-2153	19-1029-0373	ENVIRON
9		Mar	17	19:30	3.757	-1.883	-1.163	(-)		15-5000-9198	13-5264-4225	ENVIRON
10		Apr	14	17:15	6.621	0.9807	0.4589			20-6935-4588	11-5576-6536	ENVIRON
11		Jul	13	19:55	5.147	-0.4936	-0.2622			21-3594-7965	13-9208-2204	ENVIRON
12			20	19:37	6.871	1.23	0.5649			15-8198-2198	11-4931-7833	ENVIRON
13		Aug	3	18:20	4.732	-0.9088	-0.5029			01-0657-3943	18-0523-9298	ENVIRON
14			17	17:05	5.081	-0.5593	-0.2989			12-6418-6345	06-5970-9287	ENVIRON
15		Sep	21	17:05	3.644	-1.997	-1.251	(-)		12-2755-6335	12-7771-4113	ENVIRON
16		Oct	28	16:55	4.947	-0.6936	-0.3756			11-5556-2644	13-8974-7601	ENVIRON
17	2017	Apr	20	17:20	7.867	2.227	0.9526			10-4553-7194	08-5173-1627	EcoAnalysts
18		Sep	27	17:50	9.055	3.414	1.355	(+)		17-5033-2538	21-1690-3737	EcoAnalysts
19		Dec	28	15:06	10.19	4.548	1.693	(+)		14-5351-9068	16-2506-4728	EcoAnalysts
20	2018	Jan	23	15:10	9.255	3.614	1.418	(+)		09-7170-7085	18-2220-1310	EcoAnalysts
21		Feb	21	16:50	5.699	0.05811	0.02934			11-9789-0593	04-0007-2351	EcoAnalysts

Bivalve Larval Survival and Development Test **All Matching Labs**

Test Type: Development-Survival **Organism:** Mytilus galloprovincialis (Bay Mussel) **Material:** Total Ammonia
Protocol: EPA/600/R-95/136 (1995) **Endpoint:** Combined Proportion Normal **Source:** Reference Toxicant-REF



Mean:	3.248	**Count:**	20	**-1s Warning Limit:**	2.051	**-2s Action Limit:**	1.295
Sigma:	n/a	**CV:**	48.50%	**+1s Warning Limit:**	5.147	**+2s Action Limit:**	8.152

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	30	18:04	2.94	-0.3079	-0.2165			20-6119-4159	17-0732-0588	ENVIRON
2		May	20	17:25	4.51	1.262	0.7138			09-2578-9028	13-7558-2393	ENVIRON
3		Jun	2	17:40	1.83	-1.418	-1.247	(-)		17-1514-2545	16-3284-8954	ENVIRON
4		Jul	15	17:28	2.77	-0.4779	-0.3461			03-2854-6295	02-6331-6633	ENVIRON
5		Aug	13	17:12	3	-0.2479	-0.1726			11-0008-2350	11-0317-1423	ENVIRON
6		Sep	28	19:46	1.77	-1.478	-1.32	(-)		13-4113-2133	01-4448-6063	ENVIRON
7	2016	Jan	15	18:45	2.96	-0.2879	-0.2018			12-5434-0454	00-8028-9046	ENVIRON
8		Feb	23	17:50	3.5	0.2521	0.1626			18-1470-2153	12-0892-9662	ENVIRON
9		Mar	17	19:30	2.02	-1.228	-1.033	(-)		15-5000-9198	10-0930-7275	ENVIRON
10		Apr	14	17:15	3.52	0.2721	0.175			20-6935-4588	02-5801-5963	ENVIRON
11		Jul	13	19:55	3.57	0.3221	0.2056			21-3594-7965	00-8086-5441	ENVIRON
12			20	19:37	5.65	2.402	1.204	(+)		15-8198-2198	15-7963-0031	ENVIRON
13		Aug	3	18:20	3.37	0.1221	0.08026			01-0657-3943	18-2881-4415	ENVIRON
14			17	17:05	3.28	0.03213	0.0214			12-6418-6345	16-7479-3581	ENVIRON
15		Sep	21	17:05	1.49	-1.758	-1.694	(-)		12-2755-6335	04-9221-3739	ENVIRON
16		Oct	28	16:55	1.78	-1.468	-1.308	(-)		11-5556-2644	02-1682-8136	ENVIRON
17	2017	Apr	20	17:20	5.33	2.082	1.077	(+)		10-4553-7194	12-0068-9010	EcoAnalysts
18		Sep	27	17:50	3.76	0.5121	0.3184			17-5033-2538	01-8974-4211	EcoAnalysts
19		Dec	28	15:06	7.64	4.392	1.86	(+)		14-5351-9068	19-5965-2391	EcoAnalysts
20	2018	Jan	23	15:10	7.23	3.982	1.74	(+)		09-7170-7085	00-5532-1927	EcoAnalysts
21		Feb	21	16:50	3.04	-0.2079	-0.1438			11-9789-0593	12-8443-3147	EcoAnalysts

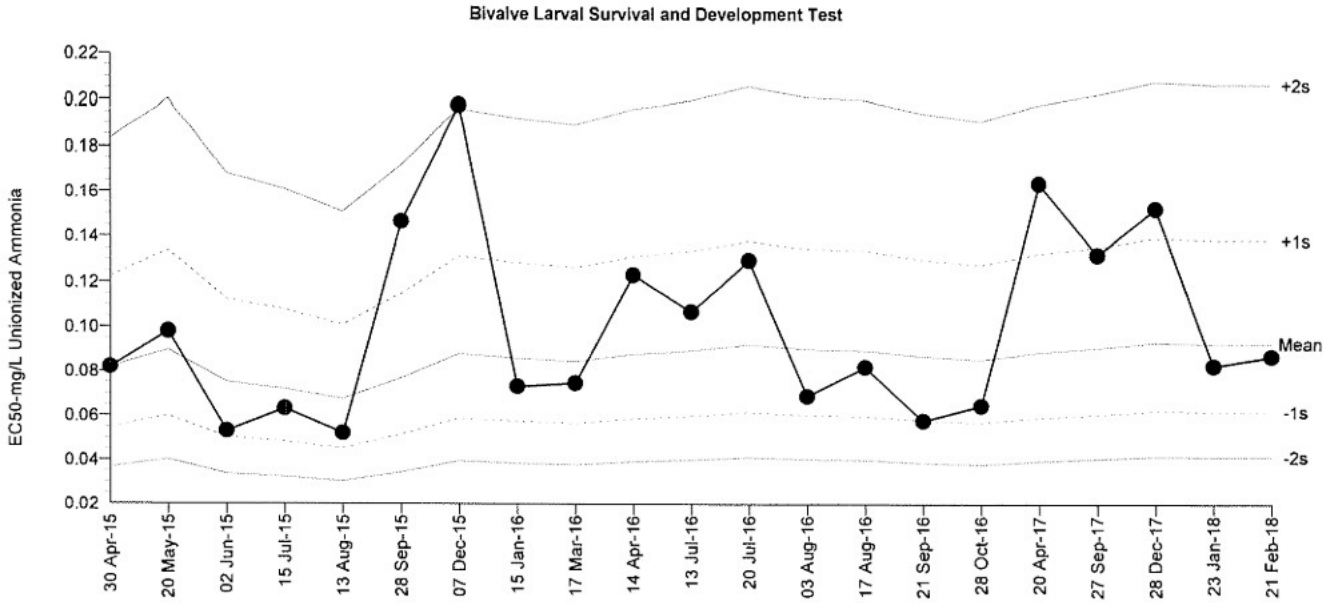
CETIS QC Plot

Report Date: 21 Mar-18 11:55 (1 of 1)

Bivalve Larval Survival and Development Test

All Matching Labs

Test Type: Development-Survival **Organism:** Mytilus galloprovincialis (Bay Mussel) **Material:** Unionized Ammonia
Protocol: EPA/600/R-95/136 (1995) **Endpoint:** Combined Proportion Normal **Source:** Reference Toxicant-REF



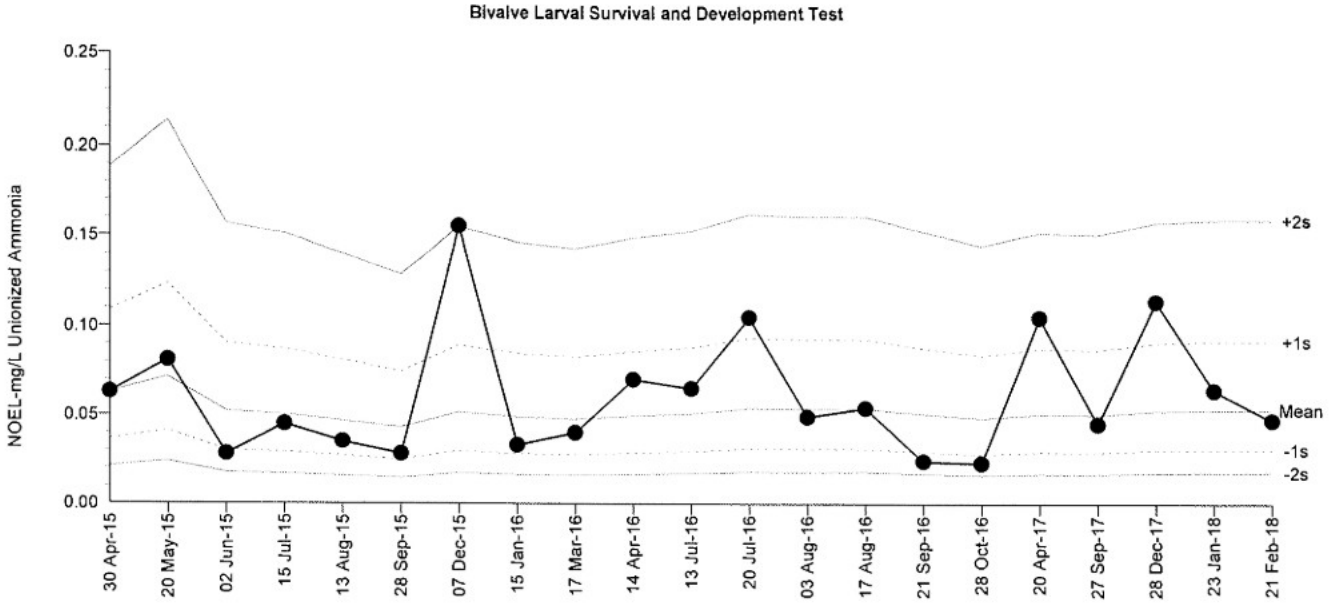
Mean:	0.09255	**Count:**	20	**-1s Warning Limit:**	0.06191	**-2s Action Limit:**	0.0414
Sigma:	n/a	**CV:**	41.90%	**+1s Warning Limit:**	0.1384	**+2s Action Limit:**	0.207

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	30	18:04	0.08192	-0.01063	-0.3034			03-9240-3383	09-4512-5047	ENVIRON
2		May	20	17:25	0.09802	0.005466	0.1426			02-2718-1762	05-2499-4463	ENVIRON
3		Jun	2	17:40	0.05293	-0.03962	-1.389	(-)		05-0395-8879	02-8689-2030	ENVIRON
4		Jul	15	17:28	0.06313	-0.02942	-0.9509			00-2296-0969	17-0196-9853	ENVIRON
5		Aug	13	17:12	0.05202	-0.04053	-1.432	(-)		20-0843-4308	07-3272-8799	ENVIRON
6		Sep	28	19:46	0.1464	0.05381	1.139	(+)		14-0799-9245	10-1527-0979	ENVIRON
7		Dec	7	18:00	0.1977	0.1052	1.887	(+)		14-1153-0185	08-9940-5879	ENVIRON
8	2016	Jan	15	18:45	0.07307	-0.01948	-0.5874			14-3705-6085	19-2478-0688	ENVIRON
9		Mar	17	19:30	0.0747	-0.01785	-0.5325			04-9304-7933	11-8311-5806	ENVIRON
10		Apr	14	17:15	0.1231	0.03056	0.7093			21-0694-5716	16-1625-7449	ENVIRON
11		Jul	13	19:55	0.1066	0.01408	0.352			17-3624-8523	09-8766-4801	ENVIRON
12			20	19:37	0.1295	0.03699	0.8358			16-4492-6137	18-6316-6428	ENVIRON
13		Aug	3	18:20	0.0688	-0.02375	-0.7371			09-2291-5121	03-3596-0456	ENVIRON
14			17	17:05	0.08185	-0.0107	-0.3053			07-3188-3147	05-9364-3209	ENVIRON
15		Sep	21	17:05	0.05781	-0.03474	-1.17	(-)		12-6262-3928	08-6003-5732	ENVIRON
16		Oct	28	16:55	0.06459	-0.02796	-0.8942			05-5636-6924	16-1083-2604	ENVIRON
17	2017	Apr	20	17:20	0.1634	0.07082	1.413	(+)		05-0815-7437	21-2956-9302	EcoAnalysts
18		Sep	27	17:50	0.1319	0.03938	0.8813			20-9743-5500	21-3701-9130	EcoAnalysts
19		Dec	28	15:06	0.1522	0.05963	1.236	(+)		11-9837-6366	14-7670-9371	EcoAnalysts
20	2018	Jan	23	15:10	0.08248	-0.01007	-0.2863			14-9653-2794	09-5264-1795	EcoAnalysts
21		Feb	21	16:50	0.08676	-0.005787	-0.1605			15-2546-6673	13-8547-7245	EcoAnalysts

Bivalve Larval Survival and Development Test — **All Matching Labs**

Test Type:	Development-Survival	**Organism:**	Mytilus galloprovincialis (Bay Mussel)	**Material:**	Unionized Ammonia
Protocol:	EPA/600/R-95/136 (1995)	**Endpoint:**	Combined Proportion Normal	**Source:**	Reference Toxicant-REF



Mean:	0.05302	**Count:**	20	**-1s Warning Limit:**	0.03065	**-2s Action Limit:**	0.01771
Sigma:	n/a	**CV:**	59.20%	**+1s Warning Limit:**	0.09177	**+2s Action Limit:**	0.1588

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	30	18:04	0.063	0.009975	0.3144			03-9240-3383	00-2807-5882	ENVIRON
2		May	20	17:25	0.081	0.02798	0.7727			02-2718-1762	04-5934-5151	ENVIRON
3		Jun	2	17:40	0.028	-0.02502	-1.165	(-)		05-0395-8879	14-7577-7111	ENVIRON
4		Jul	15	17:28	0.045	-0.008025	-0.2993			00-2296-0969	19-0657-0188	ENVIRON
5		Aug	13	17:12	0.035	-0.01802	-0.7576			20-0843-4308	02-2615-4019	ENVIRON
6		Sep	28	19:46	0.028	-0.02502	-1.165	(-)		14-0799-9245	09-3291-9362	ENVIRON
7		Dec	7	18:00	0.155	0.102	1.956	(+)		14-1153-0185	11-3892-1501	ENVIRON
8	2016	Jan	15	18:45	0.033	-0.02002	-0.8649			14-3705-6085	10-1556-6538	ENVIRON
9		Mar	17	19:30	0.04	-0.01302	-0.5141			04-9304-7933	18-2075-7796	ENVIRON
10		Apr	14	17:15	0.07	0.01698	0.5065			21-0694-5716	12-4502-8479	ENVIRON
11		Jul	13	19:55	0.065	0.01198	0.3714			17-3624-8523	04-6243-8640	ENVIRON
12			20	19:37	0.105	0.05198	1.246	(+)		16-4492-6137	18-5505-5894	ENVIRON
13		Aug	3	18:20	0.049	-0.004025	-0.144			09-2291-5121	05-1896-5100	ENVIRON
14			17	17:05	0.054	0.0009754	0.03325			07-3188-3147	16-9734-3329	ENVIRON
15		Sep	21	17:05	0.024	-0.02902	-1.446	(-)		12-6262-3928	13-9034-6853	ENVIRON
16		Oct	28	16:55	0.023	-0.03002	-1.523	(-)		05-5636-6924	02-7414-4116	ENVIRON
17	2017	Apr	20	17:20	0.105	0.05198	1.246	(+)		05-0815-7437	03-4135-8920	EcoAnalysts
18		Sep	27	17:50	0.045	-0.008025	-0.2993			20-9743-5500	07-1720-0800	EcoAnalysts
19		Dec	28	15:06	0.114	0.06098	1.396	(+)		11-9837-6366	06-0841-7631	EcoAnalysts
20	2018	Jan	23	15:10	0.064	0.01098	0.3431			14-9653-2794	04-0773-5227	EcoAnalysts
21		Feb	21	16:50	0.047	-0.006025	-0.22			15-2546-6673	21-3476-8661	EcoAnalysts

CETIS Summary Report

Bivalve Larval Survival and Development Test — **EcoAnalysts**

Batch ID:	04-4179-8159	**Test Type:**	Development-Survival	**Analyst:**		
Start Date:	21 Feb-18 16:50	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Laboratory Seawater	
Ending Date:	23 Feb-18 16:20	**Species:**	Mytilus galloprovincialis	**Brine:**	Crystal Sea Marine Mix	
Test Length:	47h	**Taxon:**		**Source:**	Taylor Shellfish	**Age:**
Sample ID:	06-0235-7670	**Code:**	23E73FA6	**Project:**	Reference Toxicant	
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Source:**	Reference Toxicant	
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.66	
Sample Age:	282d 17h	**Client:**	Internal Lab			

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
12-8443-3147	Combined Proportion Norma	Dunnett Multiple Comparison Test		3.04	6.94	4.593		22.7%	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
04-0007-2351	Combined Proportion Norma	Spearman-Kärber		EC50	5.699	5.539	5.863		1

Test Acceptability

				TAC Limits				
Analysis ID	Endpoint	Attribute	Test Stat	Lower	Upper	Overlap	Decision	
12-8443-3147	Combined Proportion Norma	PMSD	0.2271	<<	0.25	No	Passes Criteria	

Combined Proportion Normal Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	0.8946	0.7946	0.9947	0.8488	0.9244	0.0233	0.0403	4.50%	0.00%
0.532		3	0.9198	0.7219	1.0000	0.8351	0.9931	0.0460	0.0797	8.66%	-2.82%
1.46		3	0.9233	0.7537	1.0000	0.8694	1.0000	0.0394	0.0682	7.39%	-3.20%
3.04		3	0.8351	0.8125	0.8576	0.8282	0.8454	0.0052	0.0091	1.09%	6.66%
6.94		3	0.3471	0.0404	0.6538	0.2062	0.4364	0.0713	0.1235	35.57%	61.20%
13.4		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%
19		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Combined Proportion Normal Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	0.9107	0.8488	0.9244
0.532		0.9931	0.8351	0.9313
1.46		0.9003	0.8694	1.0000
3.04		0.8316	0.8282	0.8454
6.94		0.2062	0.3986	0.4364
13.4		0.0000	0.0000	0.0000
19		0.0000	0.0000	0.0000

Combined Proportion Normal Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	265/291	247/291	269/291
0.532		289/291	243/291	271/291
1.46		262/291	253/291	298/298
3.04		242/291	241/291	246/291
6.94		60/291	116/291	127/291
13.4		0/291	0/291	0/291
19		0/291	0/291	0/291

CETIS Test Data Worksheet

Bivalve Larval Survival and Development Test — **EcoAnalysts**

Start Date:	21 Feb-18 16:50	**Species:**	Mytilus galloprovincialis	**Sample Code:**	23E73FA6
End Date:	23 Feb-18 16:20	**Protocol:**	EPA/600/R-95/136 (1995)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Sample Station:**	P170515.66

Conc-mg/L	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	D	1	15	291	271	271	265	
0	D	2	5	291	252	252	247	
0	D	3	20	291	276	276	269	
0.532		1	19	291	294	294	289	
0.532		2	11	291	247	247	243	
0.532		3	8	291	282	282	271	
1.46		1	18	291	269	269	262	
1.46		2	14	291	257	257	253	
1.46		3	7	291	307	307	298	
3.04		1	6	291	251	251	242	
3.04		2	17	291	247	247	241	
3.04		3	16	291	256	256	246	
6.94		1	21	291	240	240	60	
6.94		2	9	291	226	226	116	
6.94		3	4	291	275	275	127	
13.4		1	1	291	277	277	0	
13.4		2	12	291	259	259	0	
13.4		3	3	291	266	266	0	
19		1	13	291	265	265	0	
19		2	2	291	240	240	0	
19		3	10	291	274	274	0	

CETIS Summary Report

Test Code/ID: 5AECC631 / 15-2546-6673

Bivalve Larval Survival and Development Test

EcoAnalysts

Batch ID:	10-7484-8978	**Test Type:**	Development-Survival	**Analyst:**			
Start Date:	21 Feb-18 16:50	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Laboratory Seawater		
Ending Date:	23 Feb-18 16:20	**Species:**	Mytilus galloprovincialis	**Brine:**	Crystal Sea Marine Mix		
Test Length:	47h	**Taxon:**		**Source:**	Taylor Shellfish	**Age:**	
Sample ID:	13-9721-8045	**Code:**	5347DAFD	**Project:**	Reference Toxicant		
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Source:**	Reference Toxicant		
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.66		
Sample Age:	282d 17h	**Client:**	Internal Lab				

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
21-3476-8661	Combined Proportion Norma	Dunnett Multiple Comparison Test		0.047	0.106	0.07058		22.7%	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
13-8547-7245	Combined Proportion Norma	Spearman-Kärber		EC50	0.08676	0.08424	0.08937		1

Test Acceptability

				TAC Limits			
Analysis ID	Endpoint	Attribute	Test Stat	Lower	Upper	Overlap	Decision
21-3476-8661	Combined Proportion Norma	PMSD	0.2271	<<	0.25	No	Passes Criteria

Combined Proportion Normal Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	0.8946	0.7946	0.9947	0.8488	0.9244	0.0233	0.0403	4.50%	0.00%
0.006		3	0.9198	0.7219	1.0000	0.8351	0.9931	0.0460	0.0797	8.66%	-2.82%
0.018		3	0.9233	0.7537	1.0000	0.8694	1.0000	0.0394	0.0682	7.39%	-3.20%
0.047		3	0.8351	0.8125	0.8576	0.8282	0.8454	0.0052	0.0091	1.09%	6.66%
0.106		3	0.3471	0.0404	0.6538	0.2062	0.4364	0.0713	0.1235	35.57%	61.20%
0.207		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%
0.233		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Combined Proportion Normal Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	0.9107	0.8488	0.9244
0.006		0.9931	0.8351	0.9313
0.018		0.9003	0.8694	1.0000
0.047		0.8316	0.8282	0.8454
0.106		0.2062	0.3986	0.4364
0.207		0.0000	0.0000	0.0000
0.233		0.0000	0.0000	0.0000

Combined Proportion Normal Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	265/291	247/291	269/291
0.006		289/291	243/291	271/291
0.018		262/291	253/291	298/298
0.047		242/291	241/291	246/291
0.106		60/291	116/291	127/291
0.207		0/291	0/291	0/291
0.233		0/291	0/291	0/291

CETIS Test Data Worksheet

Bivalve Larval Survival and Development Test — EcoAnalysts

Start Date:	21 Feb-18 16:50	**Species:**	Mytilus galloprovincialis
End Date:	23 Feb-18 16:20	**Protocol:**	EPA/600/R-95/136 (1995)
Sample Date:	15 May-17	**Material:**	Unionized Ammonia
Sample Code:	5347DAFD		
Sample Source:	Reference Toxicant		
Sample Station:	P170515.66		

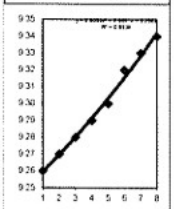
Conc-mg/L	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	D	1	18	291	271	271	265	
0	D	2	12	291	252	252	247	
0	D	3	21	291	276	276	269	
0.006		1	15	291	294	294	289	
0.006		2	13	291	247	247	243	
0.006		3	3	291	282	282	271	
0.018		1	1	291	269	269	262	
0.018		2	8	291	257	257	253	
0.018		3	9	291	307	307	298	
0.047		1	14	291	251	251	242	
0.047		2	17	291	247	247	241	
0.047		3	20	291	256	256	246	
0.106		1	11	291	240	240	60	
0.106		2	19	291	226	226	116	
0.106		3	16	291	275	275	127	
0.207		1	4	291	277	277	0	
0.207		2	10	291	259	259	0	
0.207		3	5	291	266	266	0	
0.233		1	2	291	265	265	0	
0.233		2	7	291	240	240	0	
0.233		3	6	291	274	274	0	

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	21-Feb-18
PROJECT:	Reference Toxicant	Test Type:	*Mytilus*
COMMENTS:	P170515.66		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	I-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	0		0.000	28	7.7	16.0	289.16	9.3187		
3	0.75		0.532	28	7.7	15.9	289.06	9.3187		0.006
4	1.5		1.460	28	7.7	15.9	289.06	9.3187		0.018
5	3		3.040	28	7.8	15.9	289.06	9.3187		0.047
6	6		6.940	28	7.8	15.9	289.06	9.3187		0.106
7	12		13.400	28	7.8	16.0	289.16	9.3187		0.207
8	18		19.000	28	7.7	16.0	289.16	9.3187		0.233
9										
10										
11										
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16										
17										
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48 Hour Bivalve Development Reference Toxicant Test

Test ID: PTRS15.66	Replicates: 3	Study Director: B. Hester	Location: Bath 4
Dilution Water Batch: FSW022118.01	Organism Batch: TS2589	Associated Test(s):	Organism: Mytilus sp.
Chamber Size/Type: 30 ml shell vial	Exposure Volume: 10 ml		
Toxicant: Ammonium Chloride:	Lot #: 29866510	Date Prepared: 2/21/18	Initials: LB
Target Concentrations: **See spiking worksheet**		Quantity of Stock: Target: See spiking worksheet	Quantity of Diluent: Target: 200 mL
See spiking worksheet		Actual: See spiking worksheet	Actual: ↓

0 Hours Date: 2/21/18 WQ Time: 1524 BH STOCK Start Time: 1650 Initials: LB, BH

	Control	0.75	1.5	3	6	12	18
D.O. (%) (>5.0 mg/L)	8.7	8.7	8.7	8.8	8.8	8.8	8.8
Temperature (16 ± 1°C)	16.0	15.9	15.9	15.9	15.9	16.0	16.0
Salinity (28 ± 1 ppt)	28	28	28	28	28	28	28
pH (7.8 ± 0.5)	7.7	7.7	7.7	7.8	7.8	7.8	7.7

Day 1 Temperature (16 ± 1°C) 15.4 MG, JL 2/22

Final Day Date: 2/23/18 WQ Time: 1210 JL STOCK End Time: 1620 Initials: JL

	Control	0.75	1.5	3	6	12	18
D.O. (%) (>5.0 mg/L)	8.5	8.4	8.4	8.4	8.4	8.4	8.4
Temperature (16 ± 1°C)	15.4	15.4	15.4	15.4	15.4	15.5	15.5
Salinity (28 ± 1 ppt)	28	28	28	28	28	28	28
pH (7.8 ± 0.5)	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Notes:

48 Hour Bivalve Development Reference Toxicant Test

Conc.	Rep	Number Normal	Number Abnormal	Date	Initials
Control	1	265	6	2/26/18	BG
	2	247	5		
	3	269	7		
0.75	1	289	5		
	2	243	4		
	3	271	11		
1.5	1	262	7		
	2	253	4		
	3	298	9		
3	1	242	9		
	2	241	6		
	3	246	10		
6	1	60	180		
	2	116	110		
	3	127	148		
12	1	0	277		
	2	0	259		
	3	0	266		
18	1	0	265		
	2	0	240		
	3	0	274		

Stocking Density

Rep	Count	Init.
1	295	UB
2	272	
3	306	
Mean:	291	

QA Count Checks:			
#1 conc/rep Rep 1 0	#2 conc/rep Rep 2 12	#3 conc/rep Rep 3 3	#4 conc/rep Rep 1 18
# normal 263 # abnormal 9	# normal 0 # abnormal 269	# normal 290 # abnormal 8	# normal 0 # abnormal 267
Tech. Init. UB	Tech. Init. UB	Tech. Init. UB	Tech. Init. UB
Calc. $\frac{9}{272} = 3.3\%$ $\frac{6}{271} = 2.2\%$ <5%	$\frac{0}{269} = 0\%$ $\frac{0}{259} = 0\%$ no diff.	$\frac{10}{256} = 3.9\%$ $\frac{8}{258} = 3.1\%$ <5%	$\frac{0}{267} = 0\%$ $\frac{0}{265} = 0\%$ no diff.

QA Check Acceptability: ☑ <5% difference in means of QA & orig. counts

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170515.66
Date Prepared: 2/21/18
Technician Initials: WB

Biv / Echino NH_3 RT

Assumptions in Model
Stock ammonia concentration is 9,000 mg/L = 9 mg/mL

Date: 1/23/2018
Measurement: 9676.66

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			[redacted]	SALT WATER
0.532	**0.75**	200		**0.023**
1.46	**1.5**	200		**0.047**
3.04	**3**	200		**0.093**
6.94	**6**	200		**0.186**
13.4	**12**	200		**0.372**
19.0	**18**	200		**0.558**

ORGANISM RECEIPT LOG

Date:	Time:	Batch No.
12.29.17	1216	TS 2589

Organism: Mytilus galloprovincialis

Source / Supplier: Taylor shellfish

No. Ordered:	No. Received:	Source Batch: Collection date, hatch date, etc.):
8lbs	8lbs	0 12/27/17 harvest Totten Inlet

Condition of Organisms:	Approximate Size or Age: (Days from hatch, life stage, size class, etc.):
Good	Adult
Shipper: FedEx	**B of L (Tracking No.)** 7891 4567 2589
Condition of Container: Good	**Received By:** BH

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
1	—	9.6	—	—	—	—	BH

*if >10% contact lab manager

Notes: shipped dry

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath I

Batch Number: TS 2589	Date Received: 12.29.17	Initial # of Organisms: —

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
1.7.18		X	1	8.3	9.6	31	7.8	FT	Y	1	—	BH	
↓		X	2	8.3	9.9	31	7.8	FT	Y	0	—	BH	
1/08	X		1	8.0	11.6	30	7.8	FT	Y	0	—	UL	
↓	X		2	8.3	12.0	30	7.8	↓	↓	0	—	↓	
1/09		✓	1	8.1	11.8	29	7.8	FT	Y	0	—	UL	
↓		✓	2	8.3	12.3	29	7.8	↓	↓	0	—	↓	
1/10		✓	1	8.1	11.8	29	7.7	FT	Y	0	—	UB	
↓		✓	2	8.5	12.1	29	7.8	↓	↓	0	—	↓	
1/11		✓	1	—	—	—	—	↓	Y	0	—	UL	
↓		✓	2	—	—	—	—	↓	↓	0	—	↓	
1/12	✓		1	8.1	11.7	29	7.8	FT	Y	0	—	UL	
↓	✓		2	8.5	12.2	29	7.9	↓	↓	0	—	↓	
1/14		✓	1	8.2	12.1	29	7.8	FT	Y	0	—	CR	
↓		✓	2	8.2	12.1	29	7.8	↓	↓	0	—	CR	
1/15			1	8.2	11.	30	7.7	FT	Y	0	—	UL	
↓			2	8.3	12.0	30	7.8	↓	↓	0	—	↓	
1/17	✓		1	8.0	11.9	30	7.8	FT	Y	0	—	UB	
↓	✓		2	8.2	12.1	30	7.8	↓	↓	0	—	↓	

FT = Flow-through
**if >10% notify lab manager*

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath 1

Batch Number: TS2589	Date Received: 12.29.17	Initial # of Organisms: ~

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ (Sal) ppt	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2018 1/19		✓	1	7.5	11.7	30	7.7	FT	Y			UB	
↓		✓	2	8.3	12.0	30	7.8	↓	Y	0	—	↓	
1.21		✓	1	7.9	11.9	30	7.7	FT	Y	0	—	BH	
↓		✓	2	8.2	11.8	30	7.8	FT	Y	0	—	BH	
1/22/18	✓		1	8.0	12.6	30	7.8	FT	Y	0	—	BG	
↓	~		2	6.8	12.6	29	7.5	FT	Y	0	—	BG	
1/24		✓	1	8.1	11.6	30	7.7	FT	Y	0	—	UB	
↓		✓	2	8.2	11.9	31	7.7	FT	Y	0	—	UB	
~~1/25~~ (1)		✓	1	8.4	12.0	28	7.7	FT	Y	0	—	UB	
↓		✓	2	8.1	12.3	29	7.8	FT	Y	0	—	UB	
1/29			2	8.0	12.5	29	7.7	FT	Y	0	-	BG	
↓			1	7.8	11.8	29	7.7	FT	Y	1	—	BG	est ~ 100 mussels => 10% mort
1/31		✓	1	8.2	11.6	29	7.8	FT	Y	0	—	UB	
↓		✓	2	8.2	12.4	29	7.8	FT	Y	0	—	UB	
2/2	✓		1	7.5	11.9	29	7.7	FT	Y			UB	
↓	✓		2	8.0	12.5	29	7.7	FT	Y	0	—	[illegible]	
2/05	✓		1	8.2	11.4	29	7.7	FT	Y			Y	
↓	✓		2	8.2	12.1	29	7.7	↓	↓	0	—	↓	

FT = Flow-through
if >10% notify lab manager

(1) 1/26 UB

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath 1

Batch Number: TS2589	Date Received: 12.29.17	Initial # of Organisms: —

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/7/18		✓	1	8.0	11.6	29	7.7	FT	Y	1	—	UB	
↓		✓	2	7.9	12.5	29	7.7	↓	Y	0	—	↓	
2/9/18	✓		1	7.8	11.8	27	7.8	FT	Y	0	—	UB	
↓	✓		2	7.6	12.4	28	7.8	↓	Y	0	—	↓	
2/12		✓	1	8.5	11.7	28	7.7	FT	Y	1	—	JL	
↓		✓	2	8.5	12.1	28	7.7	↓	↓	0	—	↓	
2/14	✓		1	8.3	11.2	29	8.3	FT	Y		—	JL	
↓	✓		2	8.4	11.3	29	8.2	↓	↓		—	↓	
2/16	✓		1	8.2	11.4	29	7.8	FT	Y	0	—	UB	
↓	✓		2	8.4	11.4	29	8.1	↓	Y	0	—	↓	
2/19	✓		1	8.7	11.4	28	7.6	FT	Y	①~~0~~ 2	—	JL	
↓	✓		2	8.7	11.8	28	7.6	↓	↓	0	—	↓	
2/24	—		1	7.9	11.4	29	7.7	FT	Y	0	—	UB	
↓	—		2	8.3	11.9	29	7.8	↓	↓	0	—	↓	
2/28	✓		1	7.7	11.7	29	7.5	FT	Y	0	—	UB	
↓	✓		2	8.3	12.3	29	7.7	↓	↓	0	—	UB	
3/7	✓		1 ②	8.3	11.6	30	7.8	FT	Y	0	—	UB	
3/9	✓		1	8.4	12.1	30	7.9	FT	Y	0	—	UB	

FT = Flow-through
if >10% notify lab manager

① IEJL 2/19/18
② Tub ② not present, UB 3/7

APPENDIX B. STATISTICAL COMPARISONS

Statistical Results: *Eohaustorius estuarius* Test

Constant	Value
Experiment Date	2/23/2018
Client	Landau
Project	Tru-Grit
Project Number	PG1103
Experimenter	EcoAnalysts
Protocol	Eohaustorius estuarius 10-d Survival

	Group A	Group B	Group C	Group D	Group E
	Control	Carr Reference	G-5	SG-14	SG-16
	Y	Y	Y	Y	Y
1	0	5	10	0	30
2	0	0	20	10	25
3	0	0	20	40	15
4	0	10	15	15	35
5	5	0	30	25	10

Transform	A	B	C	D	E
	Control	Carr Reference	G-5	SG-14	SG-16
	Y	Y	Y	Y	Y
1	0.000	0.226	0.322	0.000	0.580
2	0.000	0.000	0.464	0.322	0.524
3	0.000	0.000	0.464	0.685	0.398
4	0.000	0.322	0.398	0.398	0.633
5	0.226	0.000	0.580	0.524	0.322

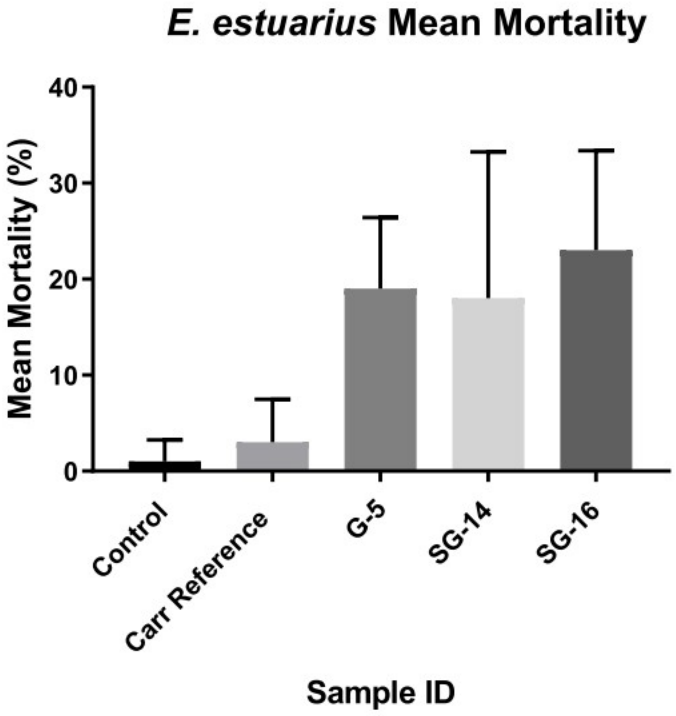
	1way ANOVA ANOVA		
1	Table Analyzed	Transform of Data 1	
2	Data sets analyzed	A : Control	B : Carr Reference
3			
4	ANOVA summary		
5	F	8.318	
6	P value	0.0004	
7	P value summary	***	
8	Significant diff. among means (P < 0.05)?	Yes	
9	R square	0.6246	
10			
11	Brown-Forsythe test		
12	F (DFn, DFd)	0.9209 (4, 20)	
13	P value	0.4713	
14	P value summary	ns	
15	Are SDs significantly different (P < 0.05)?	No	
16			
17	Bartlett's test		
18	Bartlett's statistic (corrected)	5.133	
19	P value	0.2740	
20	P value summary	ns	
21	Are SDs significantly different (P < 0.05)?	No	
22			
23	ANOVA table	SS	DF
24	Treatment (between columns)	0.8307	4
25	Residual (within columns)	0.4993	20
26	Total	1.33	24
27			
28	Data summary		
29	Number of treatments (columns)	5	
30	Number of values (total)	25	

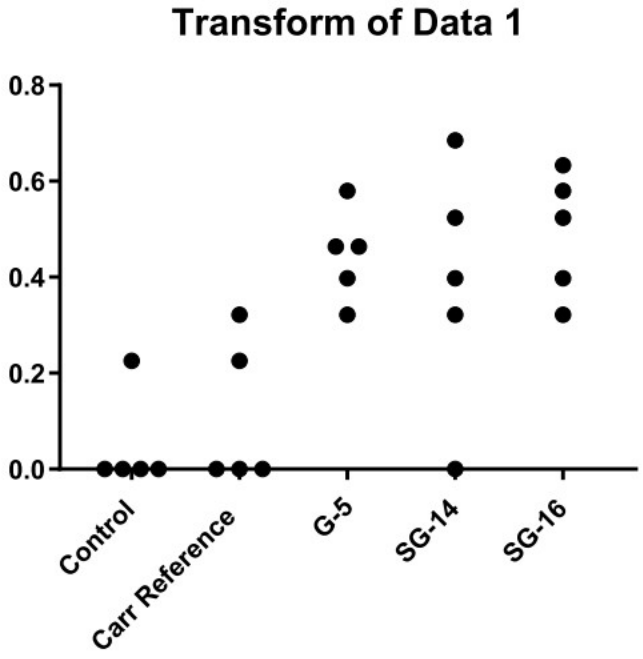
1			
2	C : G-5	D : SG-14	E : SG-16
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	MS	F (DFn, DFd)	P value
24	0.2077	F (4, 20) = 8.318	P=0.0004
25	0.02496		
26			
27			
28			
29			
30			

	1way ANOVA Multiple comparisons				
1	Number of families	1			
2	Number of comparisons per family	4			
3	Alpha	0.05			
4					
5	Holm-Sidak's multiple comparisons test	Mean Diff.	Significant?	Summary	Adjusted P Value
6					
7	Carr Reference vs. Control	0.06435	No	ns	0.5269
8	Carr Reference vs. G-5	-0.3358	Yes	**	0.0093
9	Carr Reference vs. SG-14	-0.2761	Yes	*	0.0239
10	Carr Reference vs. SG-16	-0.3817	Yes	**	0.0043
11					
12					
13	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.
14					
15	Carr Reference vs. Control	0.1095	0.0451	0.06435	0.09993
16	Carr Reference vs. G-5	0.1095	0.4453	-0.3358	0.09993
17	Carr Reference vs. SG-14	0.1095	0.3856	-0.2761	0.09993
18	Carr Reference vs. SG-16	0.1095	0.4911	-0.3817	0.09993

1				
2				
3				
4				
5	B-?			
6				
7	A	Control		
8	C	G-5		
9	D	SG-14		
10	E	SG-16		
11				
12				
13	n1	n2	t	DF
14				
15	5	5	0.644	20
16	5	5	3.361	20
17	5	5	2.763	20
18	5	5	3.82	20

1way ANOVA Descriptive Statistics		Control	Carr Reference	G-5	SG-14	SG-16
1	Number of values	5	5	5	5	5
2						
3	Minimum	0	0	0.3218	0	0.3218
4	25% Percentile	0	0	0.3597	0.1609	0.3597
5	Median	0	0	0.4636	0.3977	0.5236
6	75% Percentile	0.1128	0.2736	0.5216	0.6042	0.6063
7	Maximum	0.2255	0.3218	0.5796	0.6847	0.6331
8						
9	Mean	0.0451	0.1095	0.4453	0.3856	0.4911
10	Std. Deviation	0.1009	0.1537	0.0952	0.2556	0.1289
11	Std. Error of Mean	0.0451	0.06873	0.04257	0.1143	0.05764
12						
13	Lower 95% CI	-0.08012	-0.08138	0.3271	0.06812	0.3311
14	Upper 95% CI	0.1703	0.3003	0.5635	0.703	0.6512


E. estuarius Mean Mortality
Mean Mortality (%)
40
30
20
10
0
Control
Carr Reference
G-5
SG-14
SG-16
Sample ID


Transform of Data 1
0.8
0.6
0.4
0.2
0.0
Control
Carr Reference
G-5
SG-14
SG-16

Statistical Results: *Neanthes arenaceodentata* Test

Constant	Value
Experiment Date	2/23/2017
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (Dry Weight)

	Group A	Group B	Group C	Group D	Group E
	Control	Carr Reference	G-5	SG-14	SG-16
	Y	Y	Y	Y	Y
1	0.678	0.827	0.540	0.768	0.711
2	0.960	0.601	0.788	0.854	0.848
3	0.569	0.682	0.653	0.776	0.753
4	0.712	0.674	0.689	0.788	0.758
5	0.916	0.604	0.576	0.758	0.658

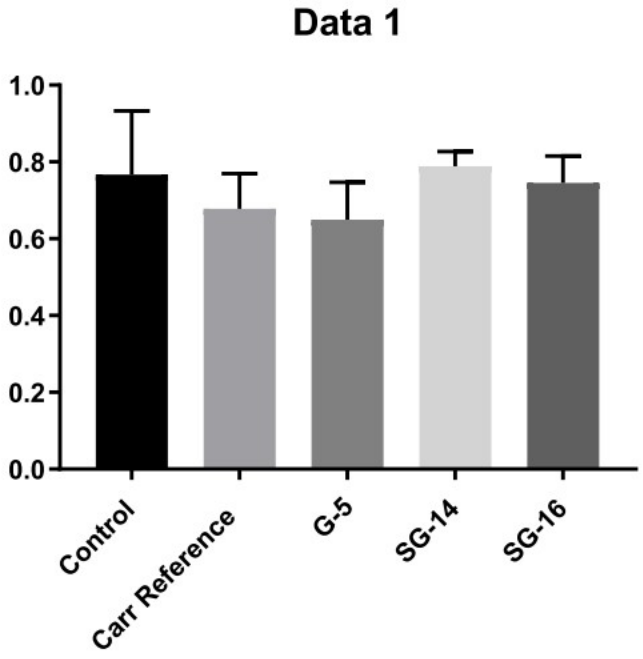
1way ANOVA ANOVA				
1	Table Analyzed	Data 1		
2	Data sets analyzed	A : Control	B : Carr Reference	C : G-5	D : SG-14
3					
4	ANOVA summary				
5	F	1.723			
6	P value	0.1844			
7	P value summary	ns			
8	Significant diff. among means (P < 0.05)?	No			
9	R square	0.2563			
10					
11	Brown-Forsythe test				
12	F (DFn, DFd)	1.702 (4, 20)			
13	P value	0.1892			
14	P value summary	ns			
15	Are SDs significantly different (P < 0.05)?	No			
16					
17	Bartlett's test				
18	Bartlett's statistic (corrected)	7.365			
19	P value	0.1178			
20	P value summary	ns			
21	Are SDs significantly different (P < 0.05)?	No			
22					
23	ANOVA table	SS	DF	MS	F (DFn, DFd)
24	Treatment (between columns)	0.07125	4	0.01781	F (4, 20) = 1.723
25	Residual (within columns)	0.2067	20	0.01034	
26	Total	0.278	24		
27					
28	Data summary				
29	Number of treatments (columns)	5			
30	Number of values (total)	25			

1	
2	E : SG-16
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	P value
24	P=0.1844
25	
26	
27	
28	
29	
30	

	1way ANOVA Multiple comparisons					
1	Number of families	1				
2	Number of comparisons per family	4				
3	Alpha	0.05				
4						
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value
6						
7	Carr Reference vs. Control	-0.0894	-0.2653 to 0.08651	No	ns	0.5473
8	Carr Reference vs. G-5	0.0284	-0.1475 to 0.2043	No	ns	0.9872
9	Carr Reference vs. SG-14	-0.1112	-0.2871 to 0.06471	No	ns	0.3414
10	Carr Reference vs. SG-16	-0.068	-0.2439 to 0.1079	No	ns	0.7638
11						
12						
13	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	n1
14						
15	Carr Reference vs. Control	0.6776	0.767	-0.0894	0.0643	5
16	Carr Reference vs. G-5	0.6776	0.6492	0.0284	0.0643	5
17	Carr Reference vs. SG-14	0.6776	0.7888	-0.1112	0.0643	5
18	Carr Reference vs. SG-16	0.6776	0.7456	-0.068	0.0643	5

1			
2			
3			
4			
5	B-?		
6			
7	A	Control	
8	C	G-5	
9	D	SG-14	
10	E	SG-16	
11			
12			
13	n2	t	DF
14			
15	5	1.39	20
16	5	0.4417	20
17	5	1.729	20
18	5	1.057	20

1way ANOVA Descriptive Statistics		Control	Carr Reference	G-5	SG-14	SG-16
1	Number of values	5	5	5	5	5
2						
3	Minimum	0.569	0.601	0.54	0.758	0.658
4	25% Percentile	0.6235	0.6025	0.558	0.763	0.6845
5	Median	0.712	0.674	0.653	0.776	0.753
6	75% Percentile	0.938	0.7545	0.7385	0.821	0.803
7	Maximum	0.96	0.827	0.788	0.854	0.848
8						
9	Mean	0.767	0.6776	0.6492	0.7888	0.7456
10	Std. Deviation	0.1655	0.0917	0.09766	0.03807	0.06994
11	Std. Error of Mean	0.07403	0.04101	0.04367	0.01702	0.03128
12						
13	Lower 95% CI	0.5615	0.5637	0.5279	0.7415	0.6588
14	Upper 95% CI	0.9725	0.7915	0.7705	0.8361	0.8324


Data 1
1.0
0.8
0.6
0.4
0.2
0.0
Control
Carr Reference
G-5
SG-14
SG-16

Constant	Value
Experiment Date	2/23/2018
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (AFDW)

	Group A	Group B	Group C	Group D	Group E
	Control	Carr Reference	G-5	SG-14	SG-16
	Y	Y	Y	Y	Y
1	0.401	0.535	0.412	0.514	0.506
2	0.522	0.452	0.599	0.575	0.570
3	0.382	0.426	0.492	0.552	0.512
4	0.407	0.458	0.547	0.528	0.521
5	0.508	0.419	0.424	0.501	0.451

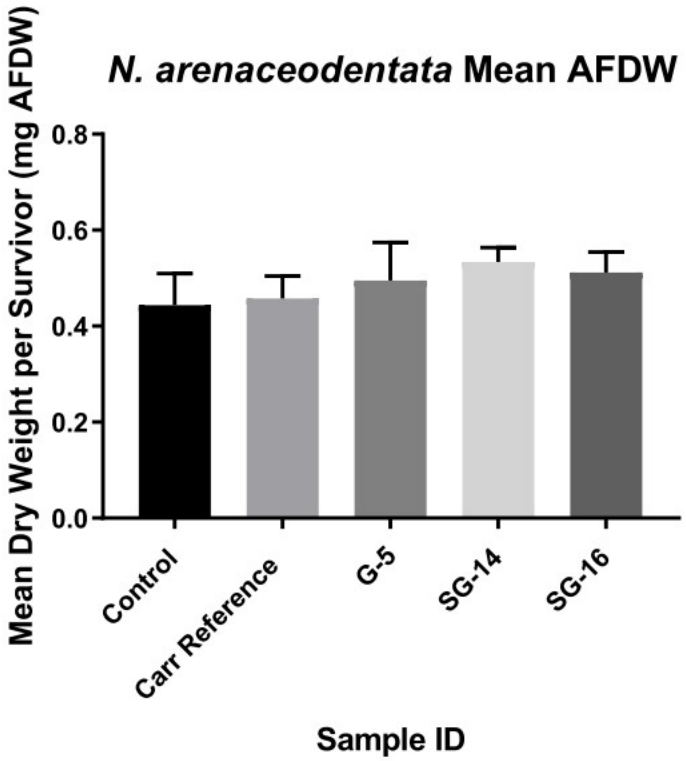
1way ANOVA ANOVA				
1	Table Analyzed	Data 1		
2	Data sets analyzed	A : Control	B : Carr Reference	C : G-5	D : SG-14
3					
4	ANOVA summary				
5	F	2.249			
6	P value	0.1000			
7	P value summary	ns			
8	Significant diff. among means (P < 0.05)?	No			
9	R square	0.3103			
10					
11	Brown-Forsythe test				
12	F (DFn, DFd)	1.049 (4, 20)			
13	P value	0.4069			
14	P value summary	ns			
15	Are SDs significantly different (P < 0.05)?	No			
16					
17	Bartlett's test				
18	Bartlett's statistic (corrected)	4.082			
19	P value	0.3950			
20	P value summary	ns			
21	Are SDs significantly different (P < 0.05)?	No			
22					
23	ANOVA table	SS	DF	MS	F (DFn, DFd)
24	Treatment (between columns)	0.02786	4	0.006966	F (4, 20) = 2.249
25	Residual (within columns)	0.06194	20	0.003097	
26	Total	0.08981	24		
27					
28	Data summary				
29	Number of treatments (columns)	5			
30	Number of values (total)	25			

1	
2	E : SG-16
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	P value
24	P=0.1000
25	
26	
27	
28	
29	
30	

	1way ANOVA Multiple comparisons					
1	Number of families	1				
2	Number of comparisons per family	4				
3	Alpha	0.05				
4						
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value
6						
7	Carr Reference vs. Control	0.014	-0.08229 to 0.1103	No	ns	0.9913
8	Carr Reference vs. G-5	-0.0368	-0.1331 to 0.05949	No	ns	0.7710
9	Carr Reference vs. SG-14	-0.076	-0.1723 to 0.02029	No	ns	0.1618
10	Carr Reference vs. SG-16	-0.054	-0.1503 to 0.04229	No	ns	0.4546
11						
12						
13	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	n1
14						
15	Carr Reference vs. Control	0.458	0.444	0.014	0.0352	5
16	Carr Reference vs. G-5	0.458	0.4948	-0.0368	0.0352	5
17	Carr Reference vs. SG-14	0.458	0.534	-0.076	0.0352	5
18	Carr Reference vs. SG-16	0.458	0.512	-0.054	0.0352	5

1			
2			
3			
4			
5	B-?		
6			
7	A	Control	
8	C	G-5	
9	D	SG-14	
10	E	SG-16	
11			
12			
13	n2	t	DF
14			
15	5	0.3978	20
16	5	1.046	20
17	5	2.159	20
18	5	1.534	20

1way ANOVA Descriptive Statistics		Control	Carr Reference	G-5	SG-14	SG-16
1	Number of values	5	5	5	5	5
2						
3	Minimum	0.382	0.419	0.412	0.501	0.451
4	25% Percentile	0.3915	0.4225	0.418	0.5075	0.4785
5	Median	0.407	0.452	0.492	0.528	0.512
6	75% Percentile	0.515	0.4965	0.573	0.5635	0.5455
7	Maximum	0.522	0.535	0.599	0.575	0.57
8						
9	Mean	0.444	0.458	0.4948	0.534	0.512
10	Std. Deviation	0.06565	0.04612	0.07978	0.02971	0.04243
11	Std. Error of Mean	0.02936	0.02063	0.03568	0.01329	0.01898
12						
13	Lower 95% CI	0.3625	0.4007	0.3957	0.4971	0.4593
14	Upper 95% CI	0.5255	0.5153	0.5939	0.5709	0.5647


N. arenaceodentata Mean AFDW
Mean Dry Weight per Survivor (mg AFDW)
0.8
0.6
0.4
0.2
0.0
Control
Carr Reference
G-5
SG-14
SG-16
Sample ID

Statistical Results: *Mytilus galloprovnicialis* Larval Test

Constant	Value
Experiment Date	2/21/2018
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Mytilus galloprovincialis
Experimenter	
Protocol	

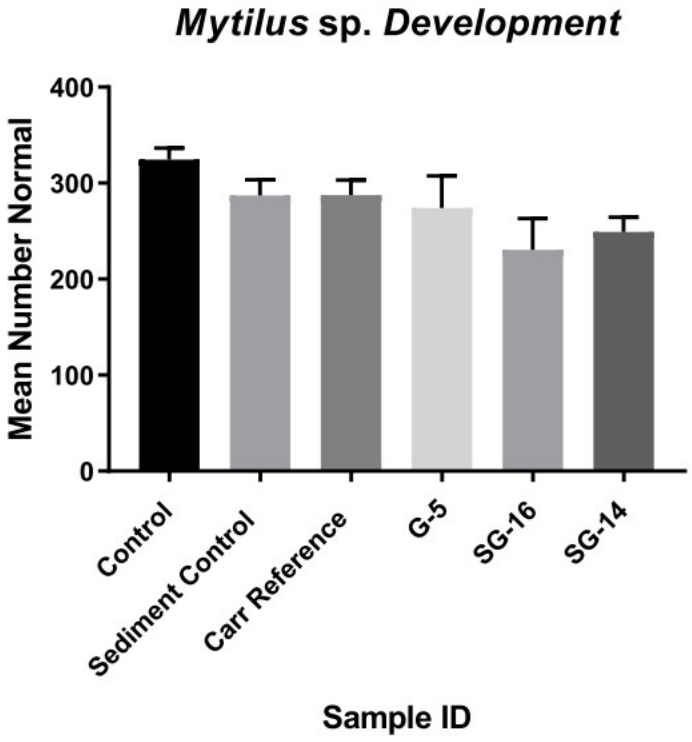
Table format: **Column**	**Group A**	**Group B**	**Group C**	**Group D**	**Group E**	**Group F**
	Control	Sediment Control	rr Referer	G-5	SG-14	SG-16
	Y	**Y**	**Y**	**Y**	**Y**	**Y**
1	328.0	277.0	300.0	279.0	266.0	175.0
2	314.0	272.0	282.0	269.0	243.0	257.0
3	344.0	284.0	265.0	325.0	226.0	239.0
4	317.0	314.0	304.0	232.0	253.0	233.0
5	319.0	289.0	287.0	266.0	258.0	249.0

	1way ANOVA ANOVA			
1	Table Analyzed	Data 1		
2	Data sets analyzed	A : Control	B : Sediment Control	C : Carr Reference
3				
4	ANOVA summary			
5	F	10.54		
6	P value	<0.0001		
7	P value summary	****		
8	Significant diff. among means (P < 0.05)?	Yes		
9	R square	0.6872		
10				
11	Brown-Forsythe test			
12	F (DFn, DFd)	0.512 (5, 24)		
13	P value	0.7645		
14	P value summary	ns		
15	Are SDs significantly different (P < 0.05)?	No		
16				
17	Bartlett's test			
18	Bartlett's statistic (corrected)	6.925		
19	P value	0.2263		
20	P value summary	ns		
21	Are SDs significantly different (P < 0.05)?	No		
22				
23	ANOVA table	SS	DF	MS
24	Treatment (between columns)	26919	5	5384
25	Residual (within columns)	12254	24	510.6
26	Total	39173	29	
27				
28	Data summary			
29	Number of treatments (columns)	6		
30	Number of values (total)	30		

1		
2	D : G-5	E : SG-14
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23	F (DFn, DFd)	P value
24	F (5, 24) = 10.54	P<0.0001
25		
26		
27		
28		
29		
30		

	1way ANOVA Multiple comparisons				
1	Number of families	1			
2	Number of comparisons per family	3			
3	Alpha	0.1			
4					
5	Sidak's multiple comparisons test	Mean Diff.	90.00% CI of diff.	Significant?	Summary
6					
7	Carr Reference vs. G-5	13.4	-18.63 to 45.43	No	ns
8	Carr Reference vs. SG-14	38.4	6.367 to 70.43	Yes	*
9	Carr Reference vs. SG-16	57	24.97 to 89.03	Yes	**
10					
11					
12	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.
13					
14	Carr Reference vs. G-5	287.6	274.2	13.4	14.29
15	Carr Reference vs. SG-14	287.6	249.2	38.4	14.29
16	Carr Reference vs. SG-16	287.6	230.6	57	14.29

1				
2				
3				
4				
5	Adjusted P Value			
6				
7	0.7351	C-D		
8	0.0382	C-E		
9	0.0016	C-F		
10				
11				
12	n1	n2	t	DF
13				
14	5	5	0.9377	24
15	5	5	2.687	24
16	5	5	3.989	24


Mytilus sp. *Development*
Mean Number Normal
400
300
200
100
0
Control
Sediment Control
Carr Reference
G-5
SG-16
SG-14
Sample ID

APPENDIX C. CHAIN-OF-CUSTODY LOGS AND PRE-TEST DOCUMENTS

LANDAU ASSOCIATES

- [x] **Seattle/Edmonds** (425) 778-0907
- [ ] **Tacoma** (253) 926-2493
- [ ] **Spokane** (509) 327-9737
- [ ] **Portland** (503) 542-1080
- [ ] _____

Chain-of-Custody Record

Bioassay

Date 1/25/18

Page 1 of 1

Project Name Tru Grit Project No. 241008.020

Project Location/Event Tacoma, WA / Bioassay

Sampler's Name Devan Brandt

Project Contact Jennifer Wynkoop

Send Results To " & Dani Jorgenson

Turnaround Time
- [x] Standard
- [ ] Accelerated
- [ ] _____

Sample I.D.	Date	Time	Matrix	No. of Containers	Acute 10-Day Amphipod	Acute Larval Development	Chronic Polychaete survival/growth	HOLD * (see note)	Observations/Comments
SG-14-012518	1/25/18	0930	Solid		X	X	X	X	
SG-16-012518		1010	Solid		X	X	X	X	
SG-17-012518		1040	Solid		X	X	X	X	
SG-5-012518		1115	Solid		X	X	X	X	

Testing Parameters

[x] Allow water samples to settle, collect aliquot from clear portion

[ ] NWTPH-Dx - run acid wash silica gel cleanup

[ ] Analyze for EPH if no specific product identified

VOC/BTEX/VPH (soil):
- [ ] non-preserved
- [ ] preserved w/methanol
- [ ] preserved w/sodium bisulfate
- [ ] Freeze upon receipt

[ ] Dissolved metal water samples field filtered

Other * HOLD all analysis until confirmation from LAI (Approx 2 weeks)

Special Shipment/Handling or Storage Requirements: Archive All Excess Material

Method of Shipment:

Relinquished by	Received by	Relinquished by	Received by
Signature	Signature	Signature	Signature
Printed Name Devan Brandt	Printed Name Collin Ray	Printed Name	Printed Name
Company LAI	Company EcoAnalysts	Company	Company
Date 1/25/18 Time 1430	Date 1/25/18 Time 1715	Date Time	Date Time

WHITE COPY - Project File YELLOW COPY - Laboratory PINK COPY - Client Representative

12/2014

Wet-Sieve Procedure for Determining Percent Fines (<63 µm) of Sediment

DATE:	CLIENT:	PROJECT:
2/21/18	Landau	Blaine Waterway

Procedure:

1. Collect 50 mL of sediment to be analyzed
2. Transfer sediment to a #230 (63 µm) testing sieve
3. Rinse sieve thoroughly with a stream of water until water flowing through the sieve is clear
4. Transfer all retained material to a 100mL graduated cylinder using a small funnel and DI squirt bottle
5. Allow sediment to settle. Record the volume of sediment retained below.

SAMPLE ID:	INITIAL VOLUME OF SEDIMENT (mL)	VOLUME OF SEDIMENT RETAINED (mL)	(INIT VOL - VOL RETAINED) * 2			Estimated Percent Fines
SG-16	50	21	(50 - 21)	x 2	=	58
SG-14	50	28	(50 - 28)	x 2	=	44
G-5	50	① ~~36~~ 35	(50 - ~~36~~ 35)	x 2	=	① ~~72~~ 30
Carr Inlet	50	25	(50 - 25)	x 2	=	50
SG-17	50	20	50 - 20	x 2	=	60
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	

LB 2.24.18

BH 2.22.18

① IG, VB 2/21

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway	Organism: NA	Test Duration (days): NA

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: NA

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: Bulk

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date: 3/12/18	Temperature: 21.2°C	

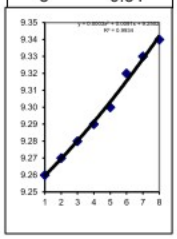
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
PW G-5	Bulk	3/12/18 JC	19.3	TAP	20.4	3/12/18 JC	N	7.7	28	10	ND		
SG-14	↓	↓	13.0	↓	↓	↓	↓	7.6	29	↓	0.002		
SG-16			11.8					7.6	29		0.002		
SG-17			9.29					7.4	29		0.003		

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	12-Mar-18
PROJECT:	Tru-Grit	Test Type:	*NA*
COMMENTS:	Bulk Porewater		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	G-5		19.300	28	7.7	20.4	293.56	9.3187		0.328
3	SG-14		13.000	29	7.6	20.4	293.56	9.3214		0.175
4	SG-16		11.800	29	7.6	20.4	293.56	9.3214		0.159
5	SG-17		9.290	29	7.4	20.4	293.56	9.3214		0.079
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	Input					Output	
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
G-5	**ND**	**20.4**	**28**	**7.7**	**#VALUE!**	**#VALUE!**	**#VALUE!**
SG-14	**2**	**20.4**	**29**	**7.6**	**0.30**	**0.000**	**15.11%**
SG-16	**2**	**20.4**	**29**	**7.6**	**0.30**	**0.000**	**15.11%**
SG-17	**3**	**20.4**	**29**	**7.4**	**0.66**	**0.001**	**22.11%**
					0.00		**#DIV/0!**
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STATION COORDINATE LOG
For Van Veen or Box Core

Project: Landau/Tru-Grit **Cruise Director:** Collin Ray

Survey Number: NA **Recorder:** Collin Ray

DATE	TIME	STATION	DROP NO.	LATITUDE	LONGITUDE	DEPTH (ft)
1/26/18	1015	Carr Inlet 1	1	47.331318°	-122.678540°	47
↓	1040	Carr Inlet 2	1	47.334500°	-122.677776°	35

ECOANALYSTS, INC.

TOXICOLOGY TESTING RESULTS

TRU-GRIT (SG-17-012518) REMEDIAL INVESTIGATION
TACOMA, WASHINGTON

Prepared for:
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On behalf of:
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EcoAnalysts Report ID: P032918.02

Submittal Date:
April 16, 2018

Revision Date:
April 25, 2018

All testing reported herein was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and EcoAnalysts is not responsible for use of less than the complete report. The test results summarized in this report apply only to the sample(s) evaluated.

APPROVED BY:

Brian Hester

_____

Brian Hester
Laboratory Director

Authors:

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APPENDICES

Appendix A: Test and Reference Toxicant Test Results
Appendix B: Statistical Comparisons
Appendix C: Supporting Documents

ACRONYMS AND ABBREVIATIONS

AFDW:	Ash-free dry weight
cm:	Centimeter
CSL:	Cleanup Screening Level
°C:	Degrees Celsius
EC_{50}:	Effective Concentration that results in a 50% reduction in a sub-lethal endpoint
g:	Grams
LC_{50}:	Lethal Concentration that results in a 50% reduction in survival
L:	Liter
µm:	Micrometer
mg:	Milligram
mg/L:	Milligrams per liter
mL:	Milliliter
mm:	Millimeter
NELAP:	National Environmental Laboratory Accreditation Program
NOEC:	No Observed Effect Concentration
ppt:	Parts per Thousand
PSEP:	Puget Sound Estuary Protocols (PSEP 1995)
SCO:	Sediment Cleanup Objective
SCUM:	Sediment Cleanup User's Manual
SMS:	Sediment Management Standards
SOP:	Standard Operation Procedure
SMARM:	Sediment Management Annual Review Meeting
UIA:	Unionized ammonia
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
WAC:	Washington Administrative Code
WDOE:	Washington (State) Department of Ecology

1. EXECUTIVE SUMMARY

EcoAnalysts conducted biological toxicity testing with sediment samples collected by EcoAnalysts personnel as part of remediation activities being performed at the Tru-Grit Site Areas on Blair Waterway in Tacoma, Washington. Sediments were evaluated for biological effects following guidance provided by the Washington State Department of Ecology (WDOE) Sediment Management Standards (SMS) under the Washington Administrative Code (WAC) 173-204-315. This report presents the results of the toxicity testing portion of the Tru-Grit remedial investigation performed on sample SG-17-012518 only.

A summary of the toxicity tests conducted on the Tru-Grit remedial investigation sediment evaluated under the SMS sediment quality criteria (Table 1-1) is provided below.

Sample SG-17-012518 failed the Sediment Cleanup Objectives (SCO) for the larval development test only. This sample passed the SCO and Cleanup Screening Level (CSL) performance criteria for all remaining tests evaluated.

Table 1-1. Executive Summary of SMS Biological Evaluation

Treatment	Sediment Cleanup Objectives (SCO)			Cleanup Screening Levels (CSL)		
	Amphipod Survival	Polychaete Growth	Bivalve Embry-Larval Development	Amphipod Survival	Polychaete Growth	Bivalve Embry-Larval Development
SG-17-012518	Pass	Pass	**Fail**	Pass	Pass	Pass

2. METHODS

This section summarizes the test methods followed for this biological characterization. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the Sediment Management Standards of Washington State (SMS, 2013), the Sediment Cleanup User's Manual II (SCUM II; WDOE 2017), and the various updates presented during the Sediment Management Annual Review Meeting (SMARM). Sediment toxicity was evaluated using three standard PSEP bioassays; the 10-day amphipod test, the 20-day juvenile polychaete survival and growth test, and the benthic larval development test.

2.1 Sample Collection and Receipt

Four test sediments were collected on January 25, 2018 and were received at the EcoAnalysts laboratory on the same day as collection. This report contains toxicological evaluation for one of the four samples (SG-17-012518). Reference sediments from Carr Inlet, WA were collected by EcoAnalysts on January 26, 2018 and received on the same day. Sediment samples were stored in a walk-in cold room at 4 ± 2°C in the dark. The test sediment was not sieved prior to testing. All testing was conducted within the 8-week sediment hold time.

2.2 Bulk Sediment Ammonia and Sulfides Measurements

Prior to testing, bulk sediment porewater total sulfides and ammonia concentrations were measured to determine whether any methods modifications or supplemental testing would be required. Bulk sediments are homogenized test composites that have not been further processed for bioassay testing. The results of the bulk sediment analyses are summarized in Table 2-1.

Table 2-1: Bulk Sediment Porewater Measurements

Treatment	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)[1]	Salinity (ppt)	pH	Total Sulfides (mg/L)	Hydrogen Sulfide (mg/L)[1]
SG-17-012518	9.29	0.079	29	7.4	0.003	0.001

[1] Calculated using the analysis temperature of 20.4°C
ND = Not detected

2.3 Sample Grain Size and Reference Comparison

Sediment grain size is one of the characteristics used in selecting the appropriate reference sediment(s) to compare the chemical and biological responses of project sediments. The percent fines value is defined as the amount of sediment that passes through a 62.5-µm sieve, expressed as a percentage of the total sample analyzed. This is also the sum of the silt and clay fraction of sediment. Wet-sieve grain size results for the reference treatments were conducted in the field (at the time of collection) and after receipt at the EcoAnalysts laboratory. The percent-fines determination of the project sediments are summarized in Table 2-2.

Table 2-2. Sample and Reference Grain Size Comparison

Treatment	Percent Fines[1]	Treatment Compared To:
Carr Inlet (Reference)	50%	
SG-17-012518	60%	Carr Inlet (Reference)

[1] Wet sieve results

Project sample SG-17-012518 was compared to the Carr Inlet reference (50% fines) for the purposes of evaluating the sediment under the sediment management standards. Station coordinates for the reference samples are summarize in Table 2-3.

Table 2-3. Reference Station Coordinates

Station	Latitude	Longitude
Carr Inlet (Reference)	47.331500	-122.677776

2.4 10-day Amphipod Bioassay

The 10-day amphipod acute toxicity test was conducted with *Eohaustorius estuarius*. Test organisms were supplied by Northwestern Aquatic Sciences in Newport, OR and held in native sediment at 15°C prior to test initiation. Organisms were fed during the holding period a diet of ground TetraMin® ad libitum. Native sediment from Yaquina Bay, OR was provided by the organism supplier for use as the control treatment sediment in the test. This matrix has been used successfully in prior tests with this species and is known to support positive organism health and survival.

The amphipod bioassay was conducted as 10-day static exposures with five replicates for each test treatment, reference treatment, and control. Two centimeters of sediment (approximately 175 mL) were placed into each 1-L glass chamber with 775 mL of overlying water. Trickle-flow aeration was provided through glass pipettes, and care was taken to avoid disturbing the sediment surface. Test chambers were placed into randomly assigned positions and allowed to equilibrate to test conditions overnight.

Prior to the test initiation, water quality measurements were taken in all replicates for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in both interstitial (pore water) and overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. Sediment pore water was extracted via centrifugation. During the test, water quality was monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, organisms were randomly allocated to each of the test chambers. Initial stocking densities were 20 organisms per test chamber. Amphipods that did not bury within approximately one hour were replaced with healthy amphipods. No food was provided during the 10-day exposure for the amphipod test.

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen to recover all organisms. The number of surviving and dead amphipods was then enumerated.

2.5 20-day Juvenile Polychaete Bioassay

The 20-day polychaete survival and growth test was conducted with juvenile polychaete worms (*Neanthes arenaceodentata*). Test organisms were obtained from Aquatic Toxicology Support in Bremerton, WA and held in seawater at 20°C (Neanthes were cultured in water-only and were not held in sediment prior to testing). Native sediment of the amphipod *Eohaustorius estuarius* from Yaquina Bay, OR was provided by Northwestern Aquatic Sciences for use as the control treatment sediment for the test. This coarse sand control sediment has been routinely tested in conjunction with this species at this laboratory and results from historical testing have demonstrated acceptable organism health and sediment quality.

The polychaete bioassay was conducted as a 20-day static-renewal test, with overlying exchanges of 300 mL of water occurring every third day. Each test treatment, reference treatment, and control consisted of five replicates of 1-L glass chambers, which were filled with two centimeters of sediment (approximately 175 mL) and 775 mL of overlying water. Trickle-flow aeration was provided through glass pipettes, and care was taken to avoid disturbing the sediment surface. Test chambers were then randomly assigned positions and allowed to equilibrate to test conditions overnight.

Prior to the test initiation, water quality measurements were taken in a surrogate chamber for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in both interstitial (pore water) and overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. Sediment pore water was extracted via centrifugation. During the test, water quality was monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, organisms were randomly allocated to each of the test chambers. Initial stocking densities were five worms per test chamber. During the test, organisms were fed a diet of 40-mg of TetraMarin® slurry every other day (approximately 8-mg dry weight per worm). Pre-test initial biomass was determined by taking dry weight and ash-free dry weight (AFDW) measurements of three replicates of five worms each on Day 0.

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen. All worms were recovered, enumerated, rinsed in deionized water (to remove salt), and transferred to pre-weighed aluminum foil weigh boats. After drying in an oven at 60°C for approximately 24 hours, each weigh-boat was removed, cooled in a desiccator and weighed to obtain dry weight measurements. They were then heated to 550°C for 2 hours to determine the ashed weight. Ash-free dry weights (AFDW) were calculated to correct for the influence of sediment grain size differences between treatments:

$$\boldsymbol{AFDW = Dry\ weight - Ashed\ weight}$$

Both dry weight and AFDW were used to determine individual worm weight and growth rates.

2.6 Larval Developmental Bioassay

The bivalve larval development test was conducted with the mussel, *Mytilus galloprovincialis*. Adult organisms were obtained from Taylor Shellfish in Shelton, WA and were held in unfiltered seawater at 12°C prior to artificial spawning. Two control treatments were employed: a clean seawater control and a sediment control, composed of *E. estuarius* native sediment from Yaquina Bay, OR.

The larval development bioassay was conducted as a static exposure with five replicates for each test treatment, reference treatment, and control. Approximately 18 g (±1 g) of sediment was placed into each 1-L glass chamber with 900 mL of overlying water. Trickle-flow aeration was provided through glass pipettes, and care was taken to avoid disturbing the sediment surface. Test chambers were then shaken for 10 seconds and placed into randomly assigned positions. The larval test was performed without aeration unless dissolved oxygen levels fell below threshold levels for action.

Prior to the test initiation, water quality measurements were taken in the surrogate chamber for each test treatment and included dissolved oxygen, temperature, salinity, and pH. Ammonia and sulfide concentrations were measured in the overlying water at initiation and termination. These measurements were made from a sacrificial surrogate chamber for each test treatment. During the test, water quality was monitored daily in one surrogate replicate per treatment. All water quality instruments were calibrated daily or on their recommended schedule. Records of instrument calibration were retained in the laboratory logs.

To initiate the test, mussels were placed in clean seawater and acclimated at 16°C for approximately 20 minutes. The water bath temperature was then increased over a period of 15 minutes to 20°C. Mussels were held at 20°C and monitored for spawning individuals. Spawning females and males were removed from the water bath and placed in individual containers with seawater. These individuals were allowed to spawn until sufficient gametes were available to initiate the test. After the spawning period, eggs were transferred to fresh seawater and filtered through a 0.5 mm Nitex® mesh screen to remove large debris, feces, and excess gonadal matter. A composite was made of the sperm and diluted with fresh seawater. The fertilization process was initiated by adding sperm to the isolated egg containers. Egg-sperm solutions were periodically homogenized with a perforated plunger during the fertilization process and sub-samples observed under the microscope for egg and sperm viability. Approximately one to one and a half hours after fertilization, embryo solutions were checked for fertilization rate. Only those embryo stocks with >90% fertilization were used to initiate the tests. Embryo solutions were rinsed free of excess sperm and then combined to create one embryo stock solution. Density of the embryo stock solution was determined by counting the number of embryos in a subsample of homogenized stock solution. This was used to determine the volume of embryo stock solution to deliver approximately 27,000 embryos to each test chamber.

The protocol calls for test termination when 95% of the embryos in the control have reached the prodissoconch I stage (approximately 48-60 hours). At termination, the overlying seawater was decanted into a clean 1-L jar and mixed with a perforated plunger. From this container, a 10 mL subsample was transferred to a scintillation vial and preserved in 5% buffered formalin. Larvae were subsequently stained with a dilute solution of Rose Bengal in 70% alcohol to help visualization of larvae. The number of normal and abnormal larvae was enumerated on an inverted microscope. Normal larvae included all D-shaped prodissoconch I stage larvae. Abnormal larvae included abnormally shaped prodissoconch I larvae and all early stage larvae.

3. RESULTS

The results of the sediment testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets are provided Appendix A and statistical analyses are provided in Appendix B.

3.1 10-day Amphipod Bioassay

The bioassay test with *E. estuarius* was validated with 1% mortality in the control, which met the performance criterion of ≤ 10% mortality for SMS evaluations. This result indicates that the test conditions were suitable for adequate amphipod survival. Mean mortality in the Carr Inlet reference treatment was 3%, which also met the performance criteria (≤ 25% reference treatment mortality), indicating that the reference sediments were acceptable for suitability determination. Mean mortality in project sample SG-17-012518 was 18%. All endpoint results are summarized in Table 3-1. A summary of the test conditions is presented in Table 3-2.

All water quality parameters were within the acceptable limits throughout the duration of the test.

A reference-toxicant test was performed on the batch of test organisms utilized for this study. The LC_{50} value was within ±2 standard deviations from the laboratory historical mean. This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia and sulfides concentrations were below any trigger values, indicating a mortality effect due to ammonia and/or sulfides was unlikely. Total ammonia concentrations at test initiation and termination were below the potential trigger of 0.8 mg/L unionized ammonia (Inouye 2015). Similarly, total sulfides were below potential trigger value of 0.122 mg/L hydrogen sulfide throughout the duration of testing, indicating that purging of overlying water to remove excess ammonia and/or sulfides was not warranted (Inouye 2015).

Table 3-1. Test Results for *Eohaustorius estuarius*

Treatment	Replicate	Number Initiated	Number Surviving	Number Missing or Dead	Mortality (%)	Mean Mortality (%)	SD
Control	1	20	20	0	0	1.0	2.2
	2	20	20	0	0		
	3	20	20	0	0		
	4	20	20	0	0		
	5	20	19	1	5		
Carr Inlet Reference	1	20	19	1	5	3.0	4.5
	2	20	20	0	0		
	3	20	20	0	0		
	4	20	18	2	10		
	5	20	20	0	0		
SG-17-012518	1	20	17	3	15	18.0	11.5
	2	20	16	4	20		
	3	20	20	0	0		
	4	20	14	6	30		
	5	20	15	5	25		

Table 3-2.Test Condition Summary for *Eohaustorius estuarius*

Test Conditions: *Eohaustorius estuarius*		
Samples Collected	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Samples Received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample Storage Conditions	4°C, dark	
Test Dates	February 23 – March 5, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 29 days
Source of Control Sediment	Yaquina Bay, OR	
Test Species	*E. estuarius*	
Organism Supplier	Northwestern Aquatic Sciences	
Organisms Acquired	February 22, 2018	
Organism Acclimation	1 Day	
Organism Age	Mature; 3-5 mm	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017), SOP No. SED002.09	
Test Location	EcoAnalysts, Port Gamble, WA	
Test Type/Duration	10-Day/ Static	
Control Water	North Hood Canal seawater, 0.45 µm-filtered	
Test Lighting	Continuous	
Test Chamber	1000-mL Glass Chamber	
Replicates per Treatment	5 + 2 surrogates	
Organisms per Replicate	20	
Exposure Volume	175 mL sediment (2 cm) / 775 mL of overlying seawater	
Feeding	None	
Water Renewal	None	
Test Dissolved Oxygen	Recommended: > 5.1 mg/L (target)	Actual: 7.7 – 8.4 mg/L
Test Temperature	Recommended: 15 ± 1°C	Actual: 15.4 – 16.1 °C
Test Salinity	Recommended: 28 ± 1 ppt	Actual: 28 – 29 ppt
Test pH	Recommended: 7 – 9 (target)	Actual: 7.9 – 8.3
Control Performance Standard	Recommended: ≤ 10% mortality	Actual: 1%
Reference Performance Standard (as per SMS)	Recommended: ≤ 25% mortality	Actual: 3%
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant LC_{50} (mg/L)	144.3	1.361
Running Lab Mean LC_{50} (mg/L) Acceptable Range (mg/L)	144.7 71.2 – 294.4	1.273 0.577 – 2.807
Reference Toxicant NOEC (mg/L)	69.7	0.825
Deviations from Test Protocol	None	

3.2 20-day Juvenile Polychaete Bioassay

No mortality was observed in the *N. arenaceodentata* control sediment. Mean individual growth (MIG) in the control was 0.767 mg/ind/day (dry weight) and 0.444 mg/ind/day (AFDW). These values fall within the test acceptability criteria of <10% mean mortality and ≥0.38 mg/ind/day AFDW (WDOE 2017), indicating that the test conditions were suitable for adequate polychaete survival and growth. A summary of the test endpoint results for all samples is shown in Table 3-3. A complete summary of test conditions is presented in Table 3-4. No deviations from testing protocol were observed in the *N. arenaceodentata* bioassay.

Mean mortality in the reference treatment was 0%, meeting the reference performance standard of ≤20% (USACE 2015). Mean individual growth as dry weight for the Carr Inlet reference treatment was 0.678 mg/ind/day and mean individual growth as ash-free dry weight was 0.458 mg/ind/day. When compared to the control, MIG expressed as AFDW was 1.03, which met the reference performance standard of ≥0.80 (WDOE 2017).

Mean mortality in project sediment SG-17-012518 was 0%. Mean individual growth (as dry weight) was 0.710 mg/ind/day while mean individual growth in the AFDW assessment (which removes variability caused by gut contents) was 0.481 mg/ind/day.

All water quality parameters were within the acceptable limits throughout the duration of the test. Initial mean individual biomass (pretest) of the test organisms was 0.439 mg per individual dry weight, which met the initial size requirement of 0.25 – 1.0 mg/individual.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The LC_{50} value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia and sulfides concentrations were below any trigger values, indicating a mortality effect due to ammonia and/or sulfides was unlikely. Ammonia concentrations observed in the *N. arenaceodentata* test were below the 10 mg/L total ammonia and 0.46 mg/L UIA no effects thresholds for purging while hydrogen sulfide concentrations were well below the potential trigger value of 3.4 mg/L throughout the duration of testing. This indicates that purging of overlying water to remove excess ammonia and/or sulfides would not be warranted (Kendall and Barton 2004).

Table 3-3. Test Results for *Neanthes arenaceodentata*

Treatment	Rep	Number Initiated	Survivors	Mean Mortality (%)	Individual Growth (mg/ind/day)					
					Dry Weight	Mean	Std Dev	AFDW	Mean	Std Dev
Control	1	5	5	0%	0.678	0.767	0.166	0.401	0.444	0.066
	2	5	5		0.960			0.522		
	3	5	5		0.569			0.382		
	4	5	5		0.712			0.407		
	5	5	5		0.916			0.508		
Carr Inlet Reference	1	5	5	0%	0.827	0.678	0.092	0.535	0.458	0.046
	2	5	5		0.601			0.452		
	3	5	5		0.682			0.426		
	4	5	5		0.674			0.458		
	5	5	5		0.604			0.419		
SG-17-012518	1	5	5	0%	0.597	0.710	0.073	0.426	0.481	0.037
	2	5	5		0.786			0.514		
	3	5	5		0.756			0.490		
	4	5	5		0.723			0.513		
	5	5	5		0.687			0.465		

Table 3-4. Test Condition Summary for *Neanthes arenaceodentata*

Test Conditions: *Neanthes arenaceodentata*		
Samples Collected	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Samples Received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample Storage Conditions	4°C, dark	
Test Dates	February 23 – March 15, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 29 days
Source of Control Sediment	Yaquina Bay, OR	
Test Species	*N. arenaceodentata*	
Organism Supplier	Aquatic Toxicology Support	
Organisms Acquired	February 22, 2018	
Organism Acclimation	1 Day	
Organism Age	Juvenile; 18 days post-emergence	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017) SOP No. SED009.08	
Test Location	EcoAnalysts, Port Gamble, WA	
Test Type/Duration	20-Day/ Static Renewal	
Control Water	North Hood Canal seawater, 0.45 µm-filtered	
Test Lighting	Continuous	
Test Chamber	1000-mL Glass Chamber	
Replicates per Treatment	5 + 2 surrogates	
Organisms per Replicate	5	
Exposure Volume	175 mL sediment (2 cm) / 775 mL of overlying seawater	
Feeding	40 mg ground TetraMin® per chamber every other day	
Water Renewal	Every third day (1/3 of overlying water)	
Test Dissolved Oxygen	Recommended: > 4.6 mg/L (target)	Actual: 6.7 – 7.9 mg/L
Test Temperature	Recommended: 20 ± 1°C	Actual: 18.7 – 21.0 °C
Test Salinity	Recommended: 28 ± 2 ppt	Actual: 28 – 29 ppt
Test pH	Recommended: 7 – 9 (target)	Actual: 7.7 – 8.1
Initial Biomass	Recommended: 0.5 – 1.0 mg Minimum: 0.25 mg (dry wt)	Actual: 0.439 mg
Control Performance Standard	Recommended Mortality: < 10% Recommended Growth: ≥ 0.38 mg/ind/day (AFDW)	Actual Mortality: 0% Actual Growth: 0.444 mg/ind/day (AFDW)
Reference Performance Standard	Recommended Mortality: ≤ 20% Recommended Growth: $MIG_R/MIG_C > 0.80$	Actual Mortality: 0% Actual Growth: 1.03 AFDW
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant LC_{50} (mg/L)	226.4	1.939
Running Lab Mean LC_{50} (mg/L) Acceptable Range (mg/L)	163.7 102.9 – 260.3	1.644 0.944– 2.864
Reference Toxicant NOEC (mg/L)	162	1.49
Deviations from Test Protocol	None	

3.3 Larval Development Bioassay

The larval development test with *M. galloprovincialis* was validated by 94.1% and 77.0% normal survivorship in the water-only control and sediment control, respectively. Normal survivorship is defined as the mean number of normal larvae within the control divided by the stocking density. These values were within the SMS acceptability criterion of ≥70%. A summary of the test results for all samples is shown in Table 3-5. A Summary of the test conditions is presented in Table 3-6.

Mean normal survival of the reference sediment was 84.9% and 100% of the control responses, which met the SMS reference acceptability criterion (N_R/N_C) of ≥65%. This is defined as the number of normal larvae in the reference sample(s) divided by the number of normal larvae in the control. The test mean chamber stocking density (measured at test initiation) was 34.5 embryos/mL and was within the test objective of 20 – 40 embryos/mL.

Water quality parameters were within the acceptable limits throughout the duration of the test.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The EC_{50} value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia concentrations observed in the *M. galloprovincialis* test were below the No Observed Effect Concentration (NOEC) values derived from the concurrent ammonia reference-toxicant test (compare to NOEC 4.05 mg/L total, 0.068 UIA), as well as the purging trigger of 0.04 UIA (Inouye 2015). This indicates that ammonia concentrations within the sediment samples should not have contributed to any adverse biological effects observed in the test treatments. Hydrogen sulfide concentrations were also below the trigger value of 0.0025 mg/L (Inouye 2015).

Table 3-5. Test Results for *Mytilus galloprovincialis*

Treatment	Rep	Number Normal	Number Abnormal	Mean # Normal (N)	Control Normal Survival N_C/I (%)	Reference Normal Survival Relative to Control N_R/N_C (%)	Performance Standard
Control	1	313	12	326.8	94.1		≥0.70; Meets Criterion
	2	316	12				
	3	325	16				
	4	358	17				
	5	322	20				
Sediment Control	1	275	9	265.2	77.0		≥0.70; Meets Criterion
	2	247	19				
	3	275	14				
	4	236	7				
	5	293	6				
Carr Inlet Reference	1	266	19	277.4		84.9[1] / 100[2]	≥0.65; Meets Criterion
	2	291	33				
	3	294	14				
	4	269	23				
	5	267	30				
SG-17-012518	1	192	32	202.2	See Section 4.3 for Larval Test Suitability Determination		
	2	182	30				
	3	216	30				
	4	210	29				
	5	211	37				

[1]Relative to Control
[2]Relative to Sediment Control
I = Mean Initial Count (stocking density); 344.6
N_C = Mean Normal in Control
N_R = Mean Normal in Reference

Table 3-6. Test Condition Summary for *Mytilus galloprovincialis*

Test Conditions: *Mytilus galloprovincialis*		
Date sampled	January 25, 2018 (Project Samples) January 26, 2018 (Reference Sediment)	
Date received	January 25, 2018 (Project Samples); January 26, 2018 (Reference Sediment)	
Sample storage conditions	4°C, dark	
Test dates	February 28 – March 2, 2018	
Days of Sample Holding	Recommended: ≤8 weeks (56 days)	Actual: 34 days
Test Species	*M. galloprovincialis*	
Supplier	Taylor Shellfish	
Date acquired	December 29, 2017	
Age class	<2-h old embryos	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2017) SOP No. SED005.05	
Test location	EcoAnalysts Port Gamble Laboratory	
Test type/duration	48-54 Hour static test	
Control water	North Hood Canal sea water, 0.45µm filtered	
Test dissolved oxygen	Recommended: > 5.0 mg/L	Observed: 6.0 – 8.7 mg/L
Test temperature	Recommended: 16 ± 1 °C	Observed: 15.9 – 17.0 °C
Test Salinity	Recommended: 28 ± 1 ppt	Observed: 28 ppt
Test pH	Recommended: 7 - 9	Observed: 7.3 – 7.9
Stocking Density	Recommended: 20 – 40 embryos/mL	Observed: 34.5 embryos/mL
Control performance standard (SMS)	Recommended: Control normal survival ≥ 70%	Observed: 94.1% Control / 77.0% Sediment Control; Pass
Reference performance standard (SMS)	Recommended: Reference normal survival relative to control ≥ 65%	Observed: 84.9% Control 100% Sediment Control; Pass
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant EC_{50} (total ammonia)	EC_{50} = 7.78 mg/L	EC_{50} = 0.132 mg/L
Mean; Acceptable Range (total ammonia)	5.76; 2.94 – 11.28 mg/L	0.119; 0.063 – 0.224 mg/L
NOEC Combined proportion normal (total ammonia)	4.05 mg/L	0.068 mg /L
Test Lighting	50 – 100 foot candles	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 1 surrogate (used for WQ measurements throughout the test)	
Exposure volume	18 g sediment/ 900 mL water	
Feeding	None	
Water renewal	None	
Deviations from Test Protocol	None	

4. DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology's Sediment Cleanup User's Manual II (SCUM II; WDOE 2017). Comparisons were made for each treatment against the appropriate reference sample. Two numerical comparisons were made under SMS, the Sediment Cleanup Objective (SCO) and the Cleanup Screening Level (CSL).

4.1 Amphipod Test Suitability Determination

Under the SMS program, a treatment will fail SCO if mean mortality in the test is >25% and the difference between mean mortality in the treatment compared to mean mortality in the reference is statistically significant ($p < 0.05$). Treatments fail the CSL if mean mortality in the test treatment is ≥30% relative to the reference sediment and the difference is statistically significant.

The project sample did not fail the SCO and CSL criteria for the amphipod test as shown in Table 4-1.

Table 4-1. SMS Comparison for *Eohaustorius estuarius*

Treatment	Mean Mortality (%)	Compared To:	Statistically Different than Reference? (p=0.05)	Mortality Comparison to Reference M_T-M_R (%)	Fails SCO?[1] (> 25%)	Fails CSL?[2] (≥ 30%)
Control	1					
Carr Inlet Reference	3					
SG-17-012518	18	Carr Inlet Reference	Yes	15	No	No

[1]SCO: Statistical Significance and M_T >25%
[2]CSL: Statistical Significance and M_T-M_R ≥ 30%
M_T = Treatment Mortality
M_R = Reference Mortality

4.2 Juvenile Polychaete Test Suitability Determination

Suitability determinations for the juvenile polychaete test were based on mean individual growth (MIG). A test treatment fails SCO criteria if MIG is statistically lower in the test treatment, relative to the reference, and if the ratio of the MIG in the test treatment is <0.70 to that of the reference. The treatments will fail CSL criteria if the MIG is significantly lower than the reference treatment and the ratio between the MIG of the treatment and the MIG of the reference is <0.50.

The project sample did not fail the SCO and CSL criteria for the juvenile polychaete test as shown in Table 4-2.

Table 4-2. SMS Comparison for *Neanthes arenaceodentata*

Treatment	MIG (mg/ind/day)	Compared To:	Statistically Less than Reference? (p=0.05)	MIG Relative to Reference (MIG_T/MIG_R)	Fails SCO?[1] (< 0.70)	Fails CSL?[2] (< 0.50)
Dry Weight						
Control	0.767					
Carr Inlet Reference	0.678					
SG-17-012518	0.710	Carr Inlet Reference	No	1.05	No	No
Ash-Free Dry Weight						
Control	0.444					
Carr Inlet Reference	0.458					
SG-17-012518	0.481	Carr Inlet Reference	No	1.05	No	No

[1]SCO: Statistical Significance and MIG_T/MIG_R <70%
[2]CSL: Statistical Significance and MIG_T/MIG_R <50%
MIG_T = Treatment Mean Individual Growth
MIG_R = Reference Mean Individual Growth

4.3 Larval Test Suitability Determination

Larval test treatments fail SCO criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.85 of the normal development in the reference. Treatments fail CSL criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.70 of the normal development in the reference.

Project sample SG-17-012518 failed the SCO criteria for the bivalve development evaluation. This sample did not fail the CSL criteria as shown in Table 4-3.

Table 4-3. SMS Comparison for *Mytilus galloprovincialis*

Treatment	Mean Normal Survival (%)[1]	Mean Number Normal	Compared To:	Statistically Less than Reference? (p=0.10)	Normal Survival to Reference N_T/N_R	Fails SCO?[4] <0.85	Fails CSL?[5] <0.70
Control	94.1	326.8					
Sediment Control	77.0	265.2					
Carr Inlet Reference	84.9[2] / 100[3]	277.4					
SG-17-012518	61.9[2]/ 76.2[3]	202.2	Carr Inlet Reference	Yes	0.729[2]/0.762[3]	Yes	No

[1] Control data is normalized to the stocking density; reference and project treatments are normalized to the control(s)
[2] Comparison to Control
[3] Comparison to Sediment Control
[4] SCO: Statistical Significance and (N_T/N_R) <0.85
[5] SL: Statistical Significance and (N_T/N_R) <0.70
N_T =Treatment Mean Number Normal Survivorship
N_R =Reference Mean Number Normal Survivorship
N_C =Control Mean Number Normal Survivorship

5. SUMMARY

A summary of the toxicity tests conducted on the Tru-Grit remedial investigation sediment evaluated under the SMS sediment quality criteria (Table 5-1) is provided below.

Sample SG-17-012518 failed the SCO criteria for the larval development test but passed the SCO and CSL performance criteria for all remaining tests performed.

Table 5-1. Summary of SMS Evaluation

Treatment	Sediment Cleanup Objectives (SCO)			Cleanup Screening Levels (CSL)		
	Amphipod Survival	Polychaete Growth	Bivalve Embry-Larval Development	Amphipod Survival	Polychaete Growth	Bivalve Embry-Larval Development
SG-17-012518	Pass	Pass	Pass	Pass	Pass	Pass

6. REFERENCES

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PSEP 1995. Puget Sound Protocols and Guidelines. Puget Sound Estuary Program. Puget Sound Water Quality Action Team, Olympia, Washington.

USACE 2015. Dredged Material Evaluation and Disposal Procedures (Users' Manual), Dredged Material Management Program (DMMP). US Army Corps of Engineers-Seattle District; US Environmental Protection Agency (Region 10); Washington State Department of Ecology, and Washington State Department of Natural Resources.

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7. DOCUMENT OF CHANGE

- Section 4.3. Corrected reference from SG-16-012518 to SG-17-012518.
- Table 5-1. Corrected column headings to match Table 1-1

APPENDIX A. ..... TEST AND REFERENCE TOXICANT TEST RESULTS

1. *Eohaustorius estuarius 10-Day Test*
2. *Neanthes arenaceodentata 20-Day Test*
3. *Mytilus galloprovincialis Bivalve Larval Test*

APPENDIX B. ..... STATISTICAL COMPARISONS

STATISTICAL RESULTS: *EOHAUSTORIUS ESTUARIUS* TEST
STATISTICAL RESULTS: *NEANTHES ARENACEODENTATA* TEST
STATISTICAL RESULTS: *MYTILUS GALLOPROVNICIALIS* LARVAL TEST

APPENDIX C. .....CHAIN-OF-CUSTODY LOGS AND PRE-TEST DOCUMENTS

APPENDIX A. TEST AND REFERENCE TOXICANT TEST RESULTS

1. *Eohaustorius estuarius* 10-Day Test

EcoAnalysts

10 DAY BENTHIC TEST
INTERACTIVE DATA SETUP

GENERAL

CLIENT:	Landau
PROJECT:	Blair Waterway
JOB NUMBER:	PG1103
PROJECT MANAGER:	Brian Hester
TEST SPECIES:	*Eohaustorius estuarius*
ORGANISM BATCH:	NAS022218
TEST PROTOCOL:	PSEP 1995
LABORATORY:	Port Gamble
TEST LOCATION:	Bath 5
TEST START DATE:	23Feb18
TEMP. RECORDER#:	NA
DILUTION WATER BATCH:	FSW022118.01
FEEDING INFORMATION:	none
WATER RENEWAL INFO:	none

TEST START TIME:	1431 UB/JL
TEST START TIME:	0900

DATE RECEIVED:	25Jan18
SAMPLE STORAGE:	4 Degrees Celsius - dark
SAMPLE TREATMENT:	none
TEST CHAMBER:	1 L mason jars
EXPOSURE VOLUME:	2 cm sediment/ 775 mL water
REFERENCE TOXICANT #1:	ammonia
REF. TOX. MATERIAL #1:	ammonium chloride

NH3 REFTOX CONC (mg/L)
0
15
30
60
120
240

	CLIENT SAMPLE ID	SAMPLE ID
1	Control	Eoh sand
2	Carr Reference	
3	SG-17	

DAILY DATA QA CHECKS: (Date/Initials)

2/23/18	JL 2/23
2/24/18	UB 2/24
2/25/18	UB 2/25
2/26/18	JL 2/26
2/27/18	UB 2/27
2/28/18	JL 3/5
3/1/18	↓
3/2/18	↓
3/3/18	UB 3/3
3/4/18	CR 3/4
3/5/18	JL 3/5

TEST PARAMETERS	TARGET	ACCEPTABLE RANGE / COMMENTS
DO: (mg/L)	>5.1	60% Sat @ 15°C, 28ppt
Temp: (°C)	15 ± 1	15 ± 3
Sal: (ppt)	28 ± 1	(20 - 35 ppt)
pH:	7 - 9	Optimal

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10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	JOB NO.	PROJECT MAN.	LABORATORY	PROTOCOL	SPECIES
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble / Bath 5	PSEP 1995	*Eohaustorius estuarius*

ENDPOINT DATA & OBSERVATIONS

#S= Number on the Surface
#M= Number of Mortality
L=Anoxic Surface
F=Fungal Patches
D=No Air Flow (DO?)
U=Excess food
N=Normal
B=No Burrows

INITIAL # OF ORGANISMS: 20

Sample ID	REP	JAR #	INITIAL #	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	NUMBER REMAINING
			DATE	2/24/18	2/25	2/26/18	2/27	2/28	3/1	3/02	3/3	3/4	3/5	
			TECHNICIAN	WB	WB	BG	WB	WB	WB	WB	WB	GR	BG	
			OBSERVNS.											
Control / Eoh sand	1			N	N	N	N	N	N	N	N	N	N	20
	2			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	3			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	4			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	5			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	19
Carr Reference /	1			N	N	N	N	N	N	↓	N	↓	N	19
	2			↓	↓	1S	↓	↓	↓	↓	1S	↓	↓	20
	3			↓	↓	1S	↓	↓	↓	↓	N	↓	↓	20
	4			↓	1S	1S	↓	↓	↓	↓	↓	↓	↓	18
	5			↓	N	N	↓	↓	↓	↓	↓	↓	↓	20
SG-17 /	1			1S	N	N	N	1S	N	1S	N	↓	1S	17 [illegible] ① WL BG 3/5/18
	2			1S	1S	1S	1S	1S	2S	1S	1S	↓	2S	16
	3			N	N	1S	1S	1S	N	N	N	1S	N	~~19~~ 20
	4			1S	↓	N	N	1S	1S	↓	1S	N	↓	14
	5			2S	↓	1S	↓	N	N	↓	N	N	↓	15

② found last one
BG 3/5/18

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10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
Control / Eoh sand	0	1	9	8.4	9	15.5	9	28	9	8.1	JL	2/23/18
Control / Eoh sand	0	2	↓	8.4	↓	15.5	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	3	↓	8.4	↓	15.6	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	4	↓	8.4	↓	15.4	↓	28	↓	8.1	↓	↓
Control / Eoh sand	0	5	↓	8.4	↓	15.5	↓	28	↓	8.1	↓	↓
Control / Eoh sand	1	Surr	8	8.2	8	15.6	8	28	8	8.1	UB	2/24
Control / Eoh sand	2	Surr	8	8.2	8	15.7	8	28	8	8.1	UB	2/25
Control / Eoh sand	3	Surr	9	7.9	9	15.9	9	28	9	8.1	BH	2/26/18
Control / Eoh sand	4	Surr	9	8.1	9	15.8	9	28	9	8.2	UB	2/27
Control / Eoh sand	5	Surr	9	8.0	9	15.9	9	28	9	8.1	UB	2/28
Control / Eoh sand	6	Surr	9	8.0	9	15.8	9	28	9	8.1	UB	3/1
Control / Eoh sand	7	Surr	9	8.1	9	15.7	9	28	9	8.1	JL	3/02
Control / Eoh sand	8	Surr	9	8.2	9	15.6	9	28	9	8.2	UB	3/3
Control / Eoh sand	9	Surr	9	8.2	9	15.7	9	28	9	8.1	CR	3/4
Control / Eoh sand	10	1	9	8.3	9	15.7	9	29	9	8.0	JL	3/05
Control / Eoh sand	10	2	↓	8.2	↓	15.7	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	3	↓	8.3	↓	15.8	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	4	↓	8.2	↓	15.7	↓	28	↓	7.9	↓	↓
Control / Eoh sand	10	5	↓	8.3	↓	15.6	↓	28	↓	8.0	↓	↓

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
Carr Reference /	0	1	9	8.4	9	15.5	9	28	9	8.1	JL	2/23/18
Carr Reference /	0	2		8.3		15.5		28		8.0		
Carr Reference /	0	3		8.3		15.5		28		8.0		
Carr Reference /	0	4		8.3		15.6		28		8.0		
Carr Reference /	0	5		8.3		15.4		28		8.0		
Carr Reference /	1	Surr	8	8.2	8	15.6	8	28	8	8.0	UB	2/24
Carr Reference /	2	Surr	8	8.2	8	15.7	8	28	8	8.0	UB	2/25
Carr Reference /	3	Surr	9	7.8	9	15.9	9	28	9	8.0	BM	2/26/18
Carr Reference /	4	Surr	9	7.9	9	15.8	9	28	9	8.1	UB	2/27
Carr Reference /	5	Surr	9	8.1	9	15.8	9	28	9	7.9	UB	2/28
Carr Reference /	6	Surr	9	7.8	9	15.8	9	28	9	8.1	UB	3/1
Carr Reference /	7	Surr	9	8.0	9	15.8	9	28	9	8.1	JL	3/02
Carr Reference /	8	Surr	9	8.2	9	15.6	9	28	9	8.1	UB	3/3
Carr Reference /	9	Surr	9	8.2	9	15.6	9	28	9	8.2	GR	3/4
Carr Reference /	10	1	9	8.2	9	15.6	9	28	9	7.9	JL	3/05
Carr Reference /	10	2		8.2		15.7		28		7.9		
Carr Reference /	10	3		8.2		15.7		28		7.9		
Carr Reference /	10	4		7.8		16.1		28		7.9		
Carr Reference /	10	5		7.9		15.7		28		7.9		

ECO ANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble	23Feb18	05Mar18
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1103	Brian Hester	Port Gamble / Bath 5	FSW022118.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SG-17 /	0	1	9	8.2	9	15.6	9	28	9	8.0	JL	2/23/18
SG-17 /	0	2		8.3		15.5		28		8.0		
SG-17 /	0	3		8.3		15.5		28		8.0		
SG-17 /	0	4		8.3		15.4		28		8.0		
SG-17 /	0	5		8.3		15.5		28		8.0		
SG-17 /	1	Surr	8	7.7	8	15.9	8	28	8	8.0	UB	2/24
SG-17 /	2	Surr	8	8.0	8	16.0	8	28	8	8.0	UB	2/25
SG-17 /	3	Surr	9	8.6	9	16.1	9	28	9	7.9	BG	2/26/18
SG-17 /	4	Surr	9	7.5	9	16.0	9	28	9	8.1	UB	2/27
SG-17 /	5	Surr	9	7.5	9	16.1	9	28	9	8.1	UB	2/28
SG-17 /	6	Surr	9	7.6	9	16.1	9	28	9	8.0	UB	3/1
SG-17 /	7	Surr	9	7.9	9	16.0	9	28	9	8.1	JL	3/02
SG-17 /	8	Surr	9	7.6	9	15.8	9	28	9	8.1	UB	3/3
SG-17 /	9	Surr	9	7.8	9	16.3	9	28	9	8.1	GR	3/4
SG-17 /	10	1	9	8.1	9	15.8	9	28	9	8.1	JL	3/05
SG-17 /	10	2		8.2		15.8		28		8.1		
SG-17 /	10	3		7.7		15.9		28		8.0		
SG-17 /	10	4		7.8		15.8		28		8.0		
SG-17 /	10	5		8.1		15.8		28		8.1		

Ammonia and Sulfide Analysis Record

Client/Project:	Organism:	Test Duration (days):
Landau / Blair Waterway	Eohs	10

PRETEST / INITIAL / FINAL / OTHER (circle one)
OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: _____

DAY of TEST: 8

Calibration Standards Temperature	
Date:	Temperature:
2/23/18	20.7°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter # / Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV. Ø	Surr.	2/23/18 JL	0.154	TAP	20.7	2/23/18 JL	N			10	0.003		
CARP ref			0.285								0.004		
①SG.5			1.12								0.000		
SG.14			0.883								0.000		
SG.16			0.681								0.001		
SG.17			0.591								0.002		
PW Ø			③	TAP	19.7			③			③		
CARP ref			3.17					7.8②	29	5	0.014	2	0.028
G.5			11.1					7.8	29		0.006		0.012
SG.14			8.54					7.8	29		0.00		
SG.16			7.57					7.9	29		0.00		
SG.17			6.78					7.8	30		0.00		

① IE. JL 2/23/18 ② Illegible. 7.8 pH. JL 2/23/18 ③ Insufficient volume for analyses. JL 2/23/18

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway | **Organism:** EOHS | **Test Duration (days):** 10

PRETEST / INITIAL / **FINAL** / OTHER (circle one)

OVERLYING (OV) / **POREWATER (PW)** (circle one) / Comments: _____

DAY of TEST: 10

Calibration Standards Temperature

Date: 3/05/18 | **Temperature:** 21.1°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV Θ	Surr.	3/05/18 JL	0.214	TAP	20.1	3/05 JL	N			10	ND	NA	
CAPP Ref			0.00								ND		
GS			1.69								0.006		
SG14			0.00								0.00		
SG16			0.00								0.003		
SG17			0.796								0.001		
PW Θ		3/05/18 JL	①	TAP	20.1	①		①					
CAPP Ref.			0.0805			3/5/18 BG		7.2	28	5	0.001	2	0.002
GS			6.61					7.5	28		0.011		0.022
SG14			1.06②					7.6	28		ND		
SG16			0.553					7.6	27		0.001		0.002
SG17			2.29					7.5	27		0.001		0.002

① Insufficient Volume for analyses. JL 3/05/18.

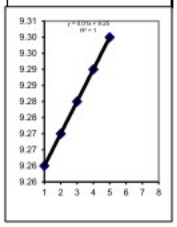
② illegible 1.06 mg/L BG 3/5/18

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Eohaustorius estuarius*
COMMENTS:	Porewater calculations performed with porewater WQ parameters		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer:	I-factor
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30



Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
Day 0 OV									
Control		0.154	28	8.1	15.5	288.66	9.3187		0.004
Carr Reference		0.285	28	8.0	15.5	288.66	9.3187		0.007
SG-17		0.591	28	8.0	15.5	288.66	9.3187		0.014
Day 0 PW									
Control		NM			15.5	288.66	9.2548		#VALUE!
Carr Reference		3.170	29	7.8	15.5	288.66	9.3214		0.047
SG-17		6.780	30	7.8	15.5	288.66	9.3242		0.100
Day 10 OV									
Control		0.214	28	7.9	15.7	288.86	9.3192		0.004
Carr Reference		0.000	28	7.9	15.8	288.92	9.3187		
SG-17		0.796	28	8.1	15.8	288.98	9.3187		0.022
Day 10 PW									
Control		NM			15.7	288.86	9.2548		#VALUE!
Carr Reference		0.081	28	7.2	15.8	288.92	9.3187		0.000
SG-17		2.290	27	7.5	15.8	288.98	9.3160		0.018

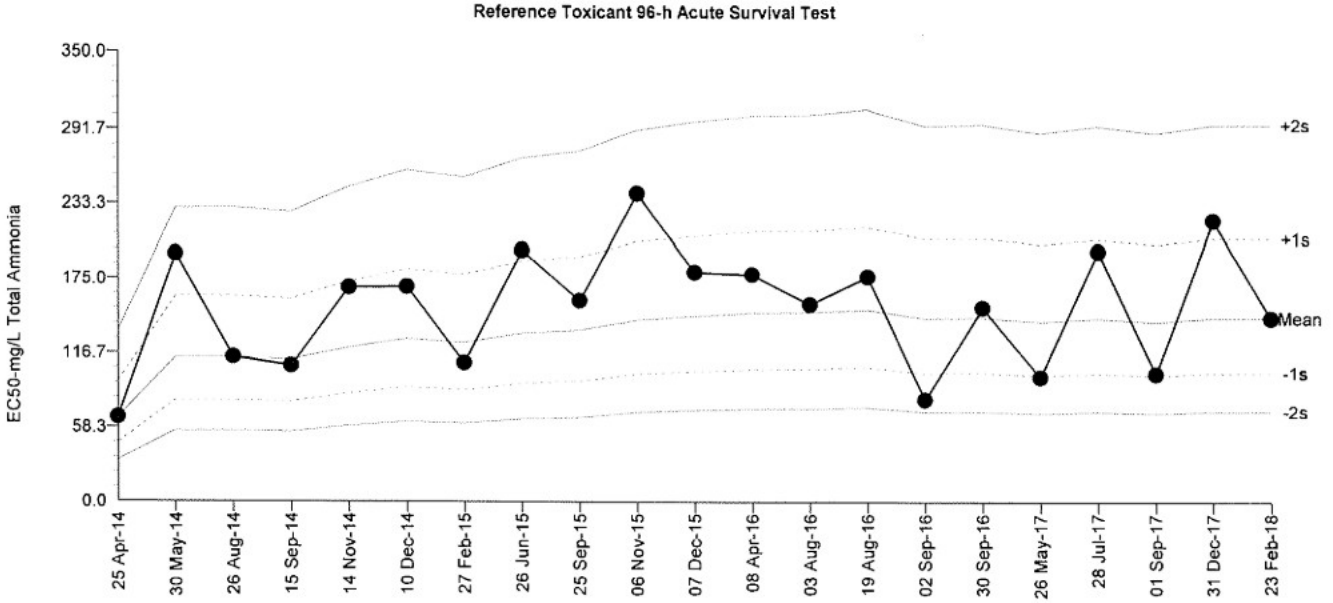
	Input				Output		
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	3	15.5	28	8.1	0.19	0.000	6.31%
Carr Reference	4	15.5	28	8.0	0.30	0.000	7.49%
SG-17	2	15.5	28	8.0	0.16	0.000	7.82%
Day 0 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	15.5	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	28	15.5	29	7.8	3.31	0.003	11.83%
SG-17	0	15.5	30	7.8	0.00	0.000	#DIV/0!
Day 10 OV					0.00	0.000	#DIV/0!
Control	#VALUE!	15.7	28	7.9	#VALUE!	#VALUE!	#VALUE!
Carr Reference	#VALUE!	15.8	28	7.9	#VALUE!	#VALUE!	#VALUE!
SG-17	1	15.8	28	8.1	0.07	0.000	6.80%
Day 10 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	15.7	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	2	15.8	28	7.2	0.70	0.001	35.25%
SG-17	2	15.8	27	7.5	0.42	0.000	21.22%

CETIS QC Plot

Report Date: 13 Mar-18 15:37 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Total Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	144.7	**Count:**	20	**-1s Warning Limit:**	101.5	**-2s Action Limit:**	71.17
Sigma:	n/a	**CV:**	36.60%	**+1s Warning Limit:**	206.4	**+2s Action Limit:**	294.4

Quality Control Data

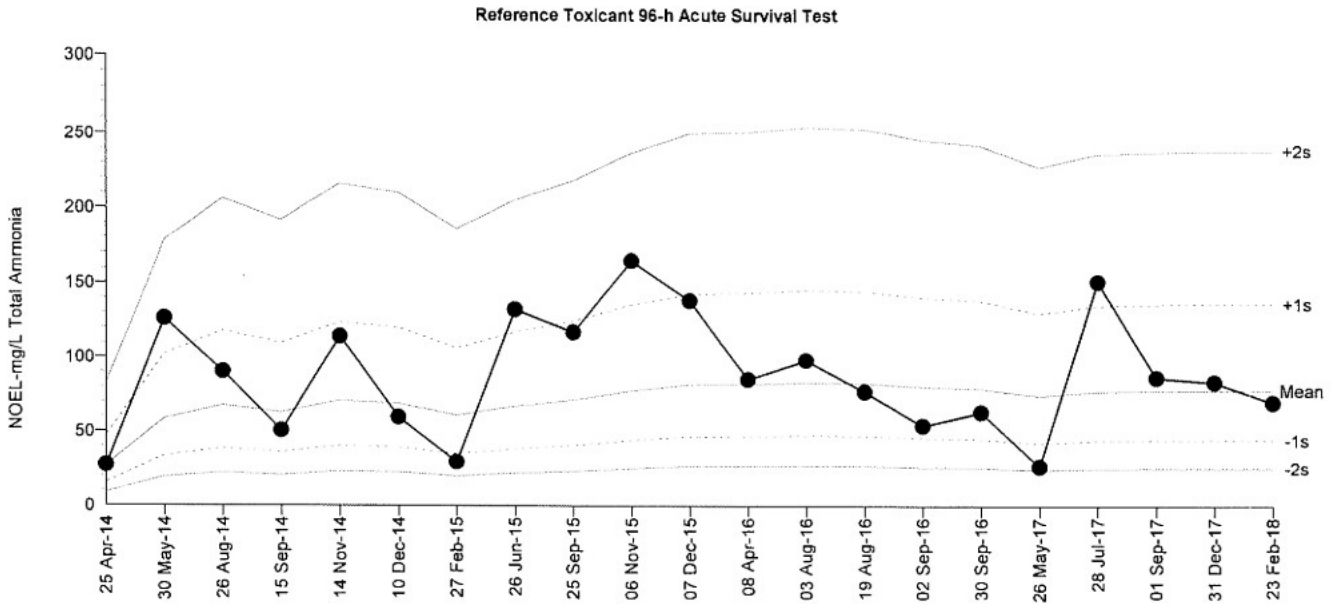
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	65.78	-78.97	-2.222	(-)	(-)	11-2394-9115	16-6351-0798	Port Gamble Environment
2		May	30	15:30	193.9	49.17	0.8238			11-1744-7543	02-6036-0984	ENVIRON
3		Aug	26	15:45	113.3	-31.43	-0.6895			15-5557-5937	00-0529-4993	ENVIRON
4		Sep	15	15:10	106.3	-38.4	-0.8685			07-1282-2061	01-5984-9612	ENVIRON
5		Nov	14	14:25	168	23.25	0.4195			09-0717-5355	19-7840-9499	ENVIRON
6		Dec	10	15:50	168.3	23.56	0.4247			19-3485-9112	05-9978-3434	ENVIRON
7	2015	Feb	27	12:35	108.8	-35.95	-0.8042			19-3876-5860	21-0291-4043	ENVIRON
8		Jun	26	13:20	197.1	52.34	0.8694			00-5720-1886	11-7391-9309	ENVIRON
9		Sep	25	17:30	157.8	13.07	0.2435			05-7835-3625	14-8488-2762	ENVIRON
10		Nov	6	15:30	240.8	96.07	1.434	(+)		07-0462-4762	05-5994-4603	ENVIRON
11		Dec	7	15:58	180.1	35.33	0.6152			18-5380-2632	01-5604-1684	ENVIRON
12	2016	Apr	8	14:40	178.3	33.58	0.5877			20-3339-4511	20-5786-8614	ENVIRON
13		Aug	3	16:55	155	10.29	0.1934			15-5854-7986	14-0317-8212	ENVIRON
14			19	14:25	177	32.21	0.566			10-0746-9736	13-2092-5186	ENVIRON
15		Sep	2	16:25	80.2	-64.55	-1.663	(-)		06-2389-4542	16-8119-8926	ENVIRON
16			30	15:00	152.6	7.899	0.1497			16-2341-4864	11-2277-7148	ENVIRON
17	2017	May	26	13:00	97.99	-46.76	-1.099	(-)		06-2743-8362	04-6967-6524	EcoAnalysts
18		Jul	28	14:20	196.9	52.11	0.8661			14-8451-4586	00-9100-0373	EcoAnalysts
19		Sep	1	15:45	100.5	-44.28	-1.028	(-)		02-8963-0820	06-1020-6763	EcoAnalysts
20		Dec	31	15:47	220.3	75.56	1.183	(+)		09-7306-1854	08-4856-6308	EcoAnalysts
21	2018	Feb	23	13:35	144.3	-0.4306	-0.008393			21-0530-3984	12-8139-0101	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:37 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Total Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	77.94	**Count:**	20	**-1s Warning Limit:**	44.62	**-2s Action Limit:**	25.54
Sigma:	n/a	**CV:**	60.50%	**+1s Warning Limit:**	136.2	**+2s Action Limit:**	238

Quality Control Data

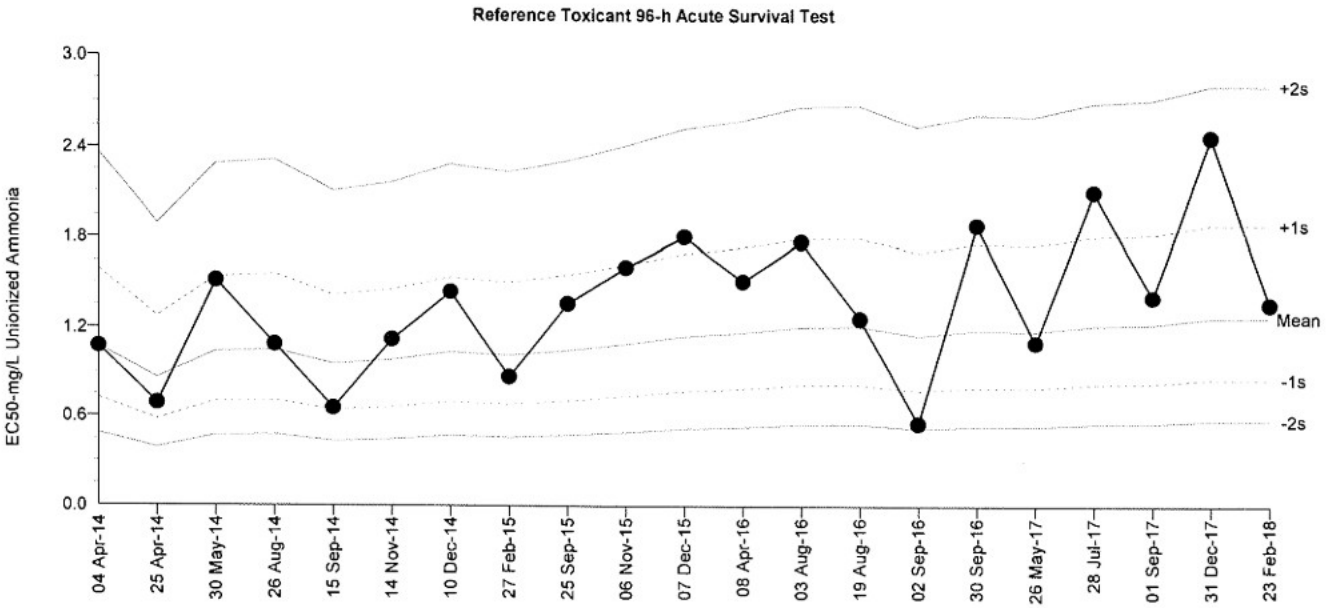
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	27	-50.94	-1.9	(-)		11-2394-9115	19-2434-9439	Port Gamble Environment
2		May	30	15:30	126	48.06	0.8606			11-1744-7543	06-3985-7474	ENVIRON
3		Aug	26	15:45	90.1	12.16	0.2597			15-5557-5937	08-3094-4388	ENVIRON
4		Sep	15	15:10	50.5	-27.44	-0.7777			07-1282-2061	16-3885-0935	ENVIRON
5		Nov	14	14:25	114	36.06	0.6812			09-0717-5355	07-0500-8008	ENVIRON
6		Dec	10	15:50	59.4	-18.54	-0.4868			19-3485-9112	07-0579-1018	ENVIRON
7	2015	Feb	27	12:35	29.3	-48.64	-1.753	(-)		19-3876-5860	19-7961-3594	ENVIRON
8		Jun	26	13:20	132	54.06	0.9439			00-5720-1886	15-3704-4199	ENVIRON
9		Sep	25	17:30	117	39.06	0.7278			05-7835-3625	21-0939-3919	ENVIRON
10		Nov	6	15:30	165	87.06	1.344	(+)		07-0462-4762	19-7906-3673	ENVIRON
11		Dec	7	15:58	138	60.06	1.024	(+)		18-5380-2632	00-7335-5231	ENVIRON
12	2016	Apr	8	14:40	85.2	7.255	0.1595			20-3339-4511	16-7438-0764	ENVIRON
13		Aug	3	16:55	98	20.06	0.4103			15-5854-7986	05-8855-9934	ENVIRON
14			19	14:25	76.9	-1.045	-0.02418			10-0746-9736	12-8850-4495	ENVIRON
15		Sep	2	16:25	54.1	-23.84	-0.6543			06-2389-4542	18-8647-7799	ENVIRON
16			30	15:00	63.2	-14.74	-0.3757			16-2341-4864	17-9345-6065	ENVIRON
17	2017	May	26	13:00	26.6	-51.34	-1.926	(-)		06-2743-8362	12-3565-7845	EcoAnalysts
18		Jul	28	14:20	151	73.06	1.185	(+)		14-8451-4586	09-8418-8824	EcoAnalysts
19		Sep	1	15:45	86.5	8.555	0.1866			02-8963-0820	17-0422-4621	EcoAnalysts
20		Dec	31	15:47	83.6	5.655	0.1255			09-7306-1854	06-1883-5465	EcoAnalysts
21	2018	Feb	23	13:35	69.7	-8.245	-0.2003			21-0530-3984	16-8514-1800	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:43 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Eohaustorius estuarius (Amphipod) | **Material:** Unionized Ammonia
Protocol: EPA/600/R-94/025 (1994) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	1.273	**Count:**	20	**-1s Warning Limit:**	0.8574	**-2s Action Limit:**	0.5774
Sigma:	n/a	**CV:**	41.10%	**+1s Warning Limit:**	1.89	**+2s Action Limit:**	2.807

Quality Control Data

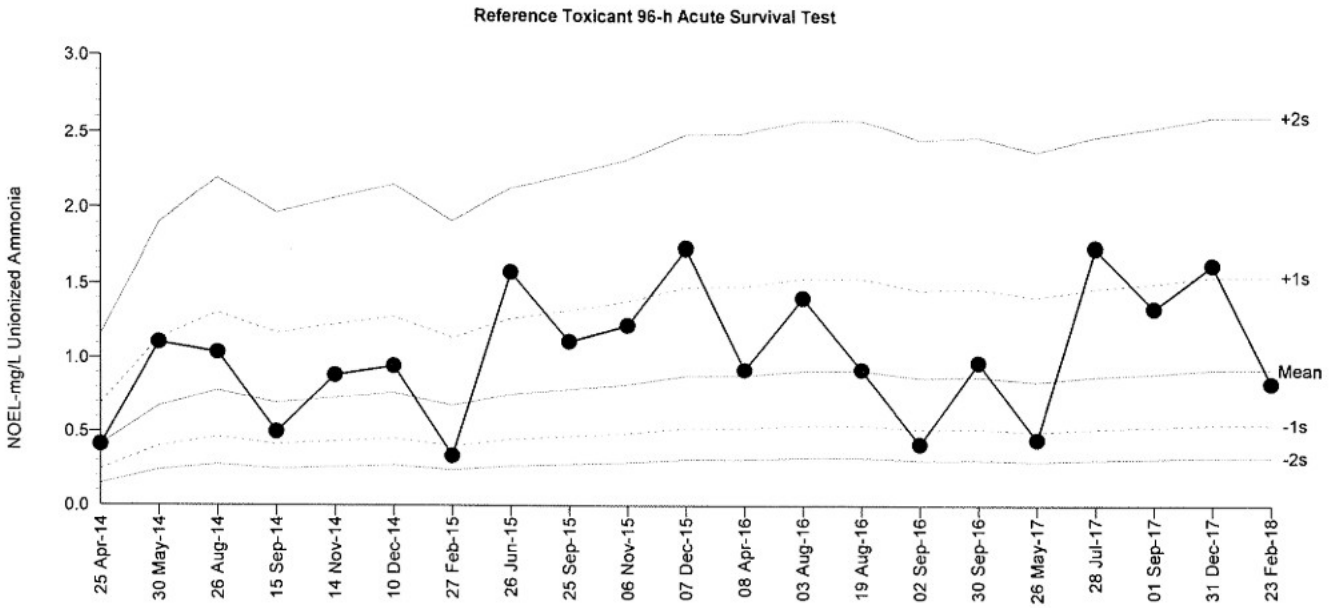
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	4	19:15	1.072	-0.2014	-0.4356			02-4910-1045	07-9486-3041	NewFields
2			25	13:00	0.6871	-0.5859	-1.56	(-)		05-3931-3196	11-2528-6540	Port Gamble Environment
3		May	30	15:30	1.517	0.2436	0.4429			03-2348-8477	19-6287-3473	ENVIRON
4		Aug	26	15:45	1.087	-0.186	-0.3995			16-9917-4183	13-7453-5343	ENVIRON
5		Sep	15	15:10	0.6543	-0.6187	-1.684	(-)		04-2286-3837	03-1229-8693	ENVIRON
6		Nov	14	14:25	1.119	-0.1539	-0.326			07-5753-6828	00-1415-6148	ENVIRON
7		Dec	10	15:50	1.441	0.1675	0.3128			04-0714-3304	08-0742-5225	ENVIRON
8	2015	Feb	27	12:35	0.8668	-0.4062	-0.9722			10-1977-7129	06-3048-0232	ENVIRON
9		Sep	25	17:30	1.361	0.08776	0.1687			00-7510-8480	16-9779-9851	ENVIRON
10		Nov	6	15:30	1.605	0.3323	0.5867			14-1974-2437	14-7486-0204	ENVIRON
11		Dec	7	15:58	1.807	0.5336	0.8855			12-1918-7694	00-1085-2209	ENVIRON
12	2016	Apr	8	14:40	1.512	0.2386	0.4347			17-7738-6530	02-5159-2977	ENVIRON
13		Aug	3	16:55	1.775	0.5015	0.8402			15-5470-2613	20-0153-1348	ENVIRON
14			19	14:25	1.264	-0.009337	-0.01862			11-7594-3529	18-2266-1841	ENVIRON
15		Sep	2	16:25	0.5558	-0.7172	-2.096	(-)	(-)	20-2236-1025	01-7459-0032	ENVIRON
16			30	15:00	1.885	0.6118	0.9928			12-0597-8760	12-1436-9613	ENVIRON
17	2017	May	26	13:00	1.101	-0.1724	-0.3682			15-8049-8093	00-1911-6893	EcoAnalysts
18		Jul	28	14:20	2.103	0.8298	1.27	(+)		11-4327-6237	03-7130-7368	EcoAnalysts
19		Sep	1	15:45	1.407	0.1342	0.2536			18-6405-8290	07-0280-8863	EcoAnalysts
20		Dec	31	15:47	2.466	1.193	1.672	(+)		16-6781-4604	13-3844-2137	EcoAnalysts
21	2018	Feb	23	13:35	1.361	0.0878	0.1687			00-2027-3508	17-9124-7622	EcoAnalysts

CETIS QC Plot

Report Date: 13 Mar-18 15:43 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — All Matching Labs

Test Type:	Survival	**Organism:**	Eohaustorius estuarius (Amphipod)	**Material:**	Unionized Ammonia
Protocol:	EPA/600/R-94/025 (1994)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	0.9206	**Count:**	20	**-1s Warning Limit:**	0.5475	**-2s Action Limit:**	0.3256
Sigma:	n/a	**CV:**	55.70%	**+1s Warning Limit:**	1.548	**+2s Action Limit:**	2.602

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2014	Apr	25	13:00	0.409	-0.5116	-1.561	(-)		05-3931-3196	00-2785-8568	Port Gamble Environment
2		May	30	15:30	1.105	0.1844	0.3514			03-2348-8477	17-7984-3461	ENVIRON
3		Aug	26	15:45	1.037	0.1164	0.2292			16-9917-4183	01-4278-7622	ENVIRON
4		Sep	15	15:10	0.497	-0.4236	-1.186	(-)		04-2286-3837	01-4675-9354	ENVIRON
5		Nov	14	14:25	0.881	-0.03957	-0.08456			07-5753-6828	01-5478-5022	ENVIRON
6		Dec	10	15:50	0.943	0.02243	0.04633			04-0714-3304	12-5251-7122	ENVIRON
7	2015	Feb	27	12:35	0.334	-0.5866	-1.951	(-)		10-1977-7129	04-0485-4050	ENVIRON
8		Jun	26	13:20	1.578	0.6574	1.037	(+)		13-7504-6588	11-4090-1553	ENVIRON
9		Sep	25	17:30	1.111	0.1904	0.3619			00-7510-8480	05-3466-1859	ENVIRON
10		Nov	6	15:30	1.22	0.2994	0.542			14-1974-2437	10-4251-0205	ENVIRON
11		Dec	7	15:58	1.733	0.8124	1.218	(+)		12-1918-7694	05-5204-9536	ENVIRON
12	2016	Apr	8	14:40	0.918	-0.002572	-0.005385			17-7738-6530	07-6987-7357	ENVIRON
13		Aug	3	16:55	1.404	0.4834	0.8123			15-5470-2613	11-2111-0216	ENVIRON
14			19	14:25	0.919	-0.001572	-0.003289			11-7594-3529	06-9525-3086	ENVIRON
15		Sep	2	16:25	0.415	-0.5056	-1.533	(-)		20-2236-1025	20-1525-6837	ENVIRON
16			30	15:00	0.967	0.04643	0.09469			12-0597-8760	06-8089-0740	ENVIRON
17	2017	May	26	13:00	0.445	-0.4756	-1.399	(-)		15-8049-8093	18-0229-5291	EcoAnalysts
18		Jul	28	14:20	1.738	0.8174	1.223	(+)		11-4327-6237	11-4496-1419	EcoAnalysts
19		Sep	1	15:45	1.334	0.4134	0.7139			18-6405-8290	16-4129-3608	EcoAnalysts
20		Dec	31	15:47	1.626	0.7054	1.095	(+)		16-6781-4604	02-2467-9837	EcoAnalysts
21	2018	Feb	23	13:35	0.825	-0.09557	-0.211			00-2027-3508	11-7925-6381	EcoAnalysts

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	03-3036-5909	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 13:35	**Protocol:**	EPA/600/R-94/025 (1994)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 11:40	**Species:**	Eohaustorius estuarius	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Malacostraca	**Source:**	Northwestern Aquatic Scien **Age:**
Sample ID:	19-1574-0154	**Code:**	722FDFFA	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	p170515.67
Sample Age:	284d 14h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
16-8514-1800	Proportion Survived	Fisher Exact Test		69.7	146	100.9		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
12-8139-0101	Proportion Survived	Spearman-Kärber		EC50	144.3	125.5	166		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
16		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
32.4		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
69.7		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
146		3	0.5333	0.3899	0.6768	0.5000	0.6000	0.0333	0.0577	10.83%	46.67%
293		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
16		1.0000	1.0000	1.0000
32.4		1.0000	1.0000	0.9000
69.7		1.0000	1.0000	1.0000
146		0.5000	0.5000	0.6000
293		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
16		10/10	10/10	10/10
32.4		10/10	10/10	9/10
69.7		10/10	10/10	10/10
146		5/10	5/10	6/10
293		0/10	0/10	0/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Start Date:	23 Feb-18 13:35	**Species:**	Eohaustorius estuarius	**Sample Code:**	722FDFFA
End Date:	27 Feb-18 11:40	**Protocol:**	EPA/600/R-94/025 (1994)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Sample Station:**	p170515.67

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	18	10	10	
0	D	2	17	10	10	
0	D	3	16	10	10	
16		1	13	10	10	
16		2	3	10	10	
16		3	14	10	10	
32.4		1	6	10	10	
32.4		2	7	10	10	
32.4		3	12	10	9	
69.7		1	11	10	10	
69.7		2	15	10	10	
69.7		3	8	10	10	
146		1	5	10	5	
146		2	4	10	5	
146		3	2	10	6	
293		1	10	10	0	
293		2	9	10	0	
293		3	1	10	0	

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Batch ID:	09-3914-4382	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 13:35	**Protocol:**	EPA/600/R-94/025 (1994)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 11:40	**Species:**	Eohaustorius estuarius	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Malacostraca	**Source:**	Northwestern Aquatic Scien **Age:**
Sample ID:	07-1989-8147	**Code:**	2AE8C623	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	p170515.67
Sample Age:	284d 14h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
11-7925-6381	Proportion Survived	Fisher Exact Test		0.825	1.377	1.066		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
17-9124-7622	Proportion Survived	Spearman-Kärber		EC50	1.361	1.234	1.5		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.24		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.482		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
0.825		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.377		3	0.5333	0.3899	0.6768	0.5000	0.6000	0.0333	0.0577	10.83%	46.67%
2.215		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
0.24		1.0000	1.0000	1.0000
0.482		1.0000	1.0000	0.9000
0.825		1.0000	1.0000	1.0000
1.377		0.5000	0.5000	0.6000
2.215		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
0.24		10/10	10/10	10/10
0.482		10/10	10/10	9/10
0.825		10/10	10/10	10/10
1.377		5/10	5/10	6/10
2.215		0/10	0/10	0/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Start Date:	23 Feb-18 13:35	**Species:**	Eohaustorius estuarius	**Sample Code:**	2AE8C623
End Date:	27 Feb-18 11:40	**Protocol:**	EPA/600/R-94/025 (1994)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Sample Station:**	p170515.67

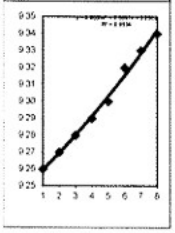
Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	12	10	10	
0	D	2	16	10	10	
0	D	3	9	10	10	
0.24		1	6	10	10	
0.24		2	14	10	10	
0.24		3	15	10	10	
0.482		1	17	10	10	
0.482		2	8	10	10	
0.482		3	11	10	9	
0.825		1	13	10	10	
0.825		2	10	10	10	
0.825		3	1	10	10	
1.377		1	18	10	5	
1.377		2	4	10	5	
1.377		3	7	10	6	
2.215		1	2	10	0	
2.215		2	3	10	0	
2.215		3	5	10	0	

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Reference Toxicant	Test Type:	*Eoh*
COMMENTS:	P170515.67		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	*NH3T (mg/L)*	*salinity (ppt)*	*pH*	*temp (C)*	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.6		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	0		0.499	28	7.9	15.6	288.76	9.3187		0.009
3	15		16.000	28	7.8	15.6	288.76	9.3187		0.240
4	30		32.400	28	7.8	15.5	288.66	9.3187		0.482
5	60		69.700	28	7.7	15.5	288.66	9.3187		0.825
6	120		146.000	28	7.6	15.5	288.66	9.3187		1.377
7	240		293.000	28	7.5	15.6	288.76	9.3187		2.215
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WS

ECO ANALYSTS

Ammonia Reference Toxicant Test Water Quality Data Sheet

CLIENT	PROJECT		Laboratory	PROTOCOL
Landau	Blair Waterway	*Eohaustorius estuarius*	Port Gamble .	PSEP
TEST ID	**LOT #:**	**DILUTION PREP INITIALS:**		
P170515.67	2986C510	UB		
CHAMBER SIZE/TYPE	**EXPOSURE VOLUME**	**TEST START DATE** / **INITIALS** / **TIME**	**TEST END DATE**	**TIME**
Glass pint jar	250 mL	23Feb18 / 1335 / JL, UB	27Feb18	1140

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L)		TEMP(C)		SAL (ppt)		pH		TECHNICIAN	AMMONIA					
					> 4.6		15 ± 1		28 ± 1		7.8 ± 0.5								
SAMPLE ID	CONCENTRATION value	CONCENTRATION units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WQ TECH/ DATE	AMMONIA METER	AMMONIA mg/L	Tech			
Ref.Tox.-ammonia	0	mg/L	0	Stock	9	8.6	9	15.6	9	28	9	7.9	UB 2/23	10	0.499	UB			
			4	1	9	7.2	9	15.7	9	27	9	7.5	UB 2/27						
Ref.Tox.-ammonia	15	mg/L	0	Stock	9	8.8	9	15.6	9	28	9	7.8	UB 2/23	10	16.0	UB			
			4	1	9	7.5	9	15.8	9	28	9	7.8	UB 2/27						
Ref.Tox.-ammonia	30	mg/L	0	Stock	9	8.8	9	15.5	9	28	9	7.8	UB 2/23	10	32.4	UB			
			4	1	9	7.8	9	16.0	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	60	mg/L	0	Stock	9	8.8	9	15.5	9	28	9	7.7	UB 2/23	10	69.7	UB			
			4	1	9	7.8	9	15.8	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	120	mg/L	0	Stock	9	8.7	9	15.5	9	28	9	7.6	UB 2/23	10	146	UB			
			4	1	9	7.8	9	16.0	9	28	9	7.9	UB 2/27						
Ref.Tox.-ammonia	240	mg/L	0	Stock	9	8.7	9	15.6	9	28	9	7.5	UB 2/23	10	293	UB			
			4	1	9	—	9	—	9	—	9	—	~~UB 2/27~~						

EcoAnalysts Ammonia Reference Toxicant Test Water Quality Data Sheet

CLIENT	PROJECT	SPECIES		
		Eohaustorius estuarius		
Landau	Blair Waterway	PROJECT MANAGER: B. Hester	LABORATORY: Port Gamble .	PROTOCOL: PSEP

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

SAMPLE ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 DATE: 2/24/18 TECHNICIAN: UB			DAY 2 DATE: 2/25/18 TECHNICIAN: UB			DAY 3 DATE: 2/26/18 TECHNICIAN: BH			DAY 4 DATE: 2/27 TECHNICIAN: UB		
					#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	10	0	3F	10	0	1F	10	0	3F	10	0	5F
			2	↓	10	0	10F	10	0	6F	10	0	N	10	0	1F
			3	↓	10	0	2F	10	0	2F	10	0	4F	10	0	1F
Ref.Tox.- Ammonia	15	mg/L	1	10	10	0	5F	10	0	2F	10	0	4F	10	0	1F
			2	↓	10	0	1F	10	0	2F	10	0	1F	10	0	N
			3	↓	10	0	2F	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	30	mg/L	1	10	10	0	4F	10	0	3F	10	0	N	10	0	N
			2	↓	10	0	5F	10	0	2F 4F (1)	10	0	4F	10	0	1F
			3	↓	9	1	3F	9 10 (3)	0	4F (2) 8F	9	0	1F	9	0	2F
Ref.Tox.- Ammonia	60	mg/L	1	10	10	0	7F	10	0	3F	10	0	2F	10	0	4F
			2	↓	10	0	5F	10	0	4F	10	0	3F	10	0	5F
			3	↓	10	0	6F	10	0	8F	10	0	8F	10	0	2F
Ref.Tox.- Ammonia	120	mg/L	1	10	0 8	2	2F	8	0	2F	6	2	1F	5	1	1F,Q
			2	↓	9	1	5F	9	0	2F	8	1	2F/Q	5	3	2F,Q
			3	↓	10	0	5F	9	1	4F	7	2	4F/Q	6	1	4F,Q
Ref.Tox.- Ammonia	240	mg/L	1	10	5	5	2F	0	5	—	—	—	—			
			2	↓	6	4	4F	3	3	Q DC	0	3	—			
			3	↓	6	4	5F	1	5	Q DC	0	1	—			

(1) 1B, 8 alive UB 2/24
(2) WC 2F, UB 2/25
(3) WC 4F UB 2/25
9 alive

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170515.67
Date Prepared: 2/23/18
Technician Initials: VB

Amp/Eoh NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 1/23/2018
Measurement: 9676.66

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			[redacted]	SALT WATER
293	**240**	750	[redacted]	**27.902**
146	**120**	750	[redacted]	**13.951**
69.7	**60**	750	[redacted]	**6.976**
32.4	**30**	750	[redacted]	**3.488**
16.0	**15**	750	[redacted]	**1.744**
0.499	**0**	750	[redacted]	**0.000**
			[redacted]	
			[redacted]	

ORGANISM RECEIPT LOG

Date: 2/22/18	Time: 1400	Batch No. NAS022218
Organism: Eohaustorius estuarius		
Source / Supplier: Northwestern Aquatic Sciences		
No. Ordered: 860 / 900	**No. Received:** 860 + 10 L / 900 + 10 L	**Source Batch:** Collection date, hatch date, etc.): 2/19/18
Condition of Organisms: Good	**Approximate Size or Age:** (Days from hatch, life stage, size class, etc.): 3-5 mm	
Shipper: FedEx	**B of L (Tracking No.)** 0215 8112 7869 9780	
Condition of Container: Good	**Received By:** JL	

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
①							JL

*if >10% contact lab manager

Notes: ① Received Dry

Northwestern Aquatic Sciences
3814 Yaquina Bay Rd., P.O. Box 1437, Newport, OR 97365
Tel: 541-265-7225, Fax: 541-265-2799, www.nwaquatic.com

SUBJECT: Animal Collection Data Sheet (shipping)

SOLD TO: EcoAnalysts
4770 NE View Dr.
P.O. Box 216
Port Gamble WA 98364

Brian Hester/Collin Ray/Hillary Eicholer
360.297.6040
Julia Baum
360.509.4141

FedEx# 1817-5747-7

P.O. # 1398 PGL

DATE OF SHIPMENT: 2-21-18

ANIMAL HISTORY

Species	Age/Size	Number Shipped
Eohaustorius estuarius	3-5mm	860 + 10%

WATER QUALITY AT TIME OF SHIPMENT

Temperature (°C): 15.2	pH: 8.1	Salinity (ppt): 30.5	D.O. (mg/L): 8.3
Other:			

PACKAGED BY: Yves Nalcheme **DATE:** 2-21-18

FIELD COLLECTION/CULTURE NOTES

Collected 2-19-18 from Yaquina Bay, OR.
Interstitial WQ: Temp: 0.0 °C, Salinity 27.0 ppt.; salinity was adjusted down or up ~ 5ppt as needed.
Held at 15°C in aerated water.

ADDITIONAL COMMENTS

P.O. # 1398 PGL

2-liters of 0.5 mm sieved home sediment included.

PLEASE RETURN ALL SHIPPING MATERIALS

If you have any questions, Please call Gary Buhler or Gerald Irissarri at (541) 265-7225. Thank You.

MAINTENANCE LOG FOR CULTURES

ORGANISM: *Eohaustorius estuarius*
LOCATION: bath 5

Feed: tetramin slurry

Batch Number: ~~NAS0221~~ ① NAS022218	Date Received: 2/22/18	Initial # of Organisms: ~1936

Date	Feed AM/PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal ppt	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/23/18	② ✓	1	8.3	15.4	29	7.9	N	Y	0	—	UB	
↓	② ✓	2	8.5	15.3	29	8.0	N	Y	0	—	UB	
2/24/18	—	1	7.7	16.1	29	8.0	Y	Y	1	<1%.	UB	
↓	—	2	8.1	15.9	28	8.0	Y	Y	1	<1%.	UB	
2/25/18	✓	1	7.7	16.1	29	7.7	N	Y	30	~1.5%.	UB	
↓	✓	2	8.0	15.9	28	7.8	N	Y	14	<1%.	UB	
2/26/18	✓	1	8.0	16.0	29	7.8	③ ~~N~~ Y	Y	1	<1%	BG	
↓	✓	2	8.1	15.9	28	7.8	③ ~~N~~ Y	Y	3	<1%	BG	
2/27	—	1	7.4	16.1	28	7.6	Y	Y	5	<1%.	UB	
↓	—	2	7.9	16.0	28	7.8	Y	Y	3	<1%.	UB	
2/28	✓	1	7.8	16.1	29	7.8	N	Y	5	<1%.	UB	
↓	✓	2	8.0	16.0	29	7.8	N	Y	0	—	UB	
3/1	—	1	7.8	16.1	29	7.9	~~N~~ Y ④	Y	2	<1%.	UB	
↓	—	2	7.8	16.0	29	7.9	~~N~~ Y ④	Y	1	<1%.	UB	
3/2	—	1	7.7	16.3	30	7.9	NA	Y	0	—	UB	
↓	—	2	7.8	16.2	30	7.9	NA	Y	0	—	UB	
3/5	—	1	7.7	15.9	31	7.8	NA	Y	0	—	BG	
↓	—	2	7.9	16.1	31	7.8	NA	Y	0	—	BG	

FT = Flow-through
*if >10% notify lab manager

① IG, UB 2/23 ② Fed in PM, UB 2/23 ③ H_2O was changed but not recorded UB 2/28
④ Increase sal to 30 ppt, UB 3/1

END OF CULTURE 3/5/18 BG

2. *Neanthes arenaceodentata* 20-Day Test

ECO ANALYSTS

20-DAY CHRONIC TEST
INTERACTIVE DATA SETUP

GENERAL

CLIENT:	Landau
PROJECT:	Blair Waterway
JOB NUMBER:	PG1103
PROJECT MANAGER:	Brian Hester
TEST SPECIES:	*Neanthes arenaceodentata*
ORGANISM BATCH:	NAS022218
TEST PROTOCOL:	PSEP 1995
LABORATORY:	Port Gamble
TEST LOCATION:	Bath 7
TEST START DATE:	23Feb18
TEMP. RECORDER#:	NA
DILUTION WATER BATCH:	FSW022118.01
FEEDING INFORMATION:	40 mg/test chamber every other day
WATER RENEWAL INFO:	1/3 of total volume every third day

TEST START TIME:	1445 JL, LB
TEST START TIME:	0900 JL, LB

FIELD SAMPLE

DATE RCVD AT PORT GAMBLE	
SAMPLE STORAGE:	4 Degrees Celsius - dark
SAMPLE TREATMENT:	none
TEST CHAMBER:	1 L glass mason jar
EXPOSURE VOLUME:	2 cm sediment/water to 950 mL
REFERENCE TOXICANT #1:	ammonia - TAN
REF. TOX. MATERIAL #1:	ammonium chloride

NH3 REFTOX CONC (mg/ L)
0
15
30
60
120
240

	CLIENT SAMPLE ID	SAMPLE ID
1	Carr Reference	
2	SG-17	

CONTROL ID	CONTROL ID
Control	Eoh Sand

DAILY DATA QA CHECKS: (Date/Initials)

2/23/18	JL 2/23
2/24/18	LB 2/24
2/25/18	LB 2/25
2/26/18	JL 2/26
2/27/18	LB 2/27
2/28/18	JL 3/12
3/1/18	↓
3/2/18	JL 3/02
3/3/18	LB 3/3
3/4/18	3/4/LB
3/5/18	JL 3/05
3/6/18	JL 3/12
3/7/18	
3/8/18	
3/9/18	↓
3/10/18	LB 3/10
3/11/18	JL 3/12
3/12/18	↓
3/13/18	JL 3/15
3/14/18	
3/15/18	↓

TEST PARAMETERS	TARGET	ACCEPTABLE RANGE / COMMENTS
DO: (mg/L)	>4.6	60% Sat @ 20°C, 28ppt
Temp: (°C)	20 ± 1	Optimal
Sal: (ppt)	28 ± 2	Optimal
pH:	7 - 9	Optimal

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
Control / Eoh Sand	0	Surr	2	9	7.8	9	19.7	9	28	9	7.7		JL	2.23.18 BH
Control / Eoh Sand	1	Surr		8	7.4	8	18.9	8	28	8	7.8			UB 2/24
Control / Eoh Sand	2	Surr		8	7.5	8	19.1	8	28	8	8.0		UB	UB 2/25
Control / Eoh Sand	3	Surr		9	7.7	9	19.1	9	28	9	7.9	BG		BG 2/26/18
Control / Eoh Sand	4	Surr		9	7.5	9	19.0	9	28	9	8.0		UB	UB 2/27
Control / Eoh Sand	5	Surr		9	7.3	9	19.5	9	28	9	7.9			UB 2/28
Control / Eoh Sand	6	Surr		9	7.2	9	20.1	9	28	9	7.8	UB/JL	UB	JL 3/01
Control / Eoh Sand	7	Surr		9	7.1	9	20.3	9	28	9	7.9			JL 3/02
Control / Eoh Sand	8	Surr		9	7.3	9	20.5	9	28	9	8.0		UB	UB 3/3
Control / Eoh Sand	9	Surr		9	7.2	9	20.9	9	28	9	7.7	GR		GR 3/4
Control / Eoh Sand	10	Surr		8	7.5	8	20.1	8	28	8	7.9		JL	JL 3/05
Control / Eoh Sand	11	Surr		8	7.2	8	20.3	8	28	8	7.9			UB 3/6
Control / Eoh Sand	12	Surr		8	7.3	8	20.4	8	28	8	8.0	UB	UB	UB 3/7
Control / Eoh Sand	13	Surr		8	7.1	8	20.6	8	28	8	7.9			UB 3/8
Control / Eoh Sand	14	Surr		8	7.3	8	20.5	8	28	8	7.9		UB	UB 3/9
Control / Eoh Sand	15	Surr		8	7.3	8	20.5	8	28	8	7.9	UB		UB 3/10
Control / Eoh Sand	16	Surr		8	7.4	8	20.7	8	28	8	7.8		JL	JL 3/11
Control / Eoh Sand	17	Surr		8	7.4	8	20.7	8	28	8	7.9			JL 3/12
Control / Eoh Sand	18	Surr		8	7.2	8	21.0	8	28	8	7.9	UB	UB	UB 3/13
Control / Eoh Sand	19	Surr		8	7.3	8	20.7	8	28	8	7.8			UB 3/14
Control / Eoh Sand	20	Surr	↓	8	7.4	8	20.4	8	28	8	7.9			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
Carr Reference /	0	Surr	5	9	7.9	9	19.7	9	28	9	7.8		JL	2.23.18 BH
Carr Reference /	1	Surr		8	7.5	8	18.9	8	28	8	7.9			UB 2/24
Carr Reference /	2	Surr		8	7.5	8	19.1	8	28	8	8.0		UB	UB 2/25
Carr Reference /	3	Surr		9	7.5	9	19.0	9	28	9	7.9	BH		BH 2/26
Carr Reference /	4	Surr		9	7.5	9	19.1	9	28	9	8.0		UB	UB 2/27
Carr Reference /	5	Surr		9	7.4	9	19.4	9	28	9	7.9			UB 2/28
Carr Reference /	6	Surr		9	7.3	9	20.0	9	28	9	7.9	UB/JL	UB	JL 3/01
Carr Reference /	7	Surr		9	7.1	9	20.4	9	28	9	7.9			JL 3/02
Carr Reference /	8	Surr		9	7.2	9	20.4	9	28	9	8.0		UB	UB 3/3
Carr Reference /	9	Surr		9	7.3	9	20.8	9	28	9	7.7	CR		CR 3/4
Carr Reference /	10	Surr		8	7.5	8	19.9	8	28	8	7.9		JL	JL 3/05
Carr Reference /	11	Surr		8	7.4	8	20.2	8	28	8	8.0			UB 3/6
Carr Reference /	12	Surr		8	7.4	8	20.3	8	28	8	8.1	UB	UB	UB 3/7
Carr Reference /	13	Surr		8	7.2	8	20.4	8	28	8	8.0			UB 3/8
Carr Reference /	14	Surr		8	7.5	8	20.4	8	28	8	8.1		UB	UB 3/9
Carr Reference /	15	Surr		8	7.4	8	20.4	8	28	8	8.0	UB		UB 3/10
Carr Reference /	16	Surr		8	7.5	8	20.5	8	28	8	8.0		JL	JL 3/11
Carr Reference /	17	Surr		8	7.5	8	20.5	8	28	8	8.0			JL 3/12
Carr Reference /	18	Surr		8	7.4	8	20.9	8	28	8	8.1	UB	UB	UB 3/13
Carr Reference /	19	Surr		8	7.5	8	20.4	8	28	8	8.0			UB 3/14
Carr Reference /	20	Surr		8	7.6	8	20.4	8	28	8	8.1			UB 3/15

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Landau	Blair Waterway	1445 / 0900	FSW022118.01	PSEP 1995	23-Feb-2018
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1103	Brian Hester	Port Gamble / Bath 7	ATS022218	*Neanthes arenaceodentata*	15-Mar-2018

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) > 4.6		TEMP (C) 20 ± 1		SALINITY (ppt) 28 ± 2		pH 8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
SG-17 /	0	Surr	22A	9	7.8	9	~~0~~ 19.5	9	28	9	7.8		JL	2.23.18 BH
SG-17 /	1	Surr		8	7.5	8	18.8	8	28	8	7.9			UB 2/24
SG-17 /	2	Surr		8	7.5	8	18.9	8	28	8	8.0		UB	UB 2/25
SG-17 /	3	Surr		9	7.4	9	18.7	9	28	9	7.9	BH		BH 2/26/18
SG-17 /	4	Surr		9	7.4	9	19.0	9	28	9	8.0		UB	UB 2/27
SG-17 /	5	Surr		9	7.4	9	19.3	9	28	9	7.9			UB 2/28
SG-17 /	6	Surr		9	7.1	9	19.8	9	28	9	7.9	UB/JL	UB	JL 3/01
SG-17 /	7	Surr		9	7.1	9	20.0	9	28	9	7.9			JL 3/02
SG-17 /	8	Surr		9	7.3	9	19.9	9	28	9	8.0		UB	UB 3/3
SG-17 /	9	Surr		9	7.3	9	20.2	9	28	9	7.8	CR		CR 3/4
SG-17 /	10	Surr		8	7.4	8	19.8	8	28	8	7.9		JL	JL 3/05
SG-17 /	11	Surr		8	7.4	8	19.9	8	28	8	8.0			UB 3/6
SG-17 /	12	Surr		8	7.3	8	19.9	8	28	8	8.0	UB	UB	UB 3/7
SG-17 /	13	Surr		8	7.1	8	20.0	8	28	8	8.0			UB 3/8
SG-17 /	14	Surr		8	7.2	8	20.0	8	28	8	8.1		UB	UB 3/9
SG-17 /	15	Surr		8	7.4	8	19.9	8	28	8	8.0	UB		UB 3/10
SG-17 /	16	Surr		8	7.4	8	20.1	8	28	8	8.0		JL	JL 3/11
SG-17 /	17	Surr		8	7.2	8	20.0	8	28	8	7.9			JL 3/12
SG-17 /	18	Surr		8	7.4	8	20.4	8	28	8	8.0	UB	UB	UB 3/13
SG-17 /	19	Surr		8	7.2	8	20.2	8	28	8	8.0			UB 3/14
SG-17 /	20	Surr		8	7.4	8	19.9	8	28	8	8.0			UB 3/15

@ IE 2.23.18 BH

Ammonia and Sulfide Analysis Record

Client/Project:	Organism:	Test Duration (days):
Landau/Blair Waterway	Neanthes	20

PRETEST / (INITIAL) / FINAL / OTHER (circle one)

(OVERLYING (OV)) / (POREWATER (PW)) (circle one) / Comments: _____

DAY of TEST: 0

Calibration Standards Temperature	
Date:	Temperature:
2/23/18	20.7°C

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV 0	Surf.	2/23/18 JL	0.102	TAp	20.7	2/23/18 JL/LB	N			10	0.003		
Ref.			0.239								0.002		
G.S			1.09								0.000		
SG.14			0.828								0.000		
SG.16			0.746								0.000		
SG.17			0.327	↓	↓						0.000		
①													
PW 0+0			②	TAp	19.7								
Ref			5.22					7.7	29	5	0.00	2	
G.S			10.4					7.8	7.8① 29		0.002		0.004
SG.14			8.46					7.8	29		0.00		
SG.16			5.58					7.8	30 24①		0.00		
SG.17			7.12	↓	↓	↓	↓	7.8	29 30①	↓	0.00	↓	

① IG.JL 2/23/18. ②

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway	Organism: Neanthes	Test Duration (days): 20

PRETEST / INITIAL / ~~FINAL~~ / OTHER (circle one)

~~OVERLYING (OV)~~ / ~~POREWATER (PW)~~ (circle one) / Comments: _____

DAY of TEST: 20

Calibration Standards Temperature		
Date: 3/15/18	Temperature: 20.8 °C	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

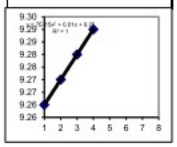
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV. Ø	Surr	3/15/18 JV	0.614	TAP	19.8	3/15/18 JV	N			10	0.006		
CARP REF.			0.196								ND		
G·5			0.136								0.001		
S6·14			0.116								0.00		
S6·16			0.143								ND		
S6·17			0.132	↓	↓					↓	ND		
PW Ø			1.25	TAP	20.8			7.5	29	2	0.00	5	0.00
CARP REF.			0.350		21.1			7.2	27	5	ND	2	—
G·5			1.36		21.8			7.2	28		0.00		0.00
S6·14			0.964		21.1			7.3	27		0.004		0.008
S6·16			1.81		21.6			7.0	27		ND		←
S6·17			0.359	↓	21.2			7.1	27		0.011	↓	0.022

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Neanthes arenaceodentata*
COMMENTS:	Porewater calculations performed with porewater WQ parameters		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29

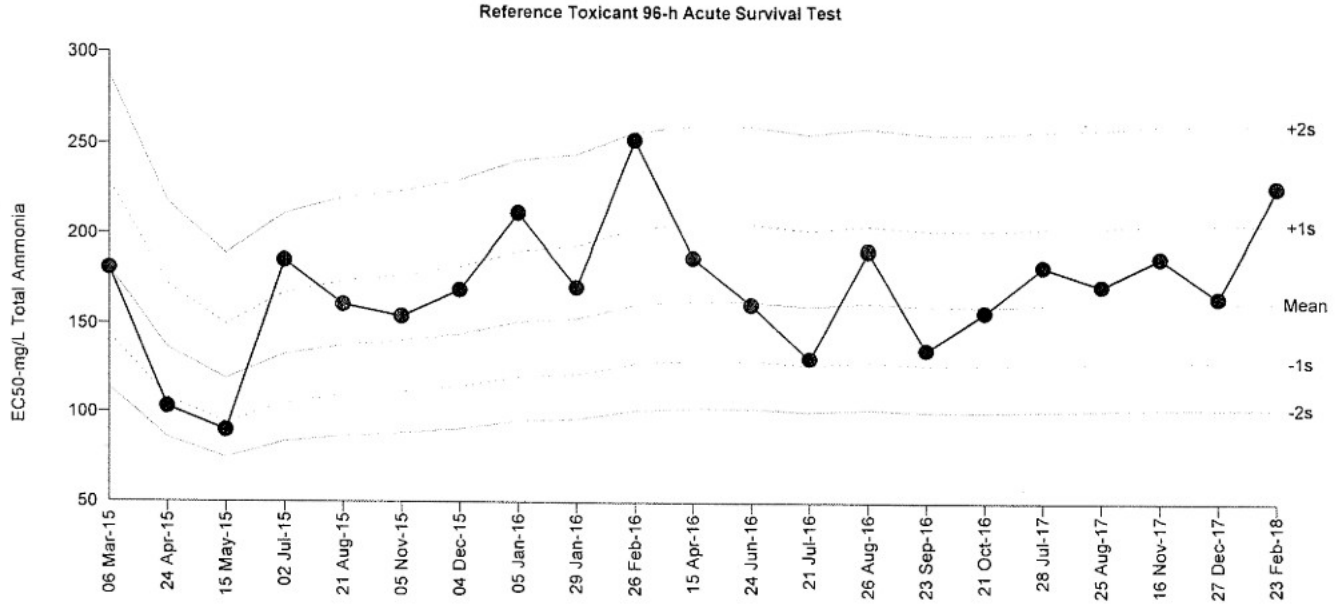


Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
Day 0 OV									
Control		0.102	28	7.7	19.7	292.86	9.3187		0.002
Carr Reference		0.239	28	7.8	19.7	292.86	9.3187		0.005
SG-17		0.327	28	7.8	19.5	292.66	9.3187		0.007
Day 0 PW									
Control		NM			19.7	292.86	9.2548		#VALUE!
Carr Reference		5.220	29	7.7	19.7	292.86	9.3214		0.084
SG-17		7.120	29	7.8	19.5	292.66	9.3214		0.141
Day 20 OV									
Control		0.614	28	7.9	20.4	293.56	9.3187		0.016
Carr Reference		0.196	28	8.1	20.4	293.56	9.3187		0.008
SG-17		0.132	28	8.0	19.9	293.06	9.3187		0.004
Day 20 PW									
Control		1.250	29	7.5	20.4	293.56	9.3214		0.013
Carr Reference		0.350	27	7.2	20.4	293.56	9.3160		0.002
SG-17		0.359	27	7.1	19.9	293.06	9.3160		0.002

	Input				Output		
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	3	19.7	28	7.7	0.38	0.000	12.70%
Carr Reference	2	19.7	28	7.8	0.21	0.000	10.34%
SG-17	0	19.5	28	7.8	0.00	0.000	#DIV/0!
Day 0 PW					0.00	0.000	#DIV/0!
Control	#VALUE!	19.7	0	0	#VALUE!	#VALUE!	#VALUE!
Carr Reference	0	19.7	29	7.7	0.00	0.000	#DIV/0!
SG-17	0	19.5	29	7.8	0.00	0.000	#DIV/0!
Day 20 OV					0.00	0.000	#DIV/0!
Control	6	20.4	28	7.9	0.49	0.000	8.19%
Carr Reference	#VALUE!	20.4	28	8.1	#VALUE!	#VALUE!	#VALUE!
SG-17	#VALUE!	19.9	28	8.0	#VALUE!	#VALUE!	#VALUE!
Day 20 PW					0.00	0.000	#DIV/0!
Control	0	20.4			0.00	0.000	#DIV/0!
Carr Reference	#VALUE!	20.4	27	7.2	#VALUE!	#VALUE!	#VALUE!
SG-17	22	19.9			23.38	0.023	106.29%
36					0.00		#DIV/0!
37					0.00		#DIV/0!
38					0.00		#DIV/0!
39					0.00		#DIV/0!
40					0.00		#DIV/0!
41					0.00		#DIV/0!
42	0	19.5	30	7.8	0.00		#DIV/0!
43	24	19.5	30	7.88	2.09		8.72%
44	96	19.5	30	7.89	8.20		8.54%
45	179	19.5	30	7.91	14.65		8.19%
46	207	19.5	30	7.93	16.24		7.84%
47	247	19.5	30	7.93	19.37		7.84%

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Total Ammonia
Protocol:	PSEP (1995)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	163.7	**Count:**	20	**-1s Warning Limit:**	129.8	**-2s Action Limit:**	102.9
Sigma:	n/a	**CV:**	23.50%	**+1s Warning Limit:**	206.4	**+2s Action Limit:**	260.3

Quality Control Data

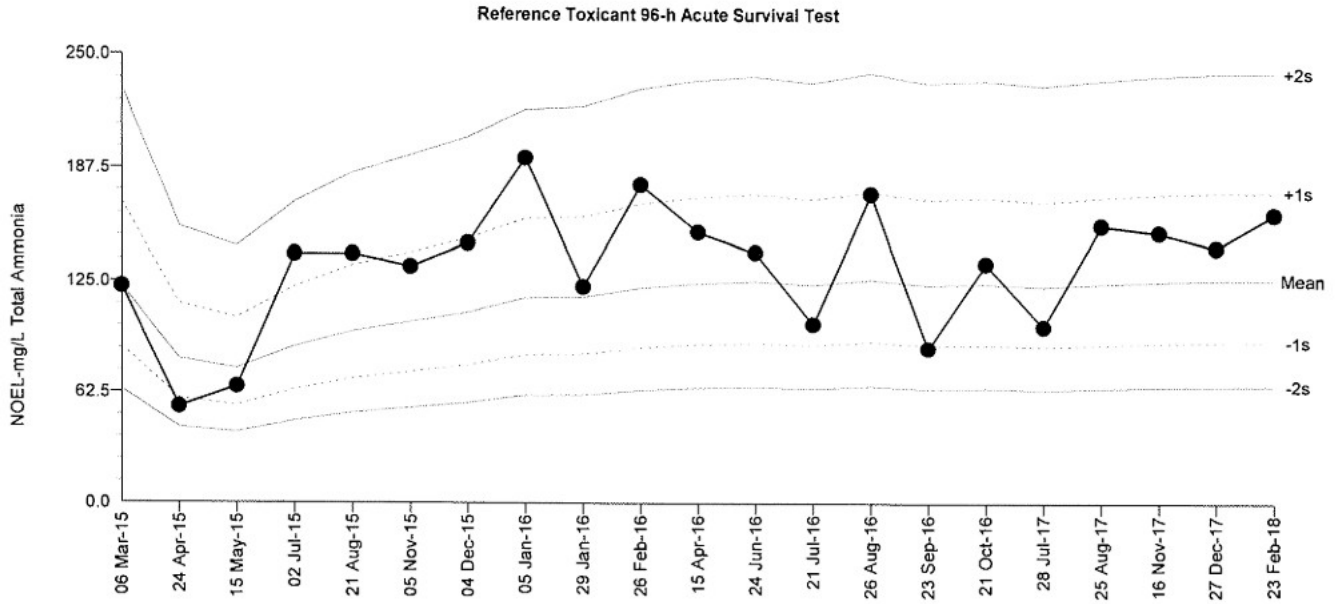
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Mar	6	11:50	181.2	17.46	0.4369			09-2159-7453	09-1672-5355	ENVIRON
2		Apr	24	12:50	103.1	-60.61	-1.993	(-)		01-6315-9057	02-6990-5019	ENVIRON
3		May	15	14:00	89.83	-73.87	-2.587	(-)	(-)	15-1184-2734	08-8902-1629	ENVIRON
4		Jul	2	14:15	185.6	21.89	0.5409			18-8075-0902	16-6019-0259	ENVIRON
5		Aug	21	16:33	161	-2.709	-0.07194			18-5704-8732	08-2852-0434	ENVIRON
6		Nov	5	16:00	154.3	-9.358	-0.2537			15-0871-2744	12-3779-6972	ENVIRON
7		Dec	4	15:55	169.2	5.529	0.1432			15-8650-5167	03-4063-5051	ENVIRON
8	2016	Jan	5	15:40	211.6	47.91	1.107	(+)		08-2089-5605	19-0377-2050	ENVIRON
9			29	10:55	170.9	7.215	0.1859			17-5198-4435	10-4316-4458	ENVIRON
10		Feb	26	13:05	251.9	88.21	1.858	(+)		12-4659-9912	05-2938-3515	ENVIRON
11		Apr	15	11:20	187.5	23.79	0.5848			14-5662-2397	01-2817-7421	ENVIRON
12		Jun	24	14:10	161.5	-2.186	-0.05794			18-4503-3329	10-8210-8087	ENVIRON
13		Jul	21	14:00	130.8	-32.86	-0.9658			03-2252-3368	14-5043-4569	ENVIRON
14		Aug	26	17:00	191.5	27.82	0.6765			03-0001-3671	08-4097-9552	ENVIRON
15		Sep	23	14:00	135.9	-27.83	-0.8032			11-8849-2684	05-6423-6975	ENVIRON
16		Oct	21	12:20	157.3	-6.356	-0.1707			07-3517-7142	10-6382-3344	ENVIRON
17	2017	Jul	28	10:45	183.1	19.39	0.4825			04-6413-3650	06-5419-2075	EcoAnalysts
18		Aug	25	10:40	172.2	8.538	0.2191			03-6651-4426	03-4165-4995	EcoAnalysts
19		Nov	16	13:40	188.2	24.52	0.6016			03-0415-6136	04-9955-5124	EcoAnalysts
20		Dec	27	15:35	165.8	2.149	0.05622			01-8821-8905	08-9204-3617	EcoAnalysts
21	2018	Feb	23	16:20	226.4	62.72	1.398	(+)		13-7905-8989	13-7098-6720	EcoAnalysts

CETIS QC Plot

Report Date: 21 Mar-18 12:07 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Total Ammonia
Protocol:	PSEP (1995)	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	126.2	**Count:**	20	**-1s Warning Limit:**	91.44	**-2s Action Limit:**	66.26
Sigma:	n/a	**CV:**	33.10%	**+1s Warning Limit:**	174.1	**+2s Action Limit:**	240.3

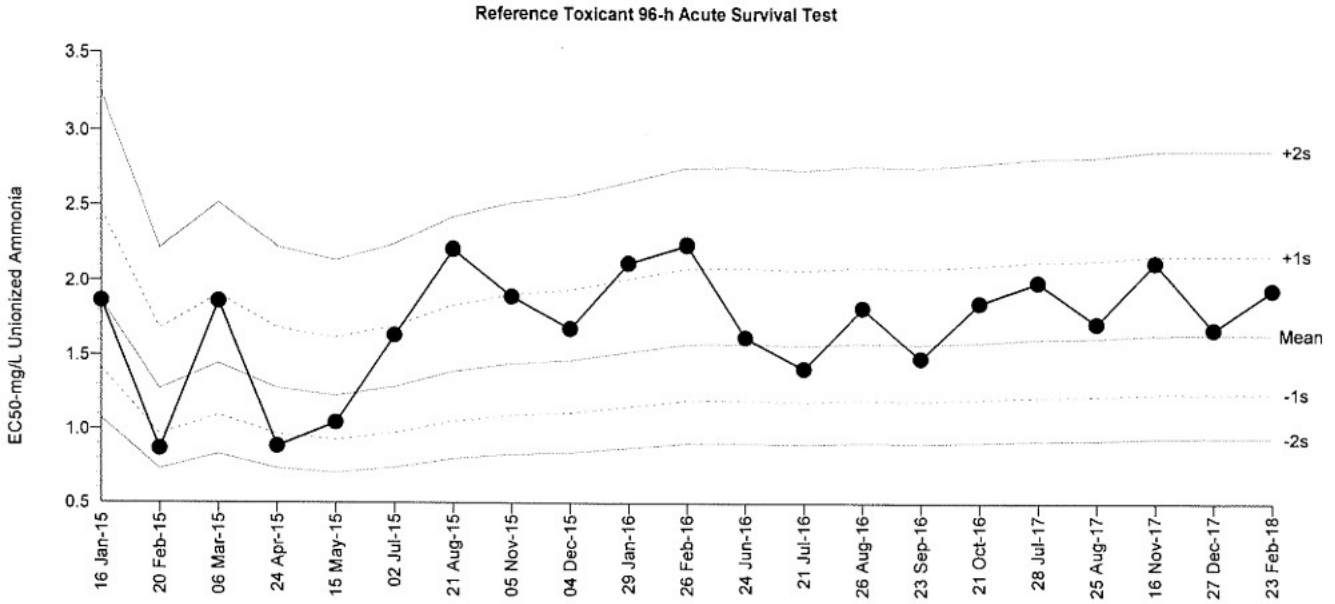
Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Mar	6	11:50	122	-4.217	-0.1055			09-2159-7453	06-6960-4147	ENVIRON
2		Apr	24	12:50	54.3	-71.92	-2.619	(-)	(-)	01-6315-9057	00-4642-5370	ENVIRON
3		May	15	14:00	65.6	-60.62	-2.032	(-)	(-)	15-1184-2734	09-3943-6020	ENVIRON
4		Jul	2	14:15	140	13.78	0.3218			18-8075-0902	00-0324-0641	ENVIRON
5		Aug	21	16:33	140	13.78	0.3218			18-5704-8732	12-5806-5521	ENVIRON
6		Nov	5	16:00	133	6.783	0.1625			15-0871-2744	05-8415-3689	ENVIRON
7		Dec	4	15:55	146	19.78	0.4521			15-8650-5167	03-6544-2607	ENVIRON
8	2016	Jan	5	15:40	193	66.78	1.319	(+)		08-2089-5605	14-5672-8302	ENVIRON
9			29	10:55	122	-4.217	-0.1055			17-5198-4435	20-2746-8183	ENVIRON
10		Feb	26	13:05	178	51.78	1.067	(+)		12-4659-9912	04-9112-4627	ENVIRON
11		Apr	15	11:20	152	25.78	0.5771			14-5662-2397	08-8399-3634	ENVIRON
12		Jun	24	14:10	141	14.78	0.3439			18-4503-3329	05-9137-4303	ENVIRON
13		Jul	21	14:00	101	-25.22	-0.692			03-2252-3368	05-6001-6512	ENVIRON
14		Aug	26	17:00	173	46.78	0.9789			03-0001-3671	13-0809-8319	ENVIRON
15		Sep	23	14:00	87.6	-38.62	-1.134	(-)		11-8849-2684	14-0354-7159	ENVIRON
16		Oct	21	12:20	135	8.783	0.2089			07-3517-7142	04-1673-2094	ENVIRON
17	2017	Jul	28	10:45	99.9	-26.32	-0.726			04-6413-3650	18-1225-7941	EcoAnalysts
18		Aug	25	10:40	156	29.78	0.6577			03-6651-4426	09-2206-9228	EcoAnalysts
19		Nov	16	13:40	152	25.78	0.5771			03-0415-6136	18-4343-4696	EcoAnalysts
20		Dec	27	15:35	144	17.78	0.4092			01-8821-8905	01-3003-6293	EcoAnalysts
21	2018	Feb	23	16:20	162	35.78	0.7749			13-7905-8989	16-4206-5191	EcoAnalysts

Analyst: LB QA: JL

Reference Toxicant 96-h Acute Survival Test All Matching Labs

Test Type: Survival **Organism:** Neanthes arenaceodentata (Polycha **Material:** Unionized Ammonia
Protocol: PSEP (1995) **Endpoint:** Proportion Survived **Source:** Reference Toxicant-REF



Mean:	1.644	**Count:**	20	**-1s Warning Limit:**	1.246	**-2s Action Limit:**	0.9438
Sigma:	n/a	**CV:**	28.30%	**+1s Warning Limit:**	2.17	**+2s Action Limit:**	2.864

Quality Control Data

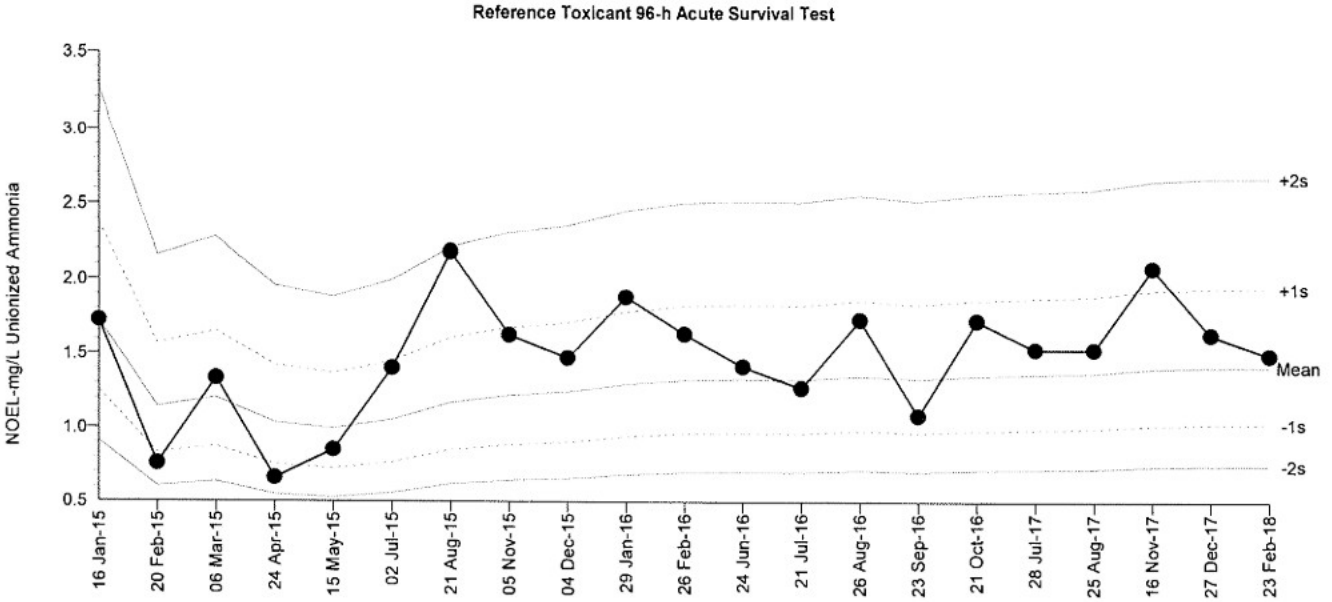
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.864	0.22	0.4527			18-9719-6747	15-5803-7088	ENVIRON
2		Feb	20	14:50	0.866	-0.7779	-2.31	(-)	(-)	15-6687-7653	15-3894-5718	ENVIRON
3		Mar	6	11:50	1.861	0.2174	0.4475			11-3697-1780	11-9165-3524	ENVIRON
4		Apr	24	12:50	0.8832	-0.7607	-2.239	(-)	(-)	01-0867-6874	09-2102-1717	ENVIRON
5		May	15	14:00	1.043	-0.6013	-1.641	(-)		09-1275-9559	04-5482-9783	ENVIRON
6		Jul	2	14:15	1.633	-0.0114	-0.02508			12-0891-3679	07-1814-7730	ENVIRON
7		Aug	21	16:33	2.206	0.5617	1.059	(+)		12-1645-6634	17-4166-4421	ENVIRON
8		Nov	5	16:00	1.894	0.2498	0.5097			13-9158-6969	12-9319-1772	ENVIRON
9		Dec	4	15:55	1.68	0.03569	0.0774			05-0232-3049	00-1680-9936	ENVIRON
10	2016	Jan	29	10:55	2.116	0.4725	0.9104			02-3774-6836	17-0304-9971	ENVIRON
11		Feb	26	13:05	2.236	0.5918	1.108	(+)		18-2733-1978	16-1252-1654	ENVIRON
12		Jun	24	14:10	1.621	-0.02294	-0.05065			14-5937-9292	12-2632-5647	ENVIRON
13		Jul	21	14:00	1.412	-0.2319	-0.548			13-0851-4355	08-2460-4906	ENVIRON
14		Aug	26	17:00	1.818	0.1739	0.3624			18-0730-6378	20-7585-3701	ENVIRON
15		Sep	23	14:00	1.482	-0.1623	-0.3746			16-0277-5330	13-3150-6775	ENVIRON
16		Oct	21	12:20	1.851	0.2074	0.4282			15-4953-5653	13-6771-5656	ENVIRON
17	2017	Jul	28	10:45	1.989	0.3452	0.6868			11-9488-2902	14-7043-7154	EcoAnalysts
18		Aug	25	10:40	1.716	0.07165	0.1537			04-3451-1040	00-3615-6317	EcoAnalysts
19		Nov	16	13:40	2.122	0.4781	0.9199			21-2485-6236	15-8866-6943	EcoAnalysts
20		Dec	27	15:35	1.678	0.03394	0.07363			14-3251-3795	10-3688-8341	EcoAnalysts
21	2018	Feb	23	16:20	1.939	0.2946	0.594			08-4313-9079	15-8743-9749	EcoAnalysts

CETIS QC Plot

Report Date: 21 Mar-18 13:07 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival | **Organism:** Neanthes arenaceodentata (Polycha | **Material:** Unionized Ammonia
Protocol: PSEP (1995) | **Endpoint:** Proportion Survived | **Source:** Reference Toxicant-REF



Mean:	1.414	**Count:**	20	**-1s Warning Limit:**	1.028	**-2s Action Limit:**	0.7469
Sigma:	n/a	**CV:**	32.70%	**+1s Warning Limit:**	1.945	**+2s Action Limit:**	2.677

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.723	0.3092	0.6198			18-9719-6747	13-2446-7374	ENVIRON
2		Feb	20	14:50	0.756	-0.6578	-1.962	(-)		15-6687-7653	19-8246-2320	ENVIRON
3		Mar	6	11:50	1.333	-0.08083	-0.1845			11-3697-1780	05-2303-0535	ENVIRON
4		Apr	24	12:50	0.659	-0.7548	-2.392	(-)	(-)	01-0867-6874	18-8094-8803	ENVIRON
5		May	15	14:00	0.85	-0.5638	-1.595	(-)		09-1275-9559	12-8836-8785	ENVIRON
6		Jul	2	14:15	1.402	-0.01183	-0.02632			12-0891-3679	17-1059-5211	ENVIRON
7		Aug	21	16:33	2.184	0.7702	1.363	(+)		12-1645-6634	17-2823-4932	ENVIRON
8		Nov	5	16:00	1.627	0.2132	0.4401			13-9158-6969	18-5085-3785	ENVIRON
9		Dec	4	15:55	1.473	0.05917	0.1285			05-0232-3049	09-1115-6716	ENVIRON
10	2016	Jan	29	10:55	1.883	0.4692	0.898			02-3774-6836	16-2829-1192	ENVIRON
11		Feb	26	13:05	1.635	0.2212	0.4555			18-2733-1978	17-6331-1700	ENVIRON
12		Jun	24	14:10	1.415	0.001173	0.0026			14-5937-9292	10-8537-0051	ENVIRON
13		Jul	21	14:00	1.27	-0.1438	-0.3362			13-0851-4355	06-2505-9350	ENVIRON
14		Aug	26	17:00	1.732	0.3182	0.6361			18-0730-6378	04-2606-0638	ENVIRON
15		Sep	23	14:00	1.085	-0.3288	-0.8296			16-0277-5330	10-1484-1501	ENVIRON
16		Oct	21	12:20	1.725	0.3112	0.6234			15-4953-5653	10-3980-3312	ENVIRON
17	2017	Jul	28	10:45	1.532	0.1182	0.2516			11-9488-2902	00-8692-4177	EcoAnalysts
18		Aug	25	10:40	1.53	0.1162	0.2475			04-3451-1040	07-6966-4955	EcoAnalysts
19		Nov	16	13:40	2.079	0.6652	1.208	(+)		21-2485-6236	00-9775-4668	EcoAnalysts
20		Dec	27	15:35	1.633	0.2192	0.4516			14-3251-3795	04-4998-7500	EcoAnalysts
21	2018	Feb	23	16:20	1.491	0.07717	0.1666			08-4313-9079	12-5767-7210	EcoAnalysts

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	05-8775-6843	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 16:20	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 14:35	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Polychaeta	**Source:**	Aquatic Toxicology Support **Age:**
Sample ID:	08-9579-7944	**Code:**	3564CAB8	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.68
Sample Age:	284d 16h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
16-4206-5191	Proportion Survived	Fisher Exact Test		162	192	176.4		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
13-7098-6720	Proportion Survived	Trimmed Spearman-Kärber		EC50	226.4	205.4	249.6		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
69.9		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
118		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
162		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
192		3	0.7000	0.0000	1.0000	0.2000	1.0000	0.2517	0.4359	62.27%	30.00%
267		3	0.3000	0.0000	1.0000	0.0000	0.6000	0.1732	0.3000	100.00%	70.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
69.9		1.0000	1.0000	1.0000
118		0.9000	1.0000	1.0000
162		1.0000	1.0000	1.0000
192		1.0000	0.9000	0.2000
267		0.6000	0.0000	0.3000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
69.9		10/10	10/10	10/10
118		9/10	10/10	10/10
162		10/10	10/10	10/10
192		10/10	9/10	2/10
267		6/10	0/10	3/10

CETIS Test Data Worksheet

Report Date: 10 Mar-18 12:23 (p 1 of 1)
Test Code/ID: 5232C52D / 13-7905-8989

Reference Toxicant 96-h Acute Survival Test — EcoAnalysts

Start Date:	23 Feb-18 16:20	**Species:**	Neanthes arenaceodentata	**Sample Code:**	3564CAB8
End Date:	27 Feb-18 14:35	**Protocol:**	PSEP (1995)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Sample Station:**	P170515.68

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	10	10	10	
0	D	2	18	10	10	
0	D	3	3	10	10	
69.9		1	14	10	10	
69.9		2	8	10	10	
69.9		3	7	10	10	
118		1	13	10	9	
118		2	15	10	10	
118		3	12	10	10	
162		1	6	10	10	
162		2	1	10	10	
162		3	11	10	10	
192		1	5	10	10	
192		2	16	10	9	
192		3	17	10	2	
267		1	2	10	6	
267		2	4	10	0	
267		3	9	10	3	

CETIS Summary Report

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID:	05-8775-6843	**Test Type:**	Survival	**Analyst:**	
Start Date:	23 Feb-18 16:20	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	27 Feb-18 14:35	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Test Length:	94h	**Taxon:**	Polychaeta	**Source:**	Aquatic Toxicology Support **Age:**
Sample ID:	08-8524-5379	**Code:**	34C3C5C3	**Project:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Source:**	Reference Toxicant
Receipt Date:	15 May-17	**CAS (PC):**		**Station:**	P170515.68
Sample Age:	284d 16h	**Client:**	Internal Lab		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	✓	NOEL	LOEL	TOEL	TU	PMSD	S
12-5767-7210	Proportion Survived	Fisher Exact Test		1.491	1.727	1.605		n/a	1

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	✓	Level	mg/L	95% LCL	95% UCL	TU	S
15-8743-9749	Proportion Survived	Trimmed Spearman-Kärber		EC50	1.939	1.81	2.076		1

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
0.853		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.226		3	0.9667	0.8232	1.0000	0.9000	1.0000	0.0333	0.0577	5.97%	3.33%
1.491		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.727		3	0.7000	0.0000	1.0000	0.2000	1.0000	0.2517	0.4359	62.27%	30.00%
2.176		3	0.3000	0.0000	1.0000	0.0000	0.6000	0.1732	0.3000	100.00%	70.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
0.853		1.0000	1.0000	1.0000
1.226		0.9000	1.0000	1.0000
1.491		1.0000	1.0000	1.0000
1.727		1.0000	0.9000	0.2000
2.176		0.6000	0.0000	0.3000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
0.853		10/10	10/10	10/10
1.226		9/10	10/10	10/10
1.491		10/10	10/10	10/10
1.727		10/10	9/10	2/10
2.176		6/10	0/10	3/10

CETIS Test Data Worksheet

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Start Date:	23 Feb-18 16:20	**Species:**	Neanthes arenaceodentata	**Sample Code:**	34C3C5C3
End Date:	27 Feb-18 14:35	**Protocol:**	PSEP (1995)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Sample Station:**	P170515.68

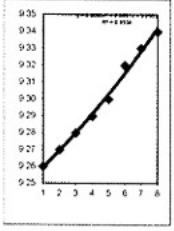
Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	14	10	10	
0	D	2	10	10	10	
0	D	3	7	10	10	
0.853		1	4	10	10	
0.853		2	6	10	10	
0.853		3	15	10	10	
1.226		1	18	10	9	
1.226		2	11	10	10	
1.226		3	16	10	10	
1.491		1	2	10	10	
1.491		2	3	10	10	
1.491		3	1	10	10	
1.727		1	17	10	10	
1.727		2	8	10	9	
1.727		3	13	10	2	
2.176		1	5	10	6	
2.176		2	12	10	0	
2.176		3	9	10	3	

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	23-Feb-18
PROJECT:	Reference Toxicant	Test Type:	*Neanthes*
COMMENTS:	P170515.68		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	0		0.000	27	7.7	19.0	292.16	9.3160		
3	60		69.900	28	7.6	19.0	292.16	9.3187		0.853
4	100		118.000	28	7.5	19.9	293.06	9.3187		1.226
5	140		162.000	28	7.5	19.8	292.96	9.3187		1.491
6	180		192.000	28	7.4	19.8	292.96	9.3187		1.727
7	220		267.000	28	7.4	19.7	292.86	9.3187		2.176
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Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT	PROJECT	SPECIES		LABORATORY	PROTOCOL
Landau	Blair Waterway	*Neanthes arenaceodentata*		Port Gamble .	PSEP
TEST ID	**LOT #:**	**TEST START DATE**	**TIME**	**4-DAY END DATE**	**TIME**
P170515.68	2986CS10	23Feb18	1620	27Feb18	1435
CHAMBER SIZE/TYPE	**EXPOSURE VOLUME**				
Glass pint jar	250mL				

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L)		TEMP(C)		SAL (ppt)		pH		TECHNICIAN	AMMONIA			SULFIDES		
					> 4.6		20 ± 1		28 ± 2		7.8 ± 0.5								
CLIENT/ENVIRON ID	CONCENTRATION		DAY	REP	D.O.		TEMP.		SALINITY		pH		WQ TECH/ DATE	AMMONIA		Tech	SULFIDES		Tech
	value	units			meter	mg/L	meter	°C	meter	ppt	meter	unit		METER	mg/L		meter	mg/L	
Ref.Tox.-ammonia	0	mg/L	0	Stock	B	8.8	B	19.0	B	27	B	7.7	JL 2/23/18	10	0.00				LB
			4	1	9	7.0	9	19.3	9	27	9	7.8	LB 2/27						
Ref.Tox.-ammonia	60	mg/L	0	Stock	B	8.9	B	19.0	B	28	B	7.6	JL 2/23	10	69.9				LB
			4	1	9	7.0	9	19.3	9	28	9	7.9	LB 2/27						
Ref.Tox.-ammonia	100	mg/L	0	Stock	B	8.8	B	19.9	B	28	B	7.5	JL 2/23	10	118				LB
			4	1	9	7.0	9	19.2	9	28	9	7.9	LB 2/27						
Ref.Tox.-ammonia	140	mg/L	0	Stock	B	8.7	B	19.8	B	28	B	7.5	JL 2/23	10	162				LB
			4	1	9	7.0	9	19.3	9	28	9	7.8	LB 2/27						
Ref.Tox.-ammonia	180	mg/L	0	Stock	B	8.7	B	19.8	B	28	B	7.4	JL 2/23	10	192				LB
			4	1	9	7.0	9	19.3	9	28	9	7.8	LB 2/27						
Ref.Tox.-ammonia	220	mg/L	0	Stock	B	8.6	B	19.7	B	28	B	7.4	JL 2/23	10	267				LB
			4	1	9	6.5	9	19.3	9	28	9	7.7	LB 2/27						

Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT	PROJECT	JOB NO.	SPECIES		
			Neanthes arenaceodentata		
			PROJECT MANAGER	LABORATORY	PROTOCOL
Landau	Blair Waterway	PG1103	B. Hester	Port Gamble .	PSEP

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

CLIENT/ENVIRON ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 DATE: 2/24/18 TECHNICIAN: UB			DAY 2 DATE: 2/25/18 TECHNICIAN: UB			DAY 3 DATE: 2/26/18 TECHNICIAN: BG			DAY 4 DATE: 2/27 TECHNICIAN: UB		
					#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS	#ALIVE	#DEAD	OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	10	0	N	10	0	N	10	0	N	10	0	N
			2	↓	10	0	N	10	0	N	10	0	N	10	0	N
			3	↓	10	0	N	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	60	mg/L	1	10	10	0	N	10	0	N	10	0	N	10	0	N
			2	↓	10	0	N	10	0	N	10	0	N	10	0	N
			3	↓	10	0	N	10	0	N	10	0	N	10	0	N
Ref.Tox.- Ammonia	100	mg/L	1	10	9	1	N	9	0	N	9	0	N	9	0	Q
			2	↓	10	0	N	10	0	N	10	0	N	10	0	Q
			3	↓	10	0	N	10	0	N	10	0	N	10	0	Q
Ref.Tox.- Ammonia	140	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			3	↓	10	0	Q	10	0	Q	10	0	Q	10	0	Q
Ref.Tox.- Ammonia	180	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	10	0	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	9	1	Q
			3	↓	10	0	Q	10	0	Q	10	0	Q	2	8	Q
Ref.Tox.- Ammonia	220	mg/L	1	10	10	0	Q	10	0	Q	10	0	Q	6	4	Q
			2	↓	10	0	Q	10	0	Q	10	0	Q	0	10	—
			3	↓	10	0	Q	10	0	Q	10	0	Q	3	7	Q

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170505-6B
Date Prepared: 2/23/18
Technician Initials: VB

Neanthes NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 1/23/2018
Measurement: 9676.66

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			FRESH WATER (mL)	SALT WATER (mL)
69.9	**60**	750	[redacted]	6.98
118	**100**	750		11.63
162	**140**	750		16.28
192	**180**	750		20.93
267	**220**	750		25.58

ORGANISM RECEIPT LOG

Date:	Time:	Batch No.
2/22/18	0915	ATS 022218

Organism: Neanthes

Source / Supplier: Aquatic Tox. Support

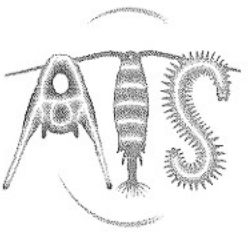
No. Ordered:	No. Received:	Source Batch: Collection date, hatch date, etc.):
345	345 + 10 ↑	Emerged 2/5/18

Condition of Organisms:	Approximate Size or Age: (Days from hatch, life stage, size class, etc.):
Good	17 days
Shipper: Courier	**B of L (Tracking No.)** NA
Condition of Container: Good	**Received By:** UL

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
1	17.1	21.0	30 ppt	7.4	0	—	UL

*if >10% contact lab manager

Notes:



Aquatic Toxicology Support
1849 Charleston Beach Road West
Bremerton, Washington 98312
(360) 813-1202

Order Summary

Species: *Neanthes arenaceodentata**	Emerge Date: 5 Feb '18
Number Ordered: 345	Number Shipped: 345 + 10%
Date Shipped: 21 Feb '18	Salinity (ppt): 30

*Smith 1964. CSU Long Beach strain. Feed upon arrival.

MAINTENANCE LOG FOR CULTURES

ORGANISM: Neanthes
LOCATION: Batch 6

Batch Number: ATS022218	Date Received: 2/22/18	Initial # of Organisms: 345 + 16 Y.

Date	Feed AM/PM	Tub No.	D.O.	Temp (°C)	Cond/ (Sal)	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/23/18	—	1	7.4	18.2	30 ppt	7.8	N	Y	0	—	JL	
2/24/18		1	7.4	19.0	35	7.9	N	N/A ①	-①	-①	BG	
↓		2					N	N/A ①	-①	-①	BG	②
2/24/18		1	7.6	18.9	31	7.9	N	Y	0	0	BG	

FT = Flow-through
if >10% notify lab manager

① too dark to see BG 2/26/18
② wrong culture BG 2/26/18

3. *Mytilus galloprovincialis* Bivalve Larval Test

ECO ANALYSTS

CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	LABORATORY	PROTOCOL
Landau	Blair Waterway	PG1103	Brian Hester	Port Gamble Bath 4	PSEP (1995)

TEST ORGANISM SPAWNING DATA

SPECIES			
Mytilus sp			
SUPPLIER: Taylor Shellfish		ORGANISM BATCH: TS2589	
SPAWNING METHOD: Heat Shock			
MALES: 3	FEMALES:	SPERM VIABILITY: ✓	EGG CONDITION: good
INITIAL SPAWNING TIME: 1227	BEGIN FERTILIZATION: 1334	CONDITION OF EMBRYOS: >90% d.v	

SAMPLE STORAGE: 4 Degrees Celsius - dark
SEDIMENT TREATMENT: none
TEST CHAMBERS: 1 L Mason Jars
EXPOSURE VOLUME: 900mL seawater / 18g Sediment
TIME OF SHAKE: 0950 LB
TIME OF INITIATION: 1550 BH/LB

SPECIAL CONDITIONS

UV LIGHT EXPOSURE (YES/NO)	AERATION FROM TEST INITIATION (YES/NO)
SCREEN TUBE TEST (YES/NO)	**OTHER (EXPLAIN)**

EMBRYO DENSITY CALCULATIONS

$89 + 60 = 149 \div 2 = 74.5$

$74.5 \cdot 100 = 7450$ ① eggs/mL

$\frac{27{,}000 \text{ target}}{74{,}50\text{Ø}^{①} \text{ actual}} = 3.6$

deliver 3.6 mL of egg stock per jar

RT

$\frac{2700 \text{ target}}{7450 \text{ actual}} = 0.36$

$40 \text{ mL} \cdot 0.36 = 14 \text{ mL}$ egg stock

26 mL sea water

deliver 100 mL of adjusted egg stock

① IE, 7450 UB 2/28

EcoAnalysts

CLIENT	PROJECT	JOB NUMBER	SPECIES	PROJECT MANAGER	LAB / LOCATION	PROTOCOL
Landau	Blair Waterway	PG1103	*Mytilus sp*	Brian Hester	Port Gamble / Bath 4	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER	DATE	TECHNICIAN	COMMENTS
STOCKING DENSITY	1		333	3/3/18	UB	
	2		365	↓	↓	
	3		330			
	4		339			
	5		356			
Control /	1	313	12	3/7/18	UB	
	2	316	12	↓	↓	
	3	325	16			
	4	358	17			
	5	322	20			
Sediment Control /	1	275	9			
	2	247	19			
	3	275	14			
	4	236	7			
	5	293	6			
Carr Reference /	1	266	19			
	2	291	33			
	3	294	14			
	4	269	23			
	5	267	30			
SG-17 /	1	192	32			
	2	182	30			
	3	216	30			
	4	210	29			
	5	211	37	↓	↓	

QA Count Checks:			
#1 conc/rep Ctrl/4	#2 conc/rep CARR REF/3	#3 conc/rep SG 17/5	#4 conc/rep H_2O Ctrl 5
# normal 253	# normal 286	# normal 288	# normal 323
# abnormal 19	# abnormal 15	# abnormal 38	# abnormal 19
Tech. Init. BG	Tech. Init. BG	Tech. Init. BG	Tech. Init. BG
Calc. $\frac{19}{272} = 7.0\%$ $\frac{7}{292} = 2.9\%$ <5%	$\frac{15}{301} / \frac{14}{308}$ 5.0% 4.5% <5%	$\frac{37}{248} / \frac{38}{246}$ 14.9% 15.4% <5%	$\frac{19}{342} / \frac{20}{342}$ 5.6% 5.8% <5%

QA Check Acceptability: ☑ <5% difference in means of QA & orig. counts

① RE JL

EcoAnalysts

CLIENT	PROJECT	SPECIES		LAB / LOCATION	PROTOCOL
Landau	Blair Waterway	*Mytilus sp*		Port Gamble / Bath 4	PSEP (1995)
JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE**	**TIME**	**TEST END DATE**	**TIME**
PG1103	Brian Hester	28Feb18	1550	1610 3/2/18	1610

* Day 3&4 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >5.0		Temp (°C) 16 ± 1		Sal (ppt) 28 ± 1		pH 7 - 9		Ammonia NA		Sulfide NA		TECH	DATE
SAMPLE ID	DAY	Random #	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	AMMONIA Techn.	AMMONIA mg/L (total)	SULFIDE Techn.	SULFIDE mg/L (Total		
Control /	0		WQ Surr	9	~~8.0~~ 8.7 ①	9	17.0	9	28	9	7.6	UB	0.00	UB	③ ND ~~0.002~~	UB	2/28/18
Control /	1		WQ Surr	9	7.9	9	~~16~~ 15.9 ②	9	28	9	7.6					UB	3/1
Control /	2		WQ Surr	9	7.4	9	16.9	9	28	9	7.9	UB	0.0369	UB	ND	UB	3/2
Sediment Control /	0		WQ Surr	9	8.5	9	17.0	9	28	9	7.6	UB	0.00	UB	0.003	UB	2/28
Sediment Control /	1		WQ Surr	9	7.7	9	16.4	9	28	9	7.7					UB	3/1
Sediment Control /	2		WQ Surr	9	7.7	9	16.7	9	28	9	7.9	UB	0.0213	UB	0.00	UB	3/2
Carr Reference /	0		WQ Surr	9	8.0	9	17.0	9	28	9	7.3	UB	0.0354	UB	0.015	UB	2/28
Carr Reference /	1		WQ Surr	9	6.4	9	16.2	9	28	9	7.5					UB	3/1
Carr Reference /	2		WQ Surr	9	6.0	9	16.9	9	28	9	7.8	UB	0.0204	UB	ND	UB	3/2
SG-17 /	0		WQ Surr	9	7.7	9	17.0	9	28	9	7.6	UB	0.058	UB	0.001	UB	2/28
SG-17 /	1		WQ Surr	9	6.8	9	16.6	9	28	9	7.7					UB	3/1
SG-17 /	2		WQ Surr	9	6.0	9	16.7	9	28	9	7.8	UB	0.105	UB	0.003	UB	3/2

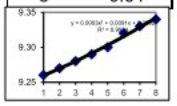
① WC UB 2/28
② MR, UB 3/1
③ Non-detect, UB

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	28-Feb-18
PROJECT:	Blair Waterway	Test Type:	*Mytilus sp*
COMMENTS:			

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1	**Day 0**									
2	Control		0.000	28	7.6	17.0	290.16	9.3187		
3	Sediment Control		0.000	28	7.6	17.0	290.16	9.3187		
4	Carr Reference		0.035	28	7.3	17.0	290.16	9.3187		0.000
5	SG-17		0.058	28	7.6	17.0	290.16	9.3187		0.001
6										
7										
8										
17	**Day 2**									
18	Control		0.037	28	7.9	16.9	290.06	9.3187		0.001
19	Sediment Control		0.021	28	7.9	16.7	289.86	9.3187		0.000
20	Carr Reference		0.020	28	7.8	16.9	290.06	9.3187		0.000
21	SG-17		0.105	28	7.8	16.7	289.86	9.3187		0.002
24										
25										
26										
27										
28										
29										
30										
31										
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35										
36										
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41										
42										
43										
44										
45										

	Input				Output		
Sample ID	Total Dissolved Sulfide (µg/L as S)	Temper-ature (˚C)	Salinity (‰)	pH	Undissociated H2S (µg/L as H2S)	Undissociated H2S (mg/L as H2S)	Weight Fraction (H2S/Total S)
Day 0 OV					0.00	0.000	#DIV/0!
Control	#VALUE!	17.0	28	7.6	0.14	0.000	#VALUE!
Sediment Control	3	17.0	28	7.6	0.14	0.000	4.68%
Carr Reference	15	17.0	28	7.3	0.68	0.001	4.51%
SG-17	1	17.0	28	7.6	0.51	0.001	50.90%
Day 2 OV					0.00	0.000	#DIV/0!
Control	#VALUE!	16.9	28	7.9	0.35	0.000	#VALUE!
Sediment Control	0	16.7	28	7.9	0.79	0.001	#DIV/0!
Carr Reference	#VALUE!	16.9	28	7.8	0.00	0.000	#VALUE!
SG-17	3	16.7	28	7.8	0.46	0.000	15.37%

ORGANISM RECEIPT LOG

Date:	Time:	Batch No.
12.29.17	1216	TS 2589

Organism: Mytilus galloprovincialis

Source / Supplier: Taylor shellfish

No. Ordered:	No. Received:	Source Batch: Collection date, hatch date, etc.):
8lbs	8lbs	0 12/27/17 harvest Totten Inlet

Condition of Organisms:	Approximate Size or Age: (Days from hatch, life stage, size class, etc.):
Good	Adult
Shipper: FedEx	**B of L (Tracking No.)** 7891 4567 2589
Condition of Container: Good	**Received By:** BH

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
1	—	9.6	—	—	—	—	BH

*if >10% contact lab manager

Notes: shipped dry

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath I

Batch Number: TS 2589	Date Received: 12.29.17	Initial # of Organisms: —

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
1.7.18		X	1	8.3	9.6	31	7.8	FT	Y	1	—	BH	
↓		X	2	8.3	9.9	31	7.8	FT	Y	0	—	BH	
1/08	X		1	8.0	11.6	30	7.8	FT	Y	0	—	UL	
↓	X		2	8.3	12.0	30	7.8	↓	↓	0	—	↓	
1/09		✓	1	8.1	11.8	29	7.8	FT	Y	0	—	UL	
↓		✓	2	8.3	12.3	29	7.8	↓	↓	0	—	↓	
1/10		✓	1	8.1	11.8	29	7.7	FT	Y	0	—	UB	
↓		✓	2	8.5	12.1	29	7.8	↓	↓	0	—	↓	
1/11		✓	1	—	—	—	—	↓	Y	0	—	UL	
↓		✓	2	—	—	—	—	↓	↓	0	—	↓	
1/12	✓		1	8.1	11.7	29	7.8	FT	Y	0	—	UL	
↓	✓		2	8.5	12.2	29	7.9	↓	↓	0	—	↓	
1/14		✓	1	8.2	12.1	29	7.8	FT	Y	0	—	CR	
↓		✓	2	8.2	12.1	29	7.8	↓	↓	0	—	CR	
1/15			1	8.2	11.	30	7.7	FT	Y	0	—	UL	
↓			2	8.3	12.0	30	7.8	↓	↓	0	—	↓	
1/17	✓		1	8.0	11.9	30	7.8	FT	Y	0	—	UB	
↓	✓		2	8.2	12.1	30	7.8	↓	↓	0	—	↓	

FT = Flow-through
**if >10% notify lab manager*

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath 1

Batch Number: TS2589	Date Received: 12.29.17	Initial # of Organisms: ~

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ (Sal) ppt	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2018 1/19		✓	1	7.5	11.7	30	7.7	FT	Y			UB	
↓		✓	2	8.3	12.0	30	7.8	↓	Y	0	—	↓	
1.21		✓	1	7.9	11.9	30	7.7	FT	Y	0	—	BH	
↓		✓	2	8.2	11.8	30	7.8	FT	Y	0	—	BH	
1/22/18	✓		1	8.0	12.6	30	7.8	FT	Y	0	—	BG	
↓	~		2	6.8	12.6	29	7.5	FT	Y	0	—	BG	
1/24		✓	1	8.1	11.6	30	7.7	FT	Y	0	—	UB	
↓		✓	2	8.2	11.9	31	7.7	FT	Y	0	—	UB	
~~1/25~~ (1)		✓	1	8.4	12.0	28	7.7	FT	Y	0	—	UB	
↓		✓	2	8.1	12.3	29	7.8	FT	Y	0	—	UB	
1/29			2	8.0	12.5	29	7.7	FT	Y	0	-	BG	
↓			1	7.8	11.8	29	7.7	FT	Y	1	—	BG	est ~ 100 mussels => 10% mort
1/31		✓	1	8.2	11.6	29	7.8	FT	Y	0	—	UB	
↓		✓	2	8.2	12.4	29	7.8	FT	Y	0	—	UB	
2/2	✓		1	7.5	11.9	29	7.7	FT	Y			UB	
↓	✓		2	8.0	12.5	29	7.7	FT	Y	0	—	[illegible]	
2/05	✓		1	8.2	11.4	29	7.7	FT	Y			Y	
↓	✓		2	8.2	12.1	29	7.7	↓	↓	0	—	↓	

FT = Flow-through
if >10% notify lab manager

(1) 1/26 UB

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus galloprovincialis
LOCATION: Bath 1

Batch Number: TS2589	Date Received: 12.29.17	Initial # of Organisms: —

Date	Feed AM	Feed PM	Tub No.	D.O.	Temp (°C)	Cond/ Sal	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
2/7/18		✓	1	8.0	11.6	29	7.7	FT	Y	1	—	UB	
↓		✓	2	7.9	12.5	29	7.7	↓	Y	0	—	↓	
2/9/18	✓		1	7.8	11.8	27	7.8	FT	Y	0	—	UB	
↓	✓		2	7.6	12.4	28	7.8	↓	Y	0	—	↓	
2/12		✓	1	8.5	11.7	28	7.7	FT	Y	1	—	JL	
↓		✓	2	8.5	12.1	28	7.7	↓	↓	0	—	↓	
2/14	✓		1	8.3	11.2	29	8.3	FT	Y		—	JL	
↓	✓		2	8.4	11.3	29	8.2	↓	↓		—	↓	
2/16	✓		1	8.2	11.4	29	7.8	FT	Y	0	—	UB	
↓	✓		2	8.4	11.4	29	8.1	↓	Y	0	—	↓	
2/19	✓		1	8.7	11.4	28	7.6	FT	Y	①~~0~~ 2	—	JL	
↓	✓		2	8.7	11.8	28	7.6	↓	↓	0	—	↓	
2/24	—		1	7.9	11.4	29	7.7	FT	Y	0	—	UB	
↓	—		2	8.3	11.9	29	7.8	↓	↓	0	—	↓	
2/28	✓		1	7.7	11.7	29	7.5	FT	Y	0	—	UB	
↓	✓		2	8.3	12.3	29	7.7	↓	↓	0	—	UB	
3/7	✓		1 ②	8.3	11.6	30	7.8	FT	Y	0	—	UB	
3/9	✓		1	8.4	12.1	30	7.9	FT	Y	0	—	UB	

FT = Flow-through
if >10% notify lab manager

① IEJL 2/19/18
② Tub ② not present, UB 3/7

APPENDIX B. STATISTICAL COMPARISONS

Statistical Results: *Eohaustorius estuarius* Test

Constant	Value
Experiment Date	2/23/2018
Client	Landau
Project	Tru-Grit
Project Number	PG1103
Experimenter	EcoAnalysts
Protocol	Eohaustorius estuarius 10-d Su

	Group A	Group B	Group C
	Control	Carr Reference	SG-17
	Y	Y	Y
1	0	5	15
2	0	0	20
3	0	0	0
4	0	10	30
5	5	0	25

Transform	A	B	C
	Control	Carr Reference	SG-17
	Y	Y	Y
1	0.000	0.226	0.398
2	0.000	0.000	0.464
3	0.000	0.000	0.000
4	0.000	0.322	0.580
5	0.226	0.000	0.524

	1way ANOVA ANOVA	
1	Table Analyzed	Transform of Data 1
2	Data sets analyzed	A : Control
3		
4	ANOVA summary	
5	F	5.93
6	P value	0.0162
7	P value summary	*
8	Significant diff. among means (P < 0.05)?	Yes
9	R square	0.497
10		
11	Brown-Forsythe test	
12	F (DFn, DFd)	0.528 (2, 12)
13	P value	0.6029
14	P value summary	ns
15	Are SDs significantly different (P < 0.05)?	No
16		
17	Bartlett's test	
18	Bartlett's statistic (corrected)	2.305
19	P value	0.3159
20	P value summary	ns
21	Are SDs significantly different (P < 0.05)?	No
22		
23	ANOVA table	SS
24	Treatment (between columns)	0.3424
25	Residual (within columns)	0.3465
26	Total	0.689
27		
28	Data summary	
29	Number of treatments (columns)	3
30	Number of values (total)	15

1			
2	B : Carr Reference	C : SG-17	
3			
4			
5			
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7			
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9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	DF	MS	F (DFn, DFd)
24	2	0.1712	F (2, 12) = 5.93
25	12	0.02888	
26	14		
27			
28			
29			
30			

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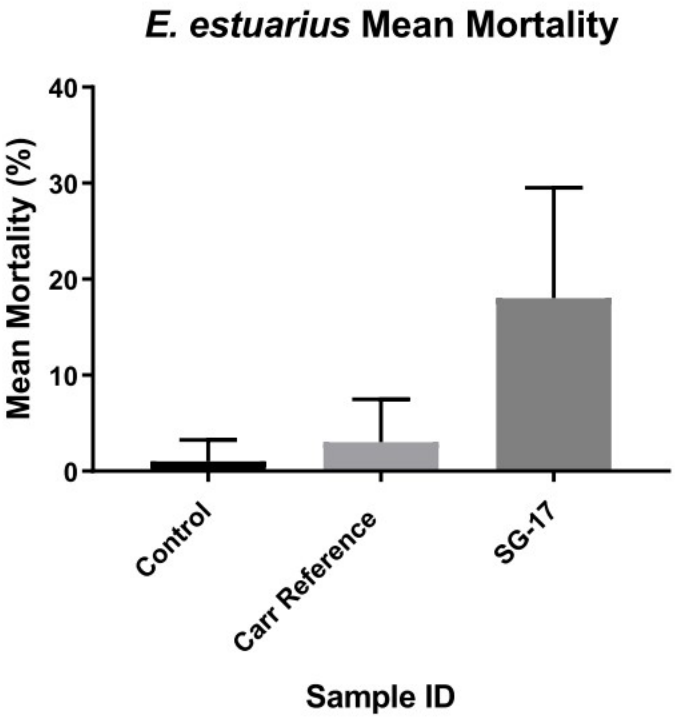
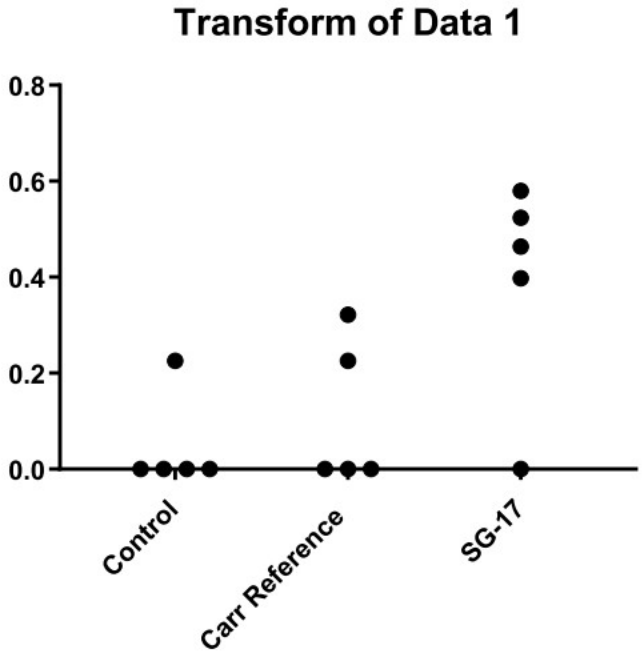
17	
18	
19	
20	
21	
22	
23	P value
24	P=0.0162
25	
26	
27	
28	
29	
30	

	1way ANOVA Multiple comparisons			
1	Number of families	1		
2	Number of comparisons per family	2		
3	Alpha	0.05		
4				
5	Holm-Sidak's multiple comparisons tes	Mean Diff.	Significant?	Summary
6				
7	Carr Reference vs. Control	0.06435	No	ns
8	Carr Reference vs. SG-17	-0.2835	Yes	*
9				
10				
11	Test details	Mean 1	Mean 2	Mean Diff.
12				
13	Carr Reference vs. Control	0.1095	0.0451	0.06435
14	Carr Reference vs. SG-17	0.1095	0.3929	-0.2835

1					
2					
3					
4					
5	Adjusted P Value	B-?			
6					
7	0.5605	A	Control		
8	0.0429	C	SG-17		
9					
10					
11	SE of diff.	n1	n2	t	DF
12					
13	0.1075	5	5	0.5988	12
14	0.1075	5	5	2.638	12

1way ANOVA Descriptive Statistics				
		Control	Carr Reference	SG-17
1	Number of values	5	5	5
2				
3	Minimum	0	0	0
4	25% Percentile	0	0	0.1988
5	Median	0	0	0.4636
6	75% Percentile	0.1128	0.2736	0.5516
7	Maximum	0.2255	0.3218	0.5796
8				
9	Mean	0.0451	0.1095	0.3929
10	Std. Deviation	0.1009	0.1537	0.2299
11	Std. Error of Mean	0.0451	0.06873	0.1028
12				
13	Lower 95% CI	-0.08012	-0.08138	0.1075
14	Upper 95% CI	0.1703	0.3003	0.6783


E. estuarius Mean Mortality
Mean Mortality (%)
40
30
20
10
0
Control
Carr Reference
SG-17
Sample ID


Transform of Data 1
0.8
0.6
0.4
0.2
0.0
Control
Carr Reference
SG-17

Statistical Results: *Neanthes arenaceodentata* Test

Constant	Value
Experiment Date	2/23/2018
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (AFDW)

	Group A	Group B	Group C
	Control	Carr Reference	SG-17
	Y	Y	Y
1	0.401	0.535	0.426
2	0.522	0.452	0.514
3	0.382	0.426	0.490
4	0.407	0.458	0.513
5	0.508	0.419	0.465

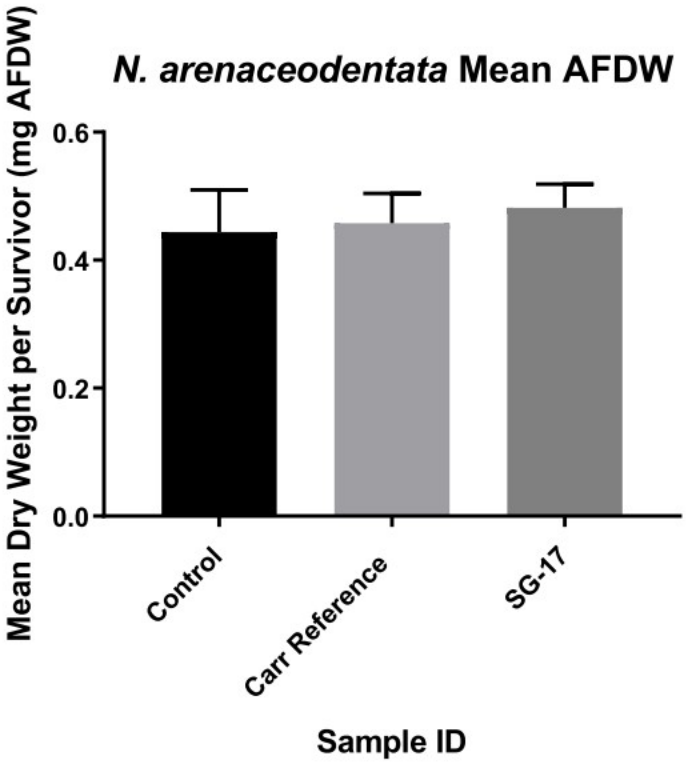
	1way ANOVA ANOVA		
1	Table Analyzed	Data 1	
2	Data sets analyzed	A : Control	B : Carr Reference
3			
4	ANOVA summary		
5	F	0.6939	
6	P value	0.5186	
7	P value summary	ns	
8	Significant diff. among means (P < 0.05)?	No	
9	R square	0.1037	
10			
11	Brown-Forsythe test		
12	F (DFn, DFd)	0.4861 (2, 12)	
13	P value	0.6266	
14	P value summary	ns	
15	Are SDs significantly different (P < 0.05)?	No	
16			
17	Bartlett's test		
18	Bartlett's statistic (corrected)	1.222	
19	P value	0.5429	
20	P value summary	ns	
21	Are SDs significantly different (P < 0.05)?	No	
22			
23	ANOVA table	SS	DF
24	Treatment (between columns)	0.003611	2
25	Residual (within columns)	0.03123	12
26	Total	0.03484	14
27			
28	Data summary		
29	Number of treatments (columns)	3	
30	Number of values (total)	15	

1			
2	C : SG-17		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	MS	F (DFn, DFd)	P value
24	0.001806	F (2, 12) = 0.6939	P=0.5186
25	0.002602		
26			
27			
28			
29			
30			

	1way ANOVA Multiple comparisons			
1	Number of families	1		
2	Number of comparisons per family	2		
3	Alpha	0.05		
4				
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?
6				
7	Carr Reference vs. Control	0.014	-0.06837 to 0.09637	No
8	Carr Reference vs. SG-17	-0.0236	-0.106 to 0.05877	No
9				
10				
11	Test details	Mean 1	Mean 2	Mean Diff.
12				
13	Carr Reference vs. Control	0.458	0.444	0.014
14	Carr Reference vs. SG-17	0.458	0.4816	-0.0236

1					
2					
3					
4					
5	Summary	Adjusted P Value	B-?		
6					
7	ns	0.8924	A	Control	
8	ns	0.7280	C	SG-17	
9					
10					
11	SE of diff.	n1	n2	t	DF
12					
13	0.03226	5	5	0.4339	12
14	0.03226	5	5	0.7315	12

1way ANOVA Descriptive Statistics				
		Control	Carr Reference	SG-17
1	Number of values	5	5	5
2				
3	Minimum	0.382	0.419	0.426
4	25% Percentile	0.3915	0.4225	0.4455
5	Median	0.407	0.452	0.49
6	75% Percentile	0.515	0.4965	0.5135
7	Maximum	0.522	0.535	0.514
8				
9	Mean	0.444	0.458	0.4816
10	Std. Deviation	0.06565	0.04612	0.03699
11	Std. Error of Mean	0.02936	0.02063	0.01654
12				
13	Lower 95% CI	0.3625	0.4007	0.4357
14	Upper 95% CI	0.5255	0.5153	0.5275


N. arenaceodentata Mean AFDW
Mean Dry Weight per Survivor (mg AFDW)
0.6
0.4
0.2
0.0
Control
Carr Reference
SG-17
Sample ID

Constant	Value
Experiment Date	2/23/2017
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (Dry We

	Group A	Group B	Group C
	Control	Carr Reference	SG-17
	Y	Y	Y
1	0.678	0.827	0.597
2	0.960	0.601	0.786
3	0.569	0.682	0.756
4	0.712	0.674	0.723
5	0.916	0.604	0.687

	1way ANOVA ANOVA		
1	Table Analyzed	Data 1	
2	Data sets analyzed	A : Control	B : Carr Reference
3			
4	ANOVA summary		
5	F	0.7473	
6	P value	0.4944	
7	P value summary	ns	
8	Significant diff. among means (P < 0.05)?	No	
9	R square	0.1108	
10			
11	Brown-Forsythe test		
12	F (DFn, DFd)	1.408 (2, 12)	
13	P value	0.2824	
14	P value summary	ns	
15	Are SDs significantly different (P < 0.05)?	No	
16			
17	Bartlett's test		
18	Bartlett's statistic (corrected)	2.667	
19	P value	0.2636	
20	P value summary	ns	
21	Are SDs significantly different (P < 0.05)?	No	
22			
23	ANOVA table	SS	DF
24	Treatment (between columns)	0.0205	2
25	Residual (within columns)	0.1646	12
26	Total	0.1851	14
27			
28	Data summary		
29	Number of treatments (columns)	3	
30	Number of values (total)	15	

1			
2	C : SG-17		
3			
4			
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19			
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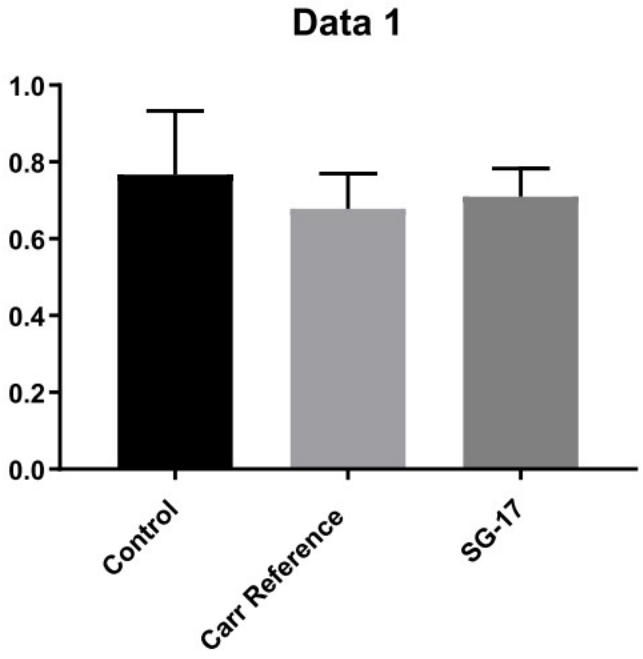
21			
22			
23	MS	F (DFn, DFd)	P value
24	0.01025	F (2, 12) = 0.7473	P=0.4944
25	0.01372		
26			
27			
28			
29			
30			

	1way ANOVA Multiple comparisons			
1	Number of families	1		
2	Number of comparisons per family	2		
3	Alpha	0.05		
4				
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?
6				
7	Carr Reference vs. Control	-0.0894	-0.2785 to 0.09971	No
8	Carr Reference vs. SG-17	-0.0322	-0.2213 to 0.1569	No
9				
10				
11	Test details	Mean 1	Mean 2	Mean Diff.
12				
13	Carr Reference vs. Control	0.6776	0.767	-0.0894
14	Carr Reference vs. SG-17	0.6776	0.7098	-0.0322

1					
2					
3					
4					
5	Summary	Adjusted P Value	B-?		
6					
7	ns	0.4386	A	Control	
8	ns	0.8921	C	SG-17	
9					
10					
11	SE of diff.	n1	n2	t	DF
12					
13	0.07407	5	5	1.207	12
14	0.07407	5	5	0.4347	12

1way ANOVA Descriptive Statistics				
		Control	Carr Reference	SG-17
1	Number of values	5	5	5
2				
3	Minimum	0.569	0.601	0.597
4	25% Percentile	0.6235	0.6025	0.642
5	Median	0.712	0.674	0.723
6	75% Percentile	0.938	0.7545	0.771
7	Maximum	0.96	0.827	0.786
8				
9	Mean	0.767	0.6776	0.7098
10	Std. Deviation	0.1655	0.0917	0.07307
11	Std. Error of Mean	0.07403	0.04101	0.03268
12				
13	Lower 95% CI	0.5615	0.5637	0.6191
14	Upper 95% CI	0.9725	0.7915	0.8005


Data 1
1.0
0.8
0.6
0.4
0.2
0.0
Control
Carr Reference
SG-17

Statistical Results: *Mytilus galloprovnicialis* Larval Test

Constant	Value
Experiment Date	2/28/2018
Experiment ID	Landau Tru-Grit
Notebook ID	
Project	Mytilus galloprovincialis
Experimenter	
Protocol	

	Group A	Group B	Group C	Group D
	Control	Sediment Control	rr Referer	SG-17
	Y	Y	Y	Y
1	313.0	275.0	266.0	192.0
2	316.0	247.0	291.0	182.0
3	325.0	275.0	294.0	216.0
4	358.0	236.0	269.0	210.0
5	322.0	293.0	267.0	211.0

1way ANOVA ANOVA				
1	Table Analyzed	Data 1		
2	Data sets analyzed	A : Control	B : Sediment Control	C : Carr Reference	D : SG-17
3					
4	ANOVA summary				
5	F	41.5			
6	P value	<0.0001			
7	P value summary	****			
8	Significant diff. among means (P < 0.05)?	Yes			
9	R square	0.8861			
10					
11	Brown-Forsythe test				
12	F (DFn, DFd)	0.2577 (3, 16)			
13	P value	0.8547			
14	P value summary	ns			
15	Are SDs significantly different (P < 0.05)?	No			
16					
17	Bartlett's test				
18	Bartlett's statistic (corrected)	1.261			
19	P value	0.7385			
20	P value summary	ns			
21	Are SDs significantly different (P < 0.05)?	No			
22					
23	ANOVA table	SS	DF	MS	F (DFn, DFd)
24	Treatment (between columns)	39416	3	13139	F (3, 16) = 41.5
25	Residual (within columns)	5066	16	316.6	
26	Total	44482	19		
27					
28	Data summary				
29	Number of treatments (columns)	4			
30	Number of values (total)	20			

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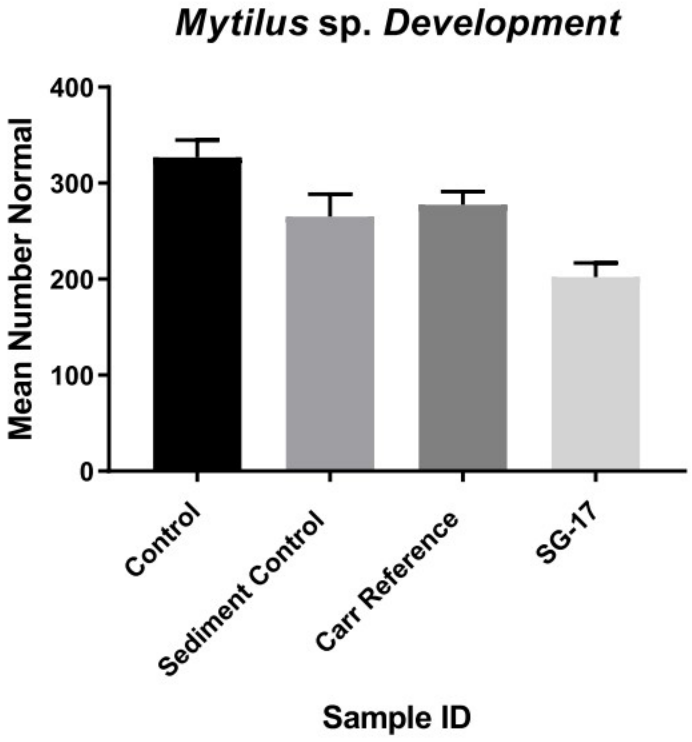
16	
17	
18	
19	
20	
21	
22	
23	P value
24	P<0.0001
25	
26	
27	
28	
29	
30	

	1way ANOVA Multiple comparisons					
1	Number of families	1				
2	Number of comparisons per family	3				
3	Alpha	0.1				
4						
5	Dunnett's multiple comparisons test	Mean Diff.	90.00% CI of diff.	Significant?	Summary	Adjusted P Value
6						
7	Carr Reference vs. Control	-49.4	-74.45 to -24.35	Yes	**	0.0013
8	Carr Reference vs. Sediment Contro	12.2	-12.85 to 37.25	No	ns	0.5791
9	Carr Reference vs. SG-17	75.2	50.15 to 100.3	Yes	****	0.0001
10						
11						
12	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	n1
13						
14	Carr Reference vs. Control	277.4	326.8	-49.4	11.25	5
15	Carr Reference vs. Sediment Contro	277.4	265.2	12.2	11.25	5
16	Carr Reference vs. SG-17	277.4	202.2	75.2	11.25	5

1			
2			
3			
4			
5	C-?		
6			
7	A	Control	
8	B	Sediment Control	
9	D	SG-17	
10			
11			
12	n2	q	DF
13			
14	5	4.39	16
15	5	1.084	16
16	5	6.682	16


Mytilus sp. *Development*
Mean Number Normal
400
300
200
100
0
Control
Sediment Control
Carr Reference
SG-17
Sample ID

APPENDIX C. CHAIN-OF-CUSTODY LOGS AND PRE-TEST DOCUMENTS

LANDAU ASSOCIATES

- [x] **Seattle/Edmonds** (425) 778-0907
- [ ] **Tacoma** (253) 926-2493
- [ ] **Spokane** (509) 327-9737
- [ ] **Portland** (503) 542-1080
- [ ] _____

Chain-of-Custody Record

Bioassay

Date 1/25/18

Page 1 of 1

Project Name Tru Grit Project No. 241008.020

Project Location/Event Tacoma, WA / Bioassay

Sampler's Name Devan Brandt

Project Contact Jennifer Wynkoop

Send Results To " & Dani Jorgenson

Turnaround Time
- [x] Standard
- [ ] Accelerated
- [ ] _____

Sample I.D.	Date	Time	Matrix	No. of Containers	Acute 10-Day Amphipod	Acute Larval Development	Chronic Polychaete survival/growth	HOLD * (see note)	Observations/Comments
SG-14-012518	1/25/18	0930	Solid		X	X	X	X	
SG-16-012518		1010	Solid		X	X	X	X	
SG-17-012518		1040	Solid		X	X	X	X	
SG-5-012518		1115	Solid		X	X	X	X	

Testing Parameters

[x] Allow water samples to settle, collect aliquot from clear portion

[ ] NWTPH-Dx - run acid wash silica gel cleanup

[ ] Analyze for EPH if no specific product identified

VOC/BTEX/VPH (soil):
- [ ] non-preserved
- [ ] preserved w/methanol
- [ ] preserved w/sodium bisulfate
- [ ] Freeze upon receipt

[ ] Dissolved metal water samples field filtered

Other * HOLD all analysis until confirmation from LAI (Approx 2 weeks)

Special Shipment/Handling or Storage Requirements: Archive All Excess Material

Method of Shipment:

Relinquished by	Received by	Relinquished by	Received by
Signature	Signature	Signature	Signature
Printed Name Devan Brandt	Printed Name Collin Ray	Printed Name	Printed Name
Company LAI	Company EcoAnalysts	Company	Company
Date 1/25/18 Time 1430	Date 1/25/18 Time 1715	Date Time	Date Time

WHITE COPY - Project File YELLOW COPY - Laboratory PINK COPY - Client Representative

12/2014

Wet-Sieve Procedure for Determining Percent Fines (<63 µm) of Sediment

DATE:	CLIENT:	PROJECT:
2/21/18	Landau	Blaine Waterway

Procedure:

1. Collect 50 mL of sediment to be analyzed
2. Transfer sediment to a #230 (63 µm) testing sieve
3. Rinse sieve thoroughly with a stream of water until water flowing through the sieve is clear
4. Transfer all retained material to a 100mL graduated cylinder using a small funnel and DI squirt bottle
5. Allow sediment to settle. Record the volume of sediment retained below.

SAMPLE ID:	INITIAL VOLUME OF SEDIMENT (mL)	VOLUME OF SEDIMENT RETAINED (mL)	(INIT VOL - VOL RETAINED) * 2			Estimated Percent Fines
SG-16	50	21	(50 - 21)	x 2	=	58
SG-14	50	28	(50 - 28)	x 2	=	44
G-5	50	① ~~36~~ 35	(50 - ~~36~~ 35)	x 2	=	① ~~72~~ 30
Carr Inlet	50	25	(50 - 25)	x 2	=	50
SG-17	50	20	50 - 20	x 2	=	60
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	
					=	

LB 2.24.18

BH 2.22.18

① IG, VB 2/21

Ammonia and Sulfide Analysis Record

Client/Project: Landau / Blair Waterway	Organism: NA	Test Duration (days): NA

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: NA

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments: Bulk

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date: 3/12/18	Temperature: 21.2°C	

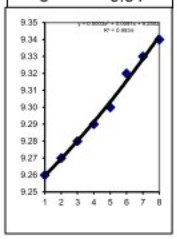
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Meter #/ Temp (°C)		Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
PW G-5	Bulk	3/12/18 JC	19.3	TAP	20.4	3/12/18 JC	N	7.7	28	10	ND		
SG-14	↓	↓	13.0	↓	↓	↓	↓	7.6	29	↓	0.002		
SG-16			11.8					7.6	29		0.002		
SG-17			9.29					7.4	29		0.003		

Un-ionized Ammonia Calculator

CLIENT:	Landau	Date of Test:	12-Mar-18
PROJECT:	Tru-Grit	Test Type:	*NA*
COMMENTS:	Bulk Porewater		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer: I-factor	
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	NH3T (mg/L)	salinity (ppt)	pH	temp (C)	temp (K)	i-factor	Mod	NH3U (mg/L)
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		#VALUE!
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		0.008
1										
2	G-5		19.300	28	7.7	20.4	293.56	9.3187		0.328
3	SG-14		13.000	29	7.6	20.4	293.56	9.3214		0.175
4	SG-16		11.800	29	7.6	20.4	293.56	9.3214		0.159
5	SG-17		9.290	29	7.4	20.4	293.56	9.3214		0.079
6										
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Input					Output		
Sample ID	**Total Dissolved Sulfide (µg/L as S)**	**Temper-ature (˚C)**	**Salinity (‰)**	**pH**	**Undissociated H2S (µg/L as H2S)**	**Undissociated H2S (mg/L as H2S)**	**Weight Fraction (H2S/Total S)**
G-5	**ND**	**20.4**	**28**	**7.7**	**#VALUE!**	**#VALUE!**	**#VALUE!**
SG-14	**2**	**20.4**	**29**	**7.6**	**0.30**	**0.000**	**15.11%**
SG-16	**2**	**20.4**	**29**	**7.6**	**0.30**	**0.000**	**15.11%**
SG-17	**3**	**20.4**	**29**	**7.4**	**0.66**	**0.001**	**22.11%**
					0.00		**#DIV/0!**
					0.00		**#DIV/0!**
					0.00		**#DIV/0!**
					0.00		**#DIV/0!**
					0.0000		**#DIV/0!**
					0.00		**#DIV/0!**
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Page ____ of ____

STATION COORDINATE LOG
For Van Veen or Box Core

Project: Landau/Tru-Grit
Survey Number: N/A
Cruise Director: Collin Ray
Recorder: Collin Ray

DATE	TIME	STATION	DROP NO.	LATITUDE	LONGITUDE	DEPTH (ft)
1/26/18	1015	Carr Inlet 1	1	47.331318°	-122.678540°	47
↓	1040	Carr Inlet 2	1	47.334500°	-122.677776°	35

APPENDIX D

Terrestrial Ecological Evaluation Exclusion Form

Washington State Department of Ecology
Toxics Cleanup Program

Terrestrial Ecological Evaluation Process - Primary Exclusions

Documentation Form

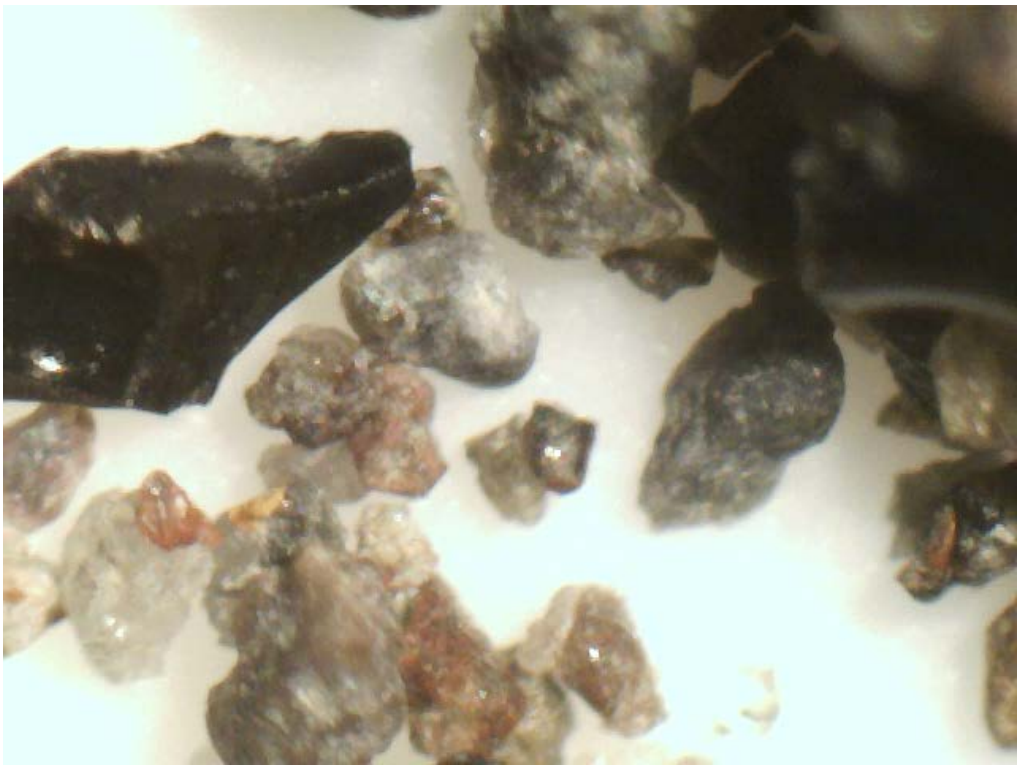
Exclusion #	Exclusion Detail	Yes or No?	Are Institutional Controls Required If The Exclusion Applies?
1	Will soil contamination be located at least 6 feet beneath the ground surface and less than 15 feet?	Yes / No	Yes
	Will soil contamination located at least 15 feet beneath the ground surface?	Yes / No	No
	Will soil contamination located below the conditional point of compliance?	Yes / No	Yes
2	Will soil contamination be covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed?	Yes / No	Yes
3	Is there less than 1.5 acres of contiguous undeveloped land on the site, or within 500 feet of any area of the site affected by hazardous substances **other than** those listed in the table of Hazardous Substances of Concern? And Is there less than 0.25 acres of contiguous undeveloped land on or within 500 feet of any area of the site affected by hazardous substances **listed in** the table of Hazardous Substances of Concern?	(Yes) / No (Yes) / No	Other factors determine
4	Are concentrations of hazardous substances in the soil less than or equal to natural background concentrations of those substances at the point of compliance	Yes / No	No

[Exclusions Main] [TEE Definitions] [Simplified or Site-Specific?] [Simplified Ecological Evaluation] [Site-Specific Ecological Evaluation] [WAC 173-340-7493]

[TEE Home]

APPENDIX E

Selected Microscope Photographs



1. Example of grit material intermixed with sediment sand granules at SG-07.

2. Example of grit material intermixed with sediment sand granules from SG-16.

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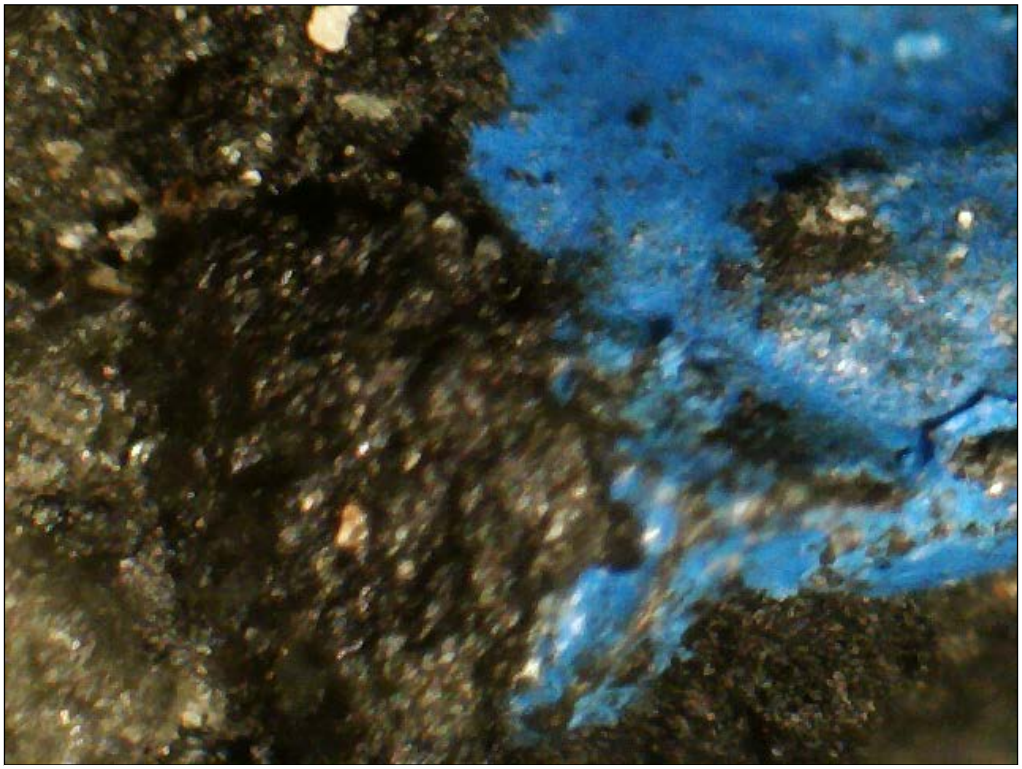
Tru-Grit Facility
Tacoma, Washington

Grit Material Microscope Photographs—Locations SG- 07 and SG-16

Figure
E-1

1. Chunk of grit material in a hardened matrix of clay and silt encountered at sediment core location SC-14A. A large, blue paint chip and some smaller white paint chips are visible within this grit layer.



2. Close-up photograph of the blue paint chip in the sample from sediment core location SC-14A. A small white paint chip is present at the top of the

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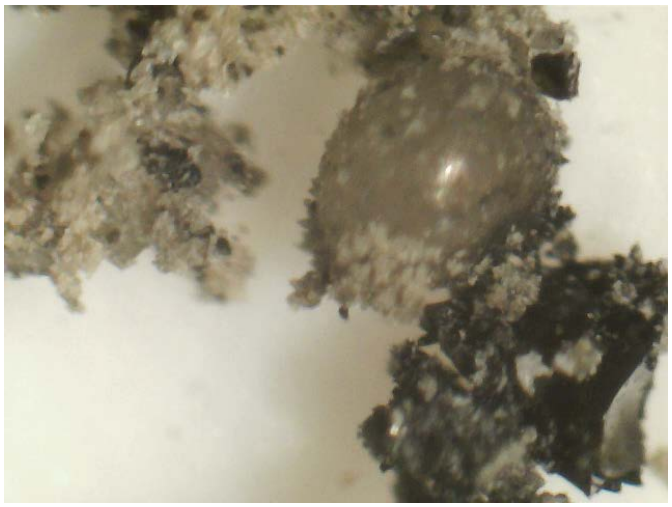
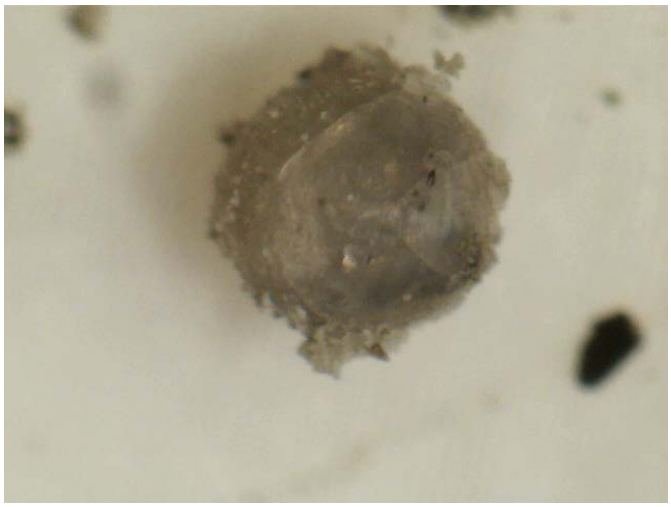
Tacoma, Washington

Clay Mass Microscope Photographs—Location SC-14A

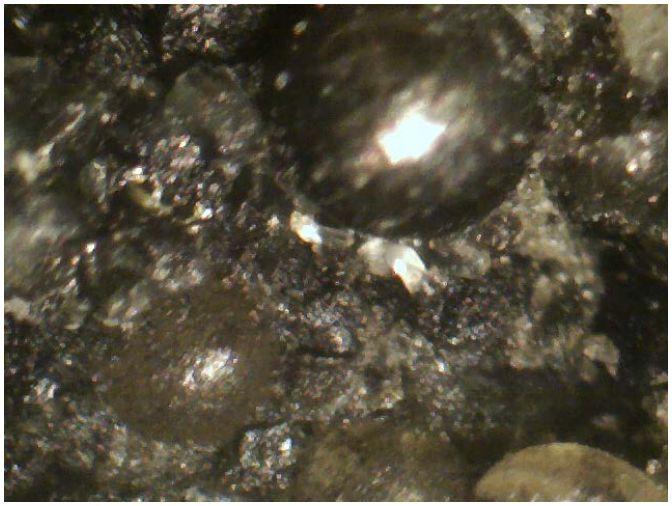
Figure
E-2



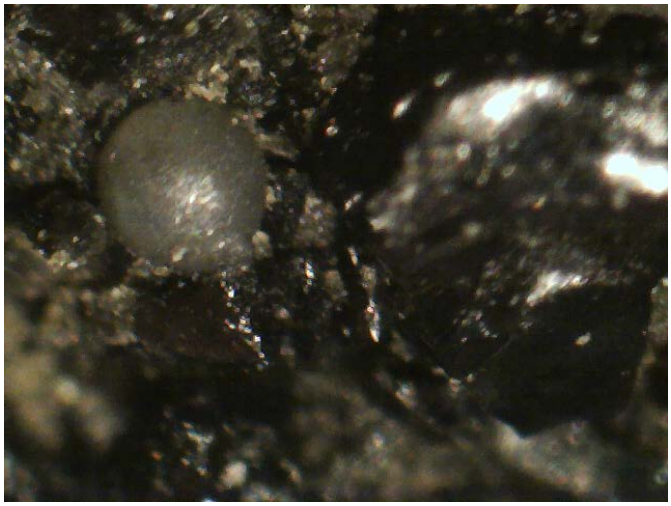
1. Bead-like material and grit encountered at sediment core location SC-14A.



2. Bead-like material encountered at sediment core location SC-14A. A fracture pattern is evident in the bead indicating that the material is relatively brittle.



3. Bead-like material encountered embedded in hardened clay matrix from sediment core location SC-14A.



4. Bead-like material and grit encountered embedded in hardened clay matrix from sediment core location SC-14A.

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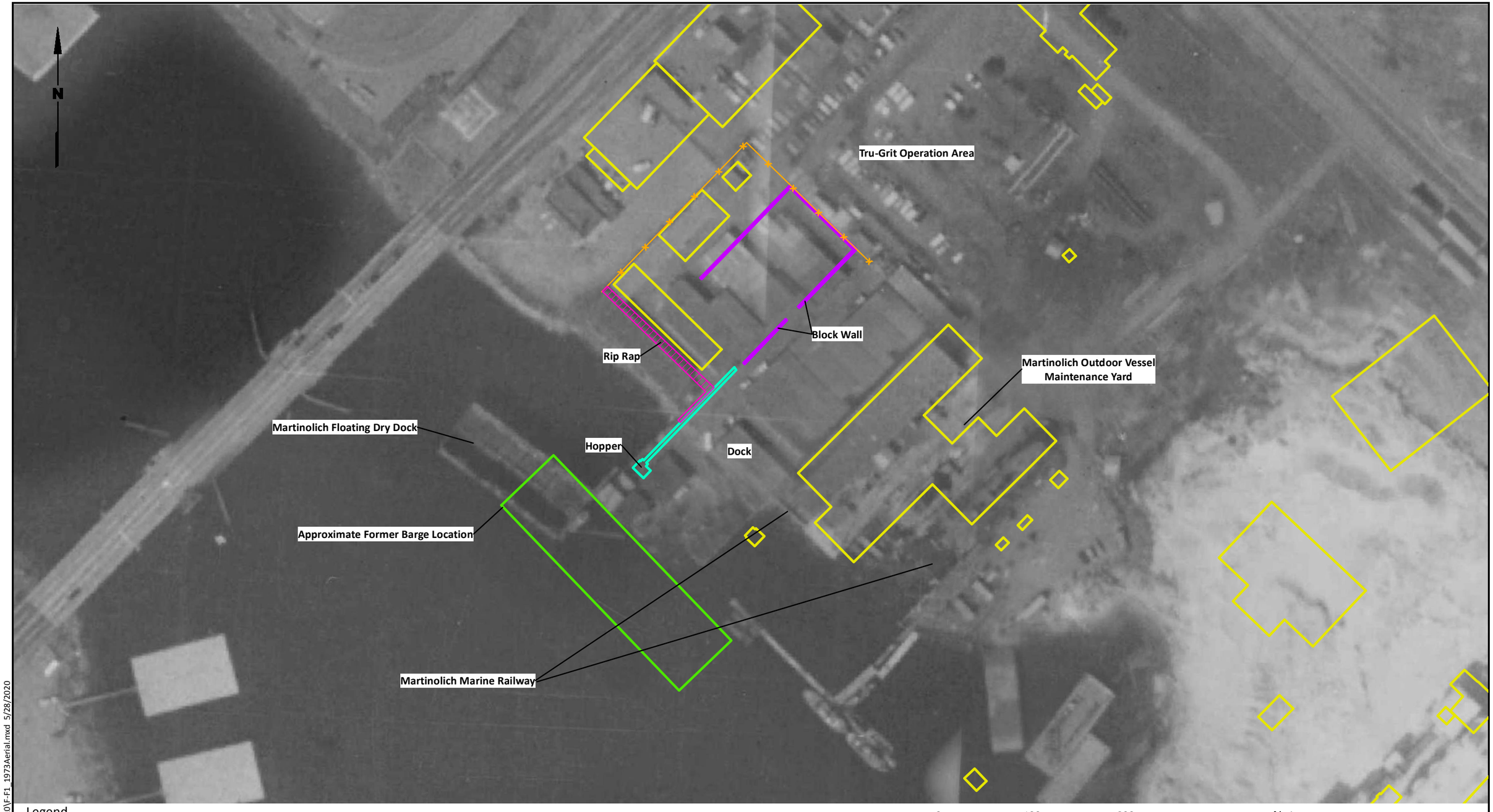
Tru-Grit Facility
Tacoma, Washington

Bead-like Material Microscope Photographs—Location SC-14A

Figure
E-3

APPENDIX F

Historical Photographs



Legend

- Approximate Former Barge Location
- Block Wall
- Current Buildings
- Hopper and Conveyor
- Fence
- Rip Rap

0 100 200

Scale in Feet

Data Sources: City of Tacoma GIS.

Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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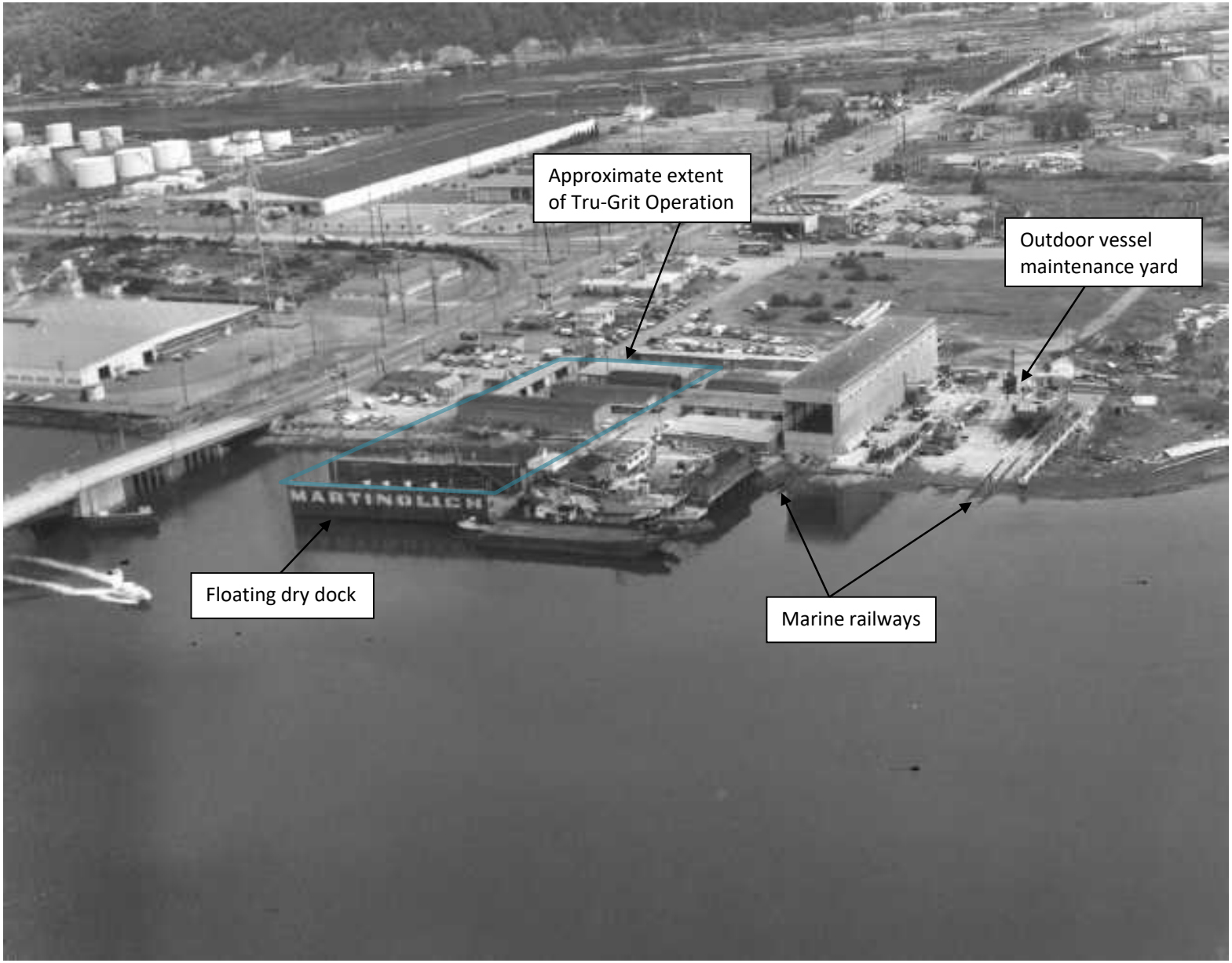
Tru-Grit Site Tacoma, Washington	**Historical Aerial Photo 1973**	Figure F-1

G:\Projects\241\008\020\F-F1_1973Aerial.mxd 5/28/2020



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Tru-Grit Site
Tacoma, Washington

Historical Aerial Photo
1971

Figure
F-2