TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 658-73

Title: Mussel (*Mytilus galloprovincialis*) larval test using static 48-hr exposure to CH2M Hill-Wyckoff Treatment Plant SP11 Final Effluent. EPA permit number WAD009248295.

Protocol No.: NAS-XXX-CG/MG2, August 28, 1990, Revision 3 (9-8-01). This protocol complies with the U.S. EPA West Coast chronic toxicity manual (EPA/600/R-95/136) and the ASTM bivalve toxicity method (E 724-89).

STUDY MANAGEMENT

Study Sponsor: CH2M Wyckoff Treatment Plant, 5350 Creosote Place NE, Bainbridge Island, WA 98110.

Sponsor's Study Monitor: Mr. Stanley Warner

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365.

Test Location: Newport laboratory.

Laboratory's Study Personnel: G.A. Buhler, B.S., Proj. Man.; G.J. Irissarri, B.S., Study Dir.; L.K. Nemeth, B.A., M.B.A., QA Officer; J. B. Brown, B.S., D.V.M., Assoc. Aq. Toxicol.; Y. Nakahama, Sr. Tech.; L. Brady, Tech.

Study Schedule:

Test Beginning: 2-10-16, 1445 hrs.

Test Ending: 2-12-16, 1445 hrs.

Disposition of Study Records: All raw data, reports and other study records are stored at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Description: CH2M Hill-Wyckoff Treatment Plant SP11 Final Effluent. Details are as follows:

NAS Sample No.	5516G
Collection Date	2-9-16
Receipt Date	2-10-16
Temperature (°C)	4.7
pH	7.6
Dissolved oxygen (mg/L)	9.5
Salinity (‰)	3.0

Treatments: Samples briefly temperature-equilibrated prior to use.

Storage: Used date of receipt.

DILUTION WATER

Source: Yaquina Bay, Oregon seawater.

Date of Collection: 2-9-16

Water Quality: Salinity, 30.0 ‰; pH, 8.0

Pretreatment: Filtered to ≤0.45 µm, aerated, salinity adjusted with Milli-Q.

BRINE USED FOR DILUTION WATER AND SALINITY CONTROL

Source: Filtered Yaquina Bay, Oregon, sea water

Salinity: 100.0 ‰

Date of Preparation: 1-21-16

Method of Preparation: Freezing method

TEST ORGANISMS

Species: Mussel (*Mytilus galloprovincialis*).

Age: 3.3 hrs post-fertilization.

Source: Kamilche Sea Farms, Shelton, WA.
Conditioning: Adult mussels were received on 2-9-16 and placed in trays with flowing seawater. Holding conditions prior to testing were: temperature, 12.7°C; pH, 7.8; salinity, 28.0‰; and dissolved oxygen, 7.1 mg/L. Photoperiod was natural daylight.
Source of Gametes: 4 females and 3 males.

TEST PROCEDURES AND CONDITIONS

Test Chambers: 30 ml borosilicate glass vials containing 10 ml of test solutions.
Test Concentrations: 70, 35, 18, 9, 4, 2, and 0% (Control).
Brine Control: A brine control was run in which salinity-adjusted Milli-Q® deionized water (3.0 ppt) was substituted for effluent in the preparation of the highest test solution concentration. As a result, the amount of brine in the brine control was the same as used in the 70.0% effluent test concentration.
Replicates/Treatment: 4
Initial Concentration of Test Organisms: 23.0/ml.
Volume of Subsamples Taken for Counting: NA
Water Volume Changes per 24 hr: None (non-renewal static test).
Aeration: None
Feeding: None
Effects Criteria: The effect criteria used were: 1) ability of embryos to survive and produce completely developed shells; and 2) survival. Data collected were: 1) the initial embryo density; 2) the number of abnormal larvae observed; and 3) the number of normal (live with completely developed shells) larvae observed.
Water Quality and Other Test Conditions: Temperature, 16.4 ± 0.3°C; pH, 8.0 ± 0.2; salinity, 30.3 ± 0.4‰; and dissolved oxygen, 7.9 ± 0.1 mg/L. Photoperiod 16:8 hr, L:D.

DATA ANALYSIS METHODS

The proportion of surviving larvae, and the proportion of normal surviving larvae were calculated for each treatment replicate. The calculation used for the proportion of normal surviving larvae, Combined Proportion Normal, was the combined endpoint specified by EPA/600/R-95/136. The means were obtained for each treatment level and the latter were then corrected for control response using Abbott's formula. The LC50 (survival) and the EC50 (normality) were calculated, where data permitted, using either the Maximum-Likelihood Probit or the Trimmed Spearman-Karber methods. An IC25 was determined by linear interpolation with bootstrapping. NOEC and LOEC values for survival and normality were computed using either Dunnett's test, T-test with Bonferroni's adjustment, Steel's Many-One Rank Test, or Wilcoxon Rank Sum Test with Bonferroni Adjustment. The appropriate test was selected after evaluating the data for normality and homogeneity of variance. An arcsine-square root (angular) transformation was performed on the data prior to statistical analysis. The statistical software employed for these calculations was CETIS, v1.8.7.4, Tidepool Scientific Software. Toxic units (TU_c) were computed as 100/NOEC, 100/EC50, or 100/IC25.

PROTOCOL DEVIATIONS

None.

REFERENCE TOXICANT TEST

The routine reference toxicant test is a standard multi-concentration toxicity test using copper sulfate to evaluate the performance of the test organisms used in the effluent toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. A summary of the reference toxicant test result is given below. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-3521
Reference Toxicant and Source: Copper as $CuSO_4$-$5H_2O$, Argent Lot No. 0195, 1.0 mg/ml stock prepared 6-19-14.
Test Date: 2-10-16
Dilution Water Used: Yaquina Bay, OR seawater. Salinity 30.0 ppt, pH 8.0
Results: EC50, 9.56 µg/L; NOEC, 4 µg/L; IC25, 8.32 µg/L. The EC50 result was within the laboratory's control chart warning limits (7.92 – 12.7 µg/L).

TEST RESULTS

Detailed tabulations of the test results are given in Table 1. The biological effects, given as the NOEC, LOEC, EC50/LC50 for normality and survival, and IC25 for normality are summarized below.

	Combined Proportion Normal	Survival
NOEC (%)	70 (TU_c=1.43)	70 (TU_c=1.43)
LOEC (%)	>70 (TU_c<1.43)	>70 (TU_c<1.43)
EC50/LC50 (%)	>70 (TU_c<1.43)	>70 (TU_c<1.43)
(95% C.I.)	---	---
Method of Calculation	By Data Inspection	By Data Inspection
IC25 (%)	>70 (TU_c<1.43)	
(95% C.I.)	---	
Method of Calculation	Linear Interpolation	

DISCUSSION/CONCLUSIONS

The NOEC for combined proportion normal was 70% effluent. The EC50 and IC25 for abnormal development were both >70%. The brine control test indicated that the brine did not contribute to effluent toxicity.

STUDY APPROVAL

Project Manager — Date: 2/26/15

Study Director — Date: 2-28-16

Assistant Laboratory Director — Date: 2/24/16

Quality Assurance Unit — Date: 2-29-16

Table 1. Test response of mussel (*Mytilus galloprovincialis*) larvae exposed to CH2M Hill-Wyckoff Treatment Plant SP11 Final Effluent.

Test Material					Combined Proportion Normal*		Proportion Survived*	
Concentration (%)	Repl.	Norm.	Abn.	Total		Mean		Mean
70	1	213	11	224	0.926		0.974	
	2	235	9	244	0.963		1.000	
	3	221	7	228	0.961		0.991	
	4	226	18	244	0.983	0.958	1.000	0.991
35	1	218	9	227	0.948		0.987	
	2	219	11	230	0.952		1.000	
	3	227	2	229	0.987		0.996	
	4	228	12	240	0.991	0.970	1.000	0.996
18	1	242	11	253	0.957		1.000	
	2	227	7	234	0.987		1.000	
	3	248	8	256	0.969		1.000	
	4	225	9	234	0.978	0.973	1.000	1.000
9	1	213	13	226	0.926		0.983	
	2	235	11	246	0.955		1.000	
	3	232	2	234	0.992		1.000	
	4	215	9	224	0.935	0.952	0.974	0.989
4	1	231	13	244	0.947		1.000	
	2	225	7	232	0.978		1.000	
	3	236	8	244	0.967		1.000	
	4	221	10	231	0.961	0.963	1.000	1.000
2	1	234	10	244	0.959		1.000	
	2	235	13	248	0.948		1.000	
	3	201	4	205	0.874		0.891	
	4	232	10	242	0.959	0.935	1.000	0.973
Normal Control	1	211	7	218	0.917		0.948	
	2	225	7	232	0.978		1.000	
	3	225	8	233	0.978		1.000	
	4	239	9	248	0.964	0.959	1.000	0.987
Brine Control[1]	1	223	10	233	0.970		1.000	
	2	192	11	203	0.835		0.883	
	3	219	12	231	0.952		1.000	
	4	236	12	248	0.952	0.927	1.000	0.971

* Based on an average initial count of 230 embryos per 10 ml sample, except that for the case in the combined proportion normal endpoint where number normal>average initial count, number normal is divided by the total count (as per EPA/600/R-95/136).

† Result significantly different (P≤0.05) from the control.

[1] Salinity-adjusted Milli Q® deionized water (3.0 ppt) was substituted for effluent so that the brine concentration is equivalent to that for the 70.0% effluent concentration.

APPENDIX I

PROTOCOL

TEST PROTOCOL

BIVALVE, PACIFIC OYSTER OR BLUE MUSSEL, 48-HR LARVAL DEVELOPMENT TEST

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this test is to estimate chronic toxicity of effluents, receiving waters, or other test materials using bivalve larval development in a 48-hr static test.

1.2 Referenced Method: This protocol complies with the U.S. EPA West Coast chronic toxicity manual (EPA/600/R-95/136), ASTM bivalve toxicity method (E 724-89), and the WDOE toxicity guidance manual (WQ-R-95-80). Amendments may be incorporated to meet other methods or regulatory requirements as needed.

1.3 Summary of Method: Pacific oyster or blue mussel larvae (<4-hr-old) are exposed for 48-hr to different concentrations of test material in a static test. Salinity adjustment and brine controls are used when testing low salinity effluents. The test chambers are 30 ml borosilicate glass vials each containing 10 ml of test solution. Four replicate chambers each with 15-30 larvae per milliliter of test solution are employed at each test concentration. Test results are based on abnormal shell development and mortality. Data analysis normally consists of the calculation of an EC50 and IC25 for "percent normal", the calculation of an LC50 for percent survival, and the determination of NOECs and LOECs for both criteria. Special requirements may apply for the State of Washington or other regulatory entities. A test summary table is appended to the end of this protocol.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

_____
_____
_____

2.2 Sponsor's Study Monitor:

_____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
3814 Yaquina Bay Road
P.O. Box 1437
Newport, OR 97365

2.4 Test Location:

_____

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: _____
Quality Assurance Unit: _____
Aquatic Toxicologist: _____
Aquatic Toxicologist: _____

2.6 Proposed Study Schedule: Effluent/receiving water tests must begin within 36 hours of the end of the sample collection period. In no case should the test be started more than 72 hours after sample collection.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

An effluent, receiving water sample, pore water or elutriate sample, or other test material as requested. A reference toxicant test is run concurrently.

4. DILUTION WATER

Dilution water is filtered (≤0.45 µm) Yaquina Bay seawater or other suitable seawater, adjusted to 30 ± 2 ‰ salinity with deionized water and/or hypersaline brine. Hypersaline brine is prepared from filtered (≤0.45 µm) Yaquina Bay water adjusted to 100 ‰ by the freezing method. When testing low salinity effluents, hypersaline brine is administered with dilution water for salinity adjustment.

5. TEST ORGANISMS

5.1 Species: Commonly used West Coast species are Pacific oyster, *Crassostrea gigas*, or blue mussel, *Mytilus edulis*, *M. galloprovincialis*, or *M. trossulus*. These three *Mytilus* species were formerly all believed to be a single cosmopolitan species, *M. edulis* (Geller et al., 1993; McDonald & Koehn, 1988; McDonald et al., 1991). The test conditions specified in this protocol apply to the aforementioned species. Other species (e.g. *M. californianus, C. virginica* and *Mercenaria mercenaria*) are allowed by one or more of the referenced methods applicable to this protocol, but their use may require modified test conditions or procedures.

5.2 Source: Adult oysters are purchased from commercial sources. Mussels are purchased from commercial sources or field collected as required.

5.3 Age at Study Initiation: <4-hr-old embryos.

5.4 Conditioning of Adult Oysters: Adult oysters may be conditioned if needed by holding for one to eight weeks in seasoned plastic tubs supplied with about 1-2 L/min of unfiltered Yaquina Bay, OR water (25-32 ‰) at a temperature of approximately 20°C. For mussels, conditioning is not ordinarily required.

5.5 Spawning and Fertilization: Adult bivalves are cleaned by brushing and placed into spawning trays supplied with seawater. Oysters are spawned by gradually increasing the water temperature to 25-28°C (23-25°C for mussels) over approximately a one-hour period. Sperm from a sacrificed male may be added to the spawning tray to aid stimulation of natural spawning in oysters. If spawning does not occur, the water is cooled to about 20°C (16°C for mussels) and the cycle is repeated. Bivalves that begin spawning are isolated in clean seawater for collection of gametes. After spawning is complete, the temperature is returned to approximately 20°C (16°C for mussels).

Eggs from two or more females are combined and filtered (200-300 µm) to remove feces and psuedofeces and adjusted in concentration to about 2500-6000/ml. Eggs are then fertilized by addition of sperm from two or more males at a concentration of 10^5 to 10^7/ml. For mussels, ten minutes after adding sperm, the egg and sperm mixture is poured through a 25 µm screen to remove excess sperm; then the eggs are rinsed and resuspended in dilution water. Next, the embryo density is adjusted to between 1500 and 3000/ml. Embryos are kept suspended by frequent gentle agitation with a perforated plunger and the temperature is maintained at approximately 20°C (16 ± 1°C for mussels). The quality of the embryos is verified before testing by microscopic examination. Embryos are used to initiate the test within 4 hours of fertilization

6. DESCRIPTION OF TEST SYSTEM

6.1 Preparation of Test Concentrations: Test concentrations are prepared by manual dilution of test material with dilution water or with a combination of hypersaline brine and dilution water. Hypersaline brine may be required when testing dilute effluents to adjust the salinity of the test solutions to the appropriate salinity. Stock test solutions are prepared then distributed to appropriate replicate test chambers. The method for determining the appropriate volume of test material, brine and dilution water to be used in preparing the stock test solution is described in the laboratory SOP for salinity adjustment using hypersaline brine. Prior to mixing, the test material and dilution water are brought to test temperature. Effluents may not be aerated, or are aerated only if necessary to maintain a minimal dissolved oxygen concentration. When necessary, a brine control is prepared at the highest test concentration by substituting for the effluent deionized water to which has been added sufficient dilution water to achieve a salinity equal to that of the effluent.

6.2 Test Chambers and Environmental Control: Larvae are tested in 30 ml glass vials containing 10 ml of the test solutions. Temperature control of test chambers is provided by placement in a constant temperature room. No aeration is required. The required photoperiod is achieved by timer control of the room lights.

6.3 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027F. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use. For this test, there is an exception in that the test chambers are used new and unwashed

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The test involves exposure of test embryos, within 4 hr of fertilization, to five or more test material concentrations and a dilution water control. Low salinity effluents require brine adjustment of salinity. Brine controls (substituting Milli-Q or low salinity water for the effluent) are run when brine is used to test effluent concentrations up to 70% effluent. A typical effluent concentration series might be 70%, 35%, 18%, 9%, 4%, 2%, 1%, and control. Exposures are for approximately 48 hours, but in no case shall the duration of exposure exceed 54 hours. Each treatment and control consists of four replicate 30 ml test vessels containing 10 ml of test solution. The final density of the embryos is between 15 and 30 embryos/ml in the test solutions. A stratified random design is employed to position vials in the temperature control chamber.

7.2 Test Procedure: Each test container is filled with 10 ml of test solution to which is added embryos at a final density of 15-30 embryos/ml. The embryos are incubated at 20 ± 1°C (16 ± 1°C for mussels) for approximately 48 hr to permit development into prodissoconch I larvae. Larvae are subsequently counted to determine the total number of abnormal and normal surviving larvae. These data are used for calculating the EC50s and LC50s.

7.3 Effect Criteria: The effect criteria are: 1) failure of embryos to survive and produce completely developed shells (abnormal/dead); and 2) mortality of the embryos.

7.4 Test Conditions: The test temperature is 20 ± 1°C for oysters, 16 ± 1°C for blue mussels. The test temperatures specified by EPA (EPA/600/R-95/136) are 15 ± 1°C or 18 ± 1°C, but these specifications were based on erroneous assumptions of the agency authors. Consequently, this protocol specifies 16 ± 1°C. The salinity is 30 ± 2 ‰. The dissolved oxygen concentration should be at least 60% of saturation at the test temperature and salinity. The photoperiod is a 16:8 hr, L/D cycle of fluorescent light. Test chambers are 30 ml glass vials held in a constant temperature room to obtain precise temperature control.

7.5 Beginning of Test: 10 ml of each test concentration is dispensed to each of the corresponding four replicate test vials. The test is then started by the addition of 0.1 ml of a suspension (1,500-3,000 embryos/ml) of <4-hr-old

embryos to the test chambers. Six extra vials of seawater controls are preserved with 5% buffered formalin for establishing the initial count of embryos in the test vessels.

7.6 Feeding: Embryos are not fed during the test.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The test duration is approximately 48 hours. The type and frequency of observations to be made during the test are summarized as follows:

Type of Observation	Times of Observation
Biological Data	
Initial number of embryos/10 ml	At start of test in six 0-time vials
Number of live abnormal larvae/10 ml	At end of test (48 hr)
Number of live normal larvae/10 ml	At end of test (48 hr)
Physical and Chemical Data	
Temperature	Daily - in water bath or two locations in the temperature control room. Beginning & end of test - in the beaker reservoirs of each test concentration and controls.
Dissolved oxygen, salinity & pH	Beginning & end of test - in the beaker reservoirs of each test concentration and controls.

The initial number of embryos is determined according to method 2 (Sect. 11.4.6.2) of ASTM 1989. This consists of the average count of all embryos exhibiting cell division in six extra test containers at time zero. Live abnormal larvae are those observed at 48 hr in which shell development is incomplete. Live normal larvae are those observed at 48 hr that have completely developed shells containing meat. Larvae possessing misshapen or otherwise malformed shells are considered normal, provided shell development has been completed.

Temperature is measured using a thermister thermometer. Dissolved oxygen is measured using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. Salinity is measured using a refractometer. The pH is measured with a pH probe and a calibrated meter with scale divisions of 0.1 pH units.

8. CRITERIA OF TEST ACCEPTANCE:

For the EPA West Coast bivalve toxicity method (EPA/600/R-95/136) the test is considered acceptable if:
1. ≥70% of embryos introduced into a required control treatment result in live larvae (≥50% for mussels).
2. normal shell development in surviving controls is ≥90%.

For the WDOE bivalve toxicity method (Publication No. WQ-R-95-80) the test is considered acceptable if:
1. ≥70% of embryos introduced into a required control treatment result in live larvae.
2. normal shell development in surviving controls is ≥90%.
3. the test must achieve a minimum significant difference (%MSD) of <25% relative to the control.
4. the coefficient of variation of the six zero time counts must be ≤15%.

For the ASTM bivalve toxicity method (E 724-89) the test is considered acceptable if:
1. All test chambers were identical.
2. Treatments were randomly assigned to individual test chamber locations.
3. Either a dilution water or solvent control was included.
4. All brood stock animals came from the same location.
5. Embryos were used at <4 hr after fertilization.
6. ≥70% of embryos introduced into a required control treatment resulted in live larvae with completely developed shells at the end of the test.
7. The DO and temperature were measured as specified in Sect. 7.7 of the method.
8. Every measured DO concentration was between 60% and 100% saturation.
9. The difference between the time-weighted average measured temperatures for any two test chambers from the beginning to the end of the test was ≤1°C.

10. Any single measured temperature was not more than 3°C different from the mean of the time-weighted average measured temperatures for individual test chambers.
11. At any one time, the difference between the measured temperatures in any two chambers was not more than 2°C.
12. Each data set must have at least one mean treatment response, corrected for controls, that is <37% and one that is >63% (not applicable for many applications).

9. DATA ANALYSIS

The proportion of normal larvae and the proportion of surviving larvae are calculated for each treatment replicate. The means are obtained for each treatment level and the latter are then corrected for control response using Abbott's formula.

For ASTM (ASTM Standard E 724-89) and EPA (EPA/600/R-95/136) the LC50 (survival) and the EC50 (normal) are calculated, where data permits, using either the Maximum Likelihood Probit or the Trimmed Spearman-Karber methods (EPA 600/4-90-027F). An IC25 is calculated by linear interpolation with bootstrapping (EPA 600/4-89/001a). NOEC and LOEC values for survival and normality are computed using either Dunnett's test, T-test with Bonferroni's Adjustment, Steel's Many-One Rank Test, or Wilcoxon Rank Sum Test with Bonferroni's Adjustment. The appropriate test is selected after evaluating the data for normality and homogeneity of variance. An arcsine square root transformation is performed on the data prior to statistical analysis. The statistical software employed for these calculations is ToxCalc, (most recent version), Tidepool Scientific Software.

For special endpoints requirements applicable in the State of Washington, refer to the WDOE guidance manual (Publication No. WQ-R-95-80, Revised December 1998) or latest version.

Some agencies require that toxic units (TU) be reported. This is reported as either toxic unit acute (TU_a), which is 100/LC50, or toxic unit chronic (TU_c), which is 100/NOEC.

10. REPORTING

A report of the test results must include all of the following standard information at a minimum:

1. Name and identification of the test; the investigator and laboratory;
2. Information on the test material;
3. Information on the dilution water;
4. Detailed information about the test organisms including acclimation conditions;
5. A description of the experimental design and test chambers and other test conditions including water quality;
6. Information about any aeration that may have been required;
7. Definition of the effect criteria and other observations;
8. Responses, if any, in the control treatment;
9. Tabulation and statistical analysis of measured responses;
10. A description of the statistical methods used;
11. Any unusual information about the test or deviations from procedures;
12. Reference toxicant testing information.

11. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the Sponsor and Study Director and should include a description of the change, the reason for the change, the date the change took effect, and the dated signatures of the Study Director and Sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

12. REFERENCE TOXICANT

Reference toxicant testing should be included with each study or at regular intervals as defined in the Quality Assurance Program of the laboratory.

13. REFERENCES AND GUIDELINES

Geller, J.B. *et al.* 1993. Interspecific and intrapopulation variation in mitochondrial ribosomal DNA sequences of *Mytilus* spp. (Bivalvia: Mollusca). Molecular Marine Biology and Biotechnology. 2:44-50.

McDonald, J.H. and R.K. Koehn. 1988. The mussels *Mytilus galloprovincialis* and *M. trossulus* on the Pacific coast of North America. Marine Biology. 99:111-118.

McDonald, J.H. et al. 1991. Allozymes and morphometric characters of three species of *Mytilus* in the northern and southern hemispheres. Marine Biology.

Standard Guide for Conducting Static Acute Toxicity Tests with Embryos of Four Species of Saltwater Bivalve Molluscs. 1989. ASTM Standard E 724-89.

U.S. Environmental Protection Agency. 1989. Supplement to "Short-term methods for estimating the chronic toxicity of effluents and surface waters to freshwater organisms". Revision 1. EPA/600/4-89/001a.

Washington State Department of Ecology. 1998. Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Publication No. WQ-R-95-80. Revised December 1998.

Weber, C.I. (Ed.) 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027F.

U.S. Environmental Protection Agency. 1995. Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (First Edition). EPA/600/R-95/136.

14. APPROVALS

_____ for _____
Name Date

_____ for Northwestern Aquatic Sciences
Name Date

Appendix A
Test Conditions Summary

1. Test type:	Static non-renewal
2. Test duration:	48 hours, or until complete development up to 54 hours
3. Temperature:	20 ± 1°C oysters 16 ± 1°C mussels (ASTM), 15 or 18 ± 1°C (EPA 1995)
4. Dissolved oxygen:	≥ 60% saturation
5. Salinity:	30 ± 2‰
6. Light quality & intensity:	Ambient laboratory light (50-100 ft-c)
7. Photoperiod:	16:8 hr L/D
8. Test chambers:	30 ml glass vials
9. Test solution volume:	10 ml per replicate
10. Renewal of test solutions:	None
11. Age of test organisms:	<4 hr old embryos
12. No. of larvae/container:	150-300
13. No. of replicates/treatment:	4
14. No. of zero time replicates:	6
15. Feeding regime:	Organisms are not fed during the test.
16. Aeration:	None. Initially aerated if necessary to achieve >60% saturation.
17. Dilution water:	Filtered Yaquina Bay seawater, salinity adjusted to 30 ± 2‰ and filtered to ≤0.45 µm.
18. Effects measured:	Survival and normal shell development.
19. Test acceptability:	≥70% of embryos introduced into a required control treatment resulted in live larvae (≥50% for mussels, EPA 1995); ≥90% normal shell development in surviving controls; must achieve minimum significant difference (%MSD) of <25% relative to the control. The cv of six zero time counts must be ≤15%.
20. Sample volume required:	1 L normally requested.

APPENDIX II

RAW DATA

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/MG2

BIVALVE LARVAL TEST BASED ON EPA/600/R-95/136

REVIEWED PAGES 1-14

Test No. 658-73 Client: CH2M Hill - Wyckoff Investigator

STUDY MANAGEMENT

Client: CH2M Hill Wyckoff Treatment Plant, 5350 Creosote Place NE, Bainbridge Island, WA 98110

Client's Study Monitor: Mr. Stanley Warner

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Mgr./Study Dir. G.A. Buhler GAB /G.J. Irissarri GJI

QA Officer L.K. Nemeth

1. Wes Nakahara WN 2. Lauren Brady LB

3. J. Brown JB 4.

Study Schedule:

Test Beginning: 2-10-16 1445 Test Ending: 2-12-16 1445

TEST MATERIAL

Description: CH2M - WYCKOFF - SP-11

NAS Sample No.	55169			
Date of Collection:	2-9-16			
Date of Receipt:	2-10-16			
Temperature (deg C):	4.7			
pH:	7.6			
Dissolved oxygen (mg/L):	9.5			
Conductivity (umhos/cm):	—			
Hardness (mg/L):	—			
Alkalinity (mg/L):	—			
Salinity (ppt):	30			
Total chlorine (mg/L):				
Total ammonia-N (mg/L):				
:				

DILUTION WATER

Description: Yaquina Bay, OR

Date of Collection: 2-9-16 Salinity (ppt) 30.0 pH 8.0

Treatments: Aerated, filtered to ≤ 0.45 um, salinity adjusted with Milli-Q deionized water

TEST ORGANISMS

Species: *Mytilus galloprovincialis* Date Received: 2-9-16

Source: Kamilche Sea Farms, Shelton, WA

Acclimation Data:

Date	Temp (deg.C)	pH	Sal (ppt)	D.O. (mg/L)	Comments
2-10-16	12.7	7.8	28.0	7.1	Held outside in trays of flowing seawater
Mean					
S.D.					
(N)					

Photoperiod during acclimation: Outdoor ambient conditions

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with correct date
4) error found in measurement; measurement repeated

Test No. 658-73 Client CH2M Hill - Wyckoff Investigator _____

SPAWNING AND GAMETE HANDLING

Spawning: Initial: 1010 Final: 1035 Fertilization: 1130
Number of organisms used: females: 4 males: 3
Egg Dilution (1 ml diluted to 100 ml):
Count/ml of dilution: 1. 38 2. 36 3. 34 Mean: 36
Dilution factor = DF (mean x 100/2500) = 1.4

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 70, 35, 18, 9, 4, 2, 0% + Brine Control

Test chamber: 30 ml glass vials Test volume: 10 ml Replicates/treatment (4): 4
Organisms/ml (15-30): 23.0 Test water changes: None Aeration during test: None
Feeding: None Photoperiod: 16L:8D Salinity: 30 +/- 2 ppt
Temperature: 20 +/- 1 °C, oysters; 16 +/- 1 °C, mussels Beaker placement:Stratified randomization

RANDOMIZATION CHART

A	18	35	70	Brine Ctl	9	2	4	Ø		
B	Ø	9	35	70	18	Brine Ctl	2	4		
C	70	2	Brine Ctl	18	35	4	Ø	9		
D	35	70	4	2	Ø	9	18	Brine Ctl		

PREPARATION OF TEST SOLUTIONS

This test uses a brine control ✓ ; a salinity control _____
If a brine control is used, follow SOP #6208 to prepare test solutions
Date of brine preparation: 1-21-16 ; brine salinity (ppt) 100.0
Source of seawater: Yaquina Bay, Oregon

$$VB = VE \frac{(TS - SE)}{(SB - TS)} = VE \frac{(30 - 3)}{(100 - 30)} = VE\ (0.386)$$

Where:
VB=volume brine
VE=volume effluent
SB=salinity of brine
SE=salinity of effluent
TS=target salinity

In making up either a brine control or a salinity control, use salinity-adjusted deionized water in place of the effluent.

Test Conc. (%)	Effluent (ml/100ml)	Brine (ml/100ml)	Dilution Water (ml/100ml)
70	70	27.0	Brought up to a final
35	35	13.5	volume of 100 ml
18	18	6.9	with dilution water
9	9	3.5	
4	4	1.5	
2	2	0.8	
0	0	Ø	
Brine Control *	-	27.0	

2-10-16 GJZ

* 70 mL OF SALINITY ADJUSTED MILLI-Q DEIONIZED WATER AT 3 PPT WAS MIXED W/ 27.0 mL OF BRINE AND BROUGHT UP TO 100 mL W/ DILUTION WATER.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/MG2

BIVALVE LARVAL TEST BASED ON EPA/600/R-95/136

Test No. 658-73 Client CH2M Hill - Wyckoff Investigator

WATER QUALITY DATA

	Date: 2-10-16 initials:				Date: 2-12-16 initials:			
Conc. (%)	Temp. (deg.C)	pH	Sal. (ppt)	DO (mg/L)	Temp. (deg.C)	pH	Sal. (ppt)	DO (mg/L)
70	15.8	7.6	30.5	7.9	16.3	8.4	31.0	7.8
35	16.1	7.7	30.0	8.0	16.4	8.3	30.5	7.7
18	16.1	7.8	30.0	8.0	16.3	8.2	31.0	7.7
9	16.4	7.9	30.0	8.0	16.4	8.1	31.0	7.8
4	16.5	7.9	30.0	8.0	16.3	8.0	30.5	7.8
2	16.6	7.9	30.0	8.0	16.5	8.0	30.5	7.8
Control	16.7	8.0	30.0	8.0	16.5	8.0	30.0	7.8
Brine control	17.0	8.2	29.5	8.1	16.5	7.9	30.0	7.8

WATER QUALITY:

	Mean	SD	N
Temperature (°C):	16.4	0.3	16
pH	8.0	0.2	16
Salinity (ppt):	30.3	0.4	16
DO (mg/L):	7.9	0.1	16

Room/ Water bath temperature: (°C)

Day 0: 16.6 Day 0: 16.5
Day 1: 16.4 Day 1: 16.6
Day 2: 16.4 Day 2: 16.5

LARVAL COUNT DATA

2-15-16 JY — 2-15-16 JBT

Conc. (%)	Replicate 1		Replicate 2		Replicate 3		Replicate 4	
	N	A	N	A	N	A	N	A
70	213	11	~~235~~	9	221	7	226	18
35	218	9	219	11	227	2	228	12
18	~~242~~	11	227	7	248	8	225	9
9	213	13	235	11	232	2	215	9
4	231	13	225	7	236	8	221	10
2	234	10	235	13	201	4	232	10
Control	211	7	225	7	225	8	239	9
Brine control	223	10	192	11	219	12	236	12
Zero time	234	220	232	225	~~242~~ 225 @ 602 2-15-16	242	—	—

Zero time: Mean 230 SD 8 N 6 CV=(sd/mean)x100 3.4%

Remarks:

KAMILCHE
SEA FARMS

Kamilche Sea Farms, Inc.
2741 SE Bloomfield Road • Shelton, WA 98584
360 427 5774 • Fax 360 427 0610
WA Cert. #217-SS
Harvested: Totten Inlet, Puget **Sound**

35313

TO North West Aquatic Sciences
(Gerald)

DATE 2-9-16
CUSTOMER ORDER NO.
SALESPERSON
VIA

TERMS:

QUANTITY	DESCRIPTION	PRICE	AMOUNT
10 lbs.	**Mussels - Beard On** 1 @ 10 lbs.	[redacted]	[redacted]
		Total	[redacted]
	RECEIVED 2-9-16		
	-GJ		

Thank You!

Bivalve Larval Survival and Development Test					Northwestern Aquatic Sciences
Analysis ID:	19-9888-4937	**Endpoint:**	Proportion Survived	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:16	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes
Batch ID:	09-1467-2228	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	10 Feb-16 14:45	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	**Species:**	Mytilis galloprovincialis	**Brine:**	
Duration:	48h	**Source:**	Kamilche Sea Farms, WA	**Age:**	
Sample ID:	21-3509-8601	**Code:**	7F4304E9	**Client:**	Wyckoff Treatment Plant
Sample Date:	09 Feb-16 09:20	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	10 Feb-16 11:55	**Source:**	Wyckoff		
Sample Age:	29h (4.7 °C)	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C <> T	NA	NA	8.15%	Passes proportion survived

Wilcoxon Rank Sum Two-Sample Test

Control	vs	Control	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		Brine Reagent	17.5	NA	1	6	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.001777816	0.001777816	1	0.1021	0.7602	Non-Significant Effect
Error	0.1044876	0.0174146	6			
Total	0.1062654		7			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.573	47.47	0.4582	Equal Variances
Variances	Mod Levene Equality of Variance	0.1021	13.75	0.7602	Equal Variances
Variances	Levene Equality of Variance	0.9188	13.75	0.3748	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.6913	0.6451	0.0018	Non-normal Distribution
Distribution	Kolmogorov-Smirnov D	0.4069	0.3313	0.0003	Non-normal Distribution
Distribution	Anderson-Darling A2 Normality	1.345	3.878	0.0012	Non-normal Distribution

Proportion Survived Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.987	0.9454	1	1	0.9478	1	0.01304	2.64%	0.0%
0	Brine Reagent	4	0.9707	0.8773	1	1	0.8826	1	0.02935	6.05%	1.65%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.488	1.331	1.646	1.538	1.34	1.538	0.04937	6.63%	0.0%
0	Brine Reagent	4	1.459	1.207	1.711	1.538	1.221	1.538	0.07918	10.86%	2.0%

Proportion Survived Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9478	1	1	1
0	Brine Reagent	1	0.8826	1	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.34	1.538	1.538	1.538
0	Brine Reagent	1.538	1.221	1.538	1.538

Bivalve Larval Survival and Development Test — Northwestern Aquatic Sciences

Analysis ID:	04-4464-3684	**Endpoint:**	Proportion Survived	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:14	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes
Batch ID:	09-1467-2228	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	10 Feb-16 14:45	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	**Species:**	Mytilis galloprovincialis	**Brine:**	
Duration:	48h	**Source:**	Kamilche Sea Farms, WA	**Age:**	
Sample ID:	21-3509-8601	**Code:**	7F4304E9	**Client:**	Wyckoff Treatment Plant
Sample Date:	09 Feb-16 09:20	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	10 Feb-16 11:55	**Source:**	Wyckoff		
Sample Age:	29h (4.7 °C)	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	3.38%	70	>70	NA	1.429

Steel Many-One Rank Sum Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		2	17.5	10	1	6	0.8141	Asymp	Non-Significant Effect
		4	20	10	1	6	0.9616	Asymp	Non-Significant Effect
		9	17	10	1	6	0.7639	Asymp	Non-Significant Effect
		18	20	10	1	6	0.9616	Asymp	Non-Significant Effect
		35	17	10	1	6	0.7639	Asymp	Non-Significant Effect
		70	17	10	1	6	0.7639	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.01990607	0.003317679	6	0.5468	0.7669	Non-Significant Effect
Error	0.1274247	0.006067846	21			
Total	0.1473308		27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	0.6693	3.812	0.6754	Equal Variances
Variances	Levene Equality of Variance	4.919	3.812	0.0028	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8362	0.8975	0.0005	Non-normal Distribution

Proportion Survived Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.987	0.9454	1	1	0.9478	1	0.01304	2.64%	0.0%
2		4	0.9728	0.8863	1	1	0.8913	1	0.02717	5.59%	1.43%
4		4	1	1	1	1	1	1	0	0.0%	-1.32%
9		4	0.9891	0.9684	1	0.9913	0.9739	1	0.006521	1.32%	-0.22%
18		4	1	1	1	1	1	1	0	0.0%	-1.32%
35		4	0.9957	0.9859	1	0.9978	0.987	1	0.003074	0.62%	-0.88%
70		4	0.9913	0.9717	1	0.9957	0.9739	1	0.006149	1.24%	-0.44%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.488	1.331	1.646	1.538	1.34	1.538	0.04937	6.63%	0.0%
2		4	1.462	1.221	1.703	1.538	1.235	1.538	0.07575	10.36%	1.77%
4		4	1.538	1.537	1.538	1.538	1.538	1.538	0	0.0%	-3.32%
9		4	1.481	1.374	1.587	1.488	1.409	1.538	0.03355	4.53%	0.52%
18		4	1.538	1.537	1.538	1.538	1.538	1.538	0	0.0%	-3.32%
35		4	1.509	1.448	1.57	1.521	1.456	1.538	0.01926	2.55%	-1.39%
70		4	1.49	1.392	1.588	1.508	1.409	1.538	0.03077	4.13%	-0.13%

Bivalve Larval Survival and Development Test — **Northwestern Aquatic Sciences**

Analysis ID:	04-4464-3684	**Endpoint:**	Proportion Survived	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:14	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

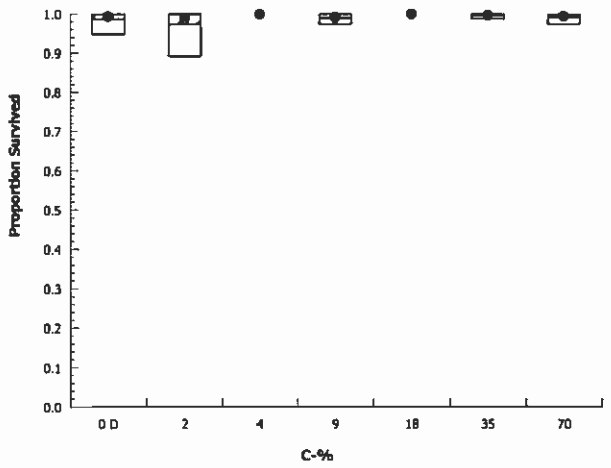
Proportion Survived Detail

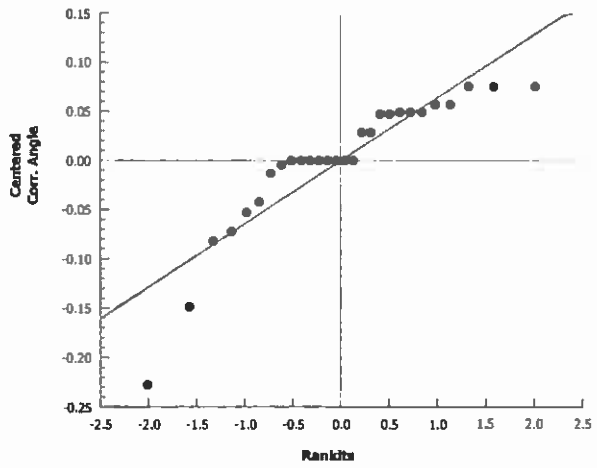
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9478	1	1	1
2		1	1	0.8913	1
4		1	1	1	1
9		0.9826	1	1	0.9739
18		1	1	1	1
35		0.987	1	0.9957	1
70		0.9739	1	0.9913	1

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.34	1.538	1.538	1.538
2		1.538	1.538	1.235	1.538
4		1.538	1.538	1.538	1.538
9		1.439	1.538	1.538	1.409
18		1.538	1.538	1.538	1.538
35		1.456	1.538	1.505	1.538
70		1.409	1.538	1.477	1.538

Graphics





$LC_{50} > 70\%$ BY DATA INSPECTION
-GJL

CETIS Analytical Report

Bivalve Larval Survival and Development Test				Northwestern Aquatic Sciences	
Analysis ID:	14-7284-2081	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:16	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes
Batch ID:	09-1467-2228	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	10 Feb-16 14:45	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	**Species:**	Mytilis galloprovincialis	**Brine:**	
Duration:	48h	**Source:**	Kamilche Sea Farms, WA	**Age:**	
Sample ID:	21-3509-8601	**Code:**	7F4304E9	**Client:**	Wyckoff Treatment Plant
Sample Date:	09 Feb-16 09:20	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	10 Feb-16 11:55	**Source:**	Wyckoff		
Sample Age:	29h (4.7 °C)	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C <> T	NA	NA	8.11%	Passes combined proportion normal

Equal Variance t Two-Sample Test

Control	vs	Control	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		Brine Reagent	1.005	2.447	0.157	6	0.3538	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.008258287	0.008258287	1	1.009	0.3538	Non-Significant Effect
Error	0.04908425	0.008180709	6			
Total	0.05734254		7			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.57	47.47	0.4587	Equal Variances
Variances	Mod Levene Equality of Variance	0.07327	13.75	0.7957	Equal Variances
Variances	Levene Equality of Variance	0.8289	13.75	0.3977	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8174	0.6451	0.0438	Normal Distribution
Distribution	Kolmogorov-Smirnov D	0.2968	0.3313	0.0365	Normal Distribution
Distribution	Anderson-Darling A2 Normality	0.837	3.878	0.0308	Normal Distribution

Combined Proportion Normal Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.9594	0.9135	1	0.9579	0.9174	0.9783	0.01442	3.01%	0.0%
0	Brine Reagent	4	0.927	0.8283	1	0.9579	0.8348	0.9696	0.03103	6.7%	3.37%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.376	1.268	1.484	1.365	1.279	1.423	0.03385	4.92%	0.0%
0	Brine Reagent	4	1.312	1.139	1.484	1.365	1.152	1.395	0.05426	8.27%	4.67%

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9174	0.9783	0.9783	0.9637
0	Brine Reagent	0.9696	0.8348	0.9522	0.9516

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.279	1.423	1.423	1.379
0	Brine Reagent	1.395	1.152	1.35	1.349

Bivalve Larval Survival and Development Test					Northwestern Aquatic Sciences
Analysis ID:	14-5834-6338	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:15	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	09-1467-2228	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	10 Feb-16 14:45	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	**Species:**	Mytilis galloprovincialis	**Brine:**	
Duration:	48h	**Source:**	Kamilche Sea Farms, WA	**Age:**	

Sample ID:	21-3509-8601	**Code:**	7F4304E9	**Client:**	Wyckoff Treatment Plant
Sample Date:	09 Feb-16 09:20	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	10 Feb-16 11:55	**Source:**	Wyckoff		
Sample Age:	29h (4.7 °C)	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	5.18%	70	>70	NA	1.429

Dunnett Multiple Comparison Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		2	1.237	2.448	0.111	6	0.3497	CDF	Non-Significant Effect
		4	-0.09447	2.448	0.111	6	0.8811	CDF	Non-Significant Effect
		9	0.3326	2.448	0.111	6	0.7484	CDF	Non-Significant Effect
		18	-0.7142	2.448	0.111	6	0.9719	CDF	Non-Significant Effect
		35	-0.6668	2.448	0.111	6	0.9682	CDF	Non-Significant Effect
		70	0.1153	2.448	0.111	6	0.8237	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.02129032	0.003548387	6	0.8708	0.5324	Non-Significant Effect
Error	0.08557164	0.00407484	21			
Total	0.106862		27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	2.817	16.81	0.8315	Equal Variances
Variances	Mod Levene Equality of Variance	0.373	3.812	0.8879	Equal Variances
Variances	Levene Equality of Variance	0.7282	3.812	0.6321	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9685	0.8975	0.5413	Normal Distribution
Distribution	Kolmogorov-Smirnov D	0.1322	0.1914	0.2335	Normal Distribution
Distribution	D'Agostino Skewness	0.4173	2.576	0.6765	Normal Distribution
Distribution	D'Agostino Kurtosis	0.6131	2.576	0.5398	Normal Distribution
Distribution	D'Agostino-Pearson K2 Omnibus	0.55	9.21	0.7596	Normal Distribution
Distribution	Anderson-Darling A2 Normality	0.4696	3.878	0.2517	Normal Distribution

Combined Proportion Normal Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.9594	0.9135	1	0.971	0.9174	0.9783	0.01442	3.01%	0.0%
2		4	0.9348	0.8697	0.9999	0.9531	0.8739	0.959	0.02047	4.38%	2.57%
4		4	0.9633	0.9423	0.9842	0.964	0.9467	0.9783	0.006582	1.37%	-0.4%
9		4	0.9519	0.9056	0.9982	0.945	0.9261	0.9915	0.01454	3.05%	0.78%
18		4	0.9726	0.9518	0.9934	0.9735	0.9565	0.987	0.006529	1.34%	-1.38%
35		4	0.9696	0.9334	1	0.9696	0.9478	0.9913	0.01137	2.34%	-1.06%
70		4	0.9582	0.9208	0.9956	0.962	0.9261	0.9826	0.01176	2.45%	0.13%

Bivalve Larval Survival and Development Test — Northwestern Aquatic Sciences

Analysis ID:	14-5834-6338	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:15	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.376	1.268	1.484	1.401	1.279	1.423	0.03385	4.92%	0.0%
2		4	1.32	1.199	1.441	1.353	1.208	1.367	0.03798	5.75%	4.06%
4		4	1.38	1.324	1.437	1.38	1.338	1.423	0.01768	2.56%	-0.31%
9		4	1.361	1.23	1.492	1.335	1.295	1.478	0.04122	6.06%	1.09%
18		4	1.408	1.343	1.473	1.408	1.361	1.456	0.02044	2.9%	-2.34%
35		4	1.406	1.293	1.519	1.403	1.34	1.477	0.03541	5.04%	-2.19%
70		4	1.371	1.278	1.464	1.375	1.295	1.439	0.02931	4.28%	0.38%

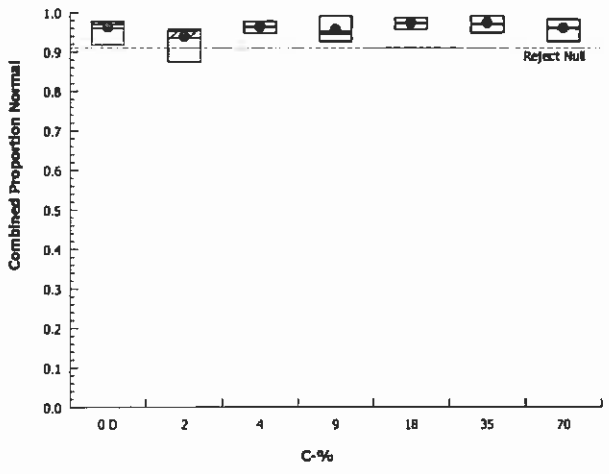
Combined Proportion Normal Detail

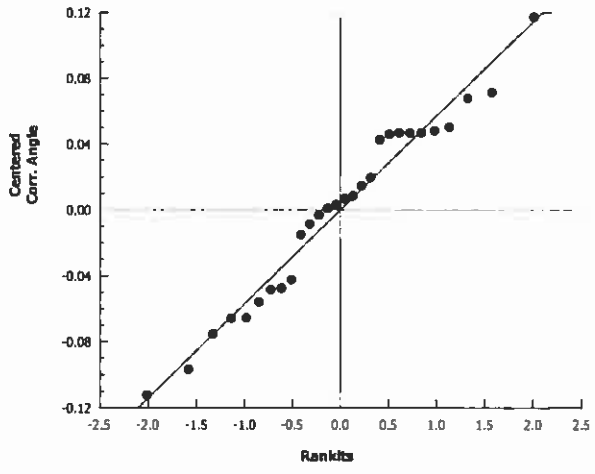
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9174	0.9783	0.9783	0.9637
2		0.959	0.9476	0.8739	0.9587
4		0.9467	0.9783	0.9672	0.9609
9		0.9261	0.9553	0.9915	0.9348
18		0.9565	0.987	0.9688	0.9783
35		0.9478	0.9522	0.987	0.9913
70		0.9261	0.9631	0.9609	0.9826

Angular (Corrected) Transformed Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.279	1.423	1.423	1.379
2		1.367	1.34	1.208	1.366
4		1.338	1.423	1.389	1.372
9		1.295	1.358	1.478	1.313
18		1.361	1.456	1.393	1.423
35		1.34	1.35	1.456	1.477
70		1.295	1.378	1.372	1.439

Graphics





$EC_{50} > 70\%$ BY DATA INSPECTION
-611

CETIS Analytical Report

Test Code: 658-73 00-0129-5616

Bivalve Larval Survival and Development Test					Northwestern Aquatic Sciences
Analysis ID:	21-4181-9524	**Endpoint:**	Combined Proportion Normal	**CETIS Version:**	CETISv1.8.7
Analyzed:	15 Feb-16 15:15	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	09-1467-2228	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	10 Feb-16 14:45	**Protocol:**	EPA/600/R-95/136 (1995)	**Diluent:**	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	**Species:**	Mytilis galloprovincialis	**Brine:**	
Duration:	48h	**Source:**	Kamilche Sea Farms, WA	**Age:**	

Sample ID:	21-3509-8601	**Code:**	7F4304E9	**Client:**	Wyckoff Treatment Plant
Sample Date:	09 Feb-16 09:20	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	10 Feb-16 11:55	**Source:**	Wyckoff		
Sample Age:	29h (4.7 °C)	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	1046939	280	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC25	>70	N/A	N/A	<1.429	NA	NA

Combined Proportion Normal Summary — Calculated Variate(A/B)

C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Dilution Water	4	0.9594	0.9174	0.9783	0.01442	0.02884	3.01%	0.0%	900	938
2		4	0.9348	0.8739	0.959	0.02047	0.04094	4.38%	2.57%	902	964
4		4	0.9633	0.9467	0.9783	0.006582	0.01316	1.37%	-0.4%	913	948
9		4	0.9519	0.9261	0.9915	0.01454	0.02907	3.05%	0.78%	895	940
18		4	0.9726	0.9565	0.987	0.006529	0.01306	1.34%	-1.38%	942	969
35		4	0.9696	0.9478	0.9913	0.01137	0.02273	2.34%	-1.06%	892	920
70		4	0.9582	0.9261	0.9826	0.01176	0.02351	2.45%	0.13%	895	934

Combined Proportion Normal Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9174	0.9783	0.9783	0.9637
2		0.959	0.9476	0.8739	0.9587
4		0.9467	0.9783	0.9672	0.9609
9		0.9261	0.9553	0.9915	0.9348
18		0.9565	0.987	0.9688	0.9783
35		0.9478	0.9522	0.987	0.9913
70		0.9261	0.9631	0.9609	0.9826

CETIS Test Data Worksheet

Test Code: 00-0129-5616/658-731

Bivalve Larval Survival and Development Test				Northwestern Aquatic Sciences
Start Date:	10 Feb-16 14:45	Species:	Mytilis galloprovincialis	Sample Code: 7F4304E9
End Date:	12 Feb-16 14:45	Protocol:	EPA/600/R-95/136 (1995)	Sample Source: Wyckoff
Sample Date:	09 Feb-16 09:20	Material:	Industrial Effluent	Sample Station:

C-%	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	B	1	32	230	233	233	223	
0	B	2	11	230	203	203	192	
0	B	3	12	230	231	231	219	
0	B	4	3	230	248	248	236	
0	D	1	10	230	218	218	211	
0	D	2	2	230	232	232	225	
0	D	3	23	230	233	233	225	
0	D	4	9	230	248	248	239	
2		1	18	230	244	244	234	
2		2	27	230	248	248	235	
2		3	22	230	205	205	201	
2		4	30	230	242	242	232	
4		1	28	230	244	244	231	
4		2	15	230	232	232	225	
4		3	14	230	244	244	236	
4		4	24	230	231	231	221	
9		1	6	230	226	226	213	
9		2	29	230	246	246	235	
9		3	5	230	234	234	232	
9		4	17	230	224	224	215	
18		1	16	230	253	253	242	
18		2	13	230	234	234	227	
18		3	1	230	256	256	248	
18		4	31	230	234	234	225	
35		1	7	230	227	227	218	
35		2	26	230	230	230	219	
35		3	21	230	229	229	227	
35		4	8	230	240	240	228	
70		1	4	230	224	224	213	
70		2	20	230	244	244	235	
70		3	19	230	228	228	221	
70		4	25	230	244	244	226	

data entry verified against laboratory bench sheets 2-22-16 JRF

EPA Lab Manchester (REGION COPY)
DateShipped: 2/9/2016
CarrierName: FedEx
AirbillNo: 7823 3950 0516

CHAIN OF CUSTODY RECORD
Wyckoff Eagle Harbor GWTP 2015/WA
Project Code: WEH-024S
Cooler #: 1 of 1

No: 10-020916-094031-0081
2016T10P303DD210W2LA00
Contact Name: Keith Allers
Contact Phone: 206-780-1711

Sample Identifier	CLP Sample No.	Matrix/Sampler	Coll. Method	Analysis/Turnaround (Days)	Tag/Preservative/Bottles	Location	Collection Date/Time	Sample Type
658- 1st Quarter		Ground Water/ K Allers	Composite	CHRTOX(8 Weeks)	A (< 6 C) (1)	SP-11	02/09/2016 09 20	Field Sample

NAS # 55166

PAGE 13 OF 14

Shipment for Case Complete? N
Samples Transferred From Chain of Custody #

Special Instructions:

Analysis Key CHRTOX=Chronic Toxicity

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	Keith Allers CH2M	2-9-2016 0945	NAS	2-10-16 1155	

ORIGIN ID BFIA (206) 780-1711
KEITH ALLERS
CH2MHILL INC
5350 CREOSOTE PLACE N E

BAINBRIDGE ISLAND, WA 98110
UNITED STATES US

SHIP DATE: 09FEB16
ACTWGT: 6.00 LB
CAD: 103963466/WSXI2500
DIMS: 7x8x10 IN

BILL SENDER

TO GEARLD IRISSARRI
NORTHWESTERN AQUATIC SCIENCES
3814 YAQUINA BAY ROAD

NEWPORT OR 97365
(541) 265-7225

REF: 436558 T1 Y4 04
INV
PO
DEPT

540J137D7727F

FedEx Express

WED - 10 FEB 12:00P
PRIORITY OVERNIGHT

TRK# 0201 7823 3950 0516

86 ONPA

97365
OR-US PDX

NORTHWESTERN
AQUATIC SCIENCES
A Division of NAS Associates, Inc.

SAMPLE NO 658-1st Quarter DATE 2-9-2016
SIGNATURE Keith Allers
PRINT NAME AND TITLE Keith Allers - Industrial Tech IV
SEAL BROKEN BY DATE 2-10-16

APPENDIX III

RAW DATA – REFERENCE TOXICANT TEST

REVIEWED PAGES 1-8 GJI

Test No. 999-3521 Client: QC Test Investigator ________

STUDY MANAGEMENT

Client: QC Test
Client's Study Monitor: QC Test
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Mgr./Study Dir. G.J. Irissarri GJI
QA Officer L.K. Nemeth
1. Yves Nakahara 2. Lauren Brady LB
3. J. Bauer JB 4. ________
Study Schedule:
Test Beginning: 2-10-16 1445 Test Ending: 2-12-16 1445

TEST MATERIAL

Description: Copper as $CuSO_4 \cdot 5H_2O$, Argent Lot# 0195,
NAS Sample No. 1.0 mg/ml stock prepared: 6-19-14
Date of Collection:
Date of Receipt:
Temperature (deg C):
pH:
Dissolved oxygen (mg/L):
Conductivity (umhos/cm):
Hardness (mg/L):
Alkalinity (mg/L):
Salinity (ppt):
Total chlorine (mg/L):
Total ammonia-N (mg/L):
________:

DILUTION WATER

Description: Yaquina Bay, OR Seawater
Date of Collection: 2-9-16 Salinity (ppt) 30.0 pH 8.0
Treatments: Aerated, filtered to ≤ 0.45 um, salinity adjusted with Milli-Q® deionized water

TEST ORGANISMS

Species: *Mytilus galloprovincialis* Date Received: 2-9-16
Source: Kamilche Sea Farms, Shelton, WA
Acclimation Data:

Date	Temp (deg.C)	pH	Sal (ppt)	D.O. (mg/L)	Comments
2-10-16	12.7	7.8	28.0	7.1	Held outside in trays of
					flowing seawater
Mean					
S.D.					
(N)					

Photoperiod during acclimation: Outdoor ambient conditions

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with correct date
4) error found in measurement; measurement repeated

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/MG2

BIVALVE LARVAL TEST BASED ON EPA/600/R-95/136

Test No. 999-3521 Client QC Test Investigator

SPAWNING AND GAMETE HANDLING

Spawning: Initial: 1010 Final: 1035 Fertilization: 1130

Number of organisms used: females: 4 males: 3

Egg Dilution (1 ml diluted to 100 ml):

Count/ml of dilution: 1. 38 2. 36 3. 34 Mean: 36

Dilution factor = DF (mean x 100/2500) = 1.4

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 64, 32, 16, 8, 4, 2, 1 and 0 ug/L

Test chamber: 30 ml glass vials Test volume: 10 ml Replicates/treatment (4): 4

Organisms/ml (15-30): 23.0 Test water changes: None Aeration during test: None

Feeding: None Photoperiod: 16L:8D Salinity: 30 +/- 2 ppt

Temperature: 20 +/- 1 °C, oysters; (16 +/- 1 °C, mussels) Beaker placement: Stratified randomization

RANDOMIZATION CHART

A	4	1	16	8	32	64	Ø	2		
B	8	Ø	2	32	16	4	1	64		
C	32	64	Ø	16	2	1	4	8		
D	64	32	1	2	4	8	16	Ø		

PREPARATION OF TEST SOLUTIONS

2-10-16
GJ

Test Conc. (Cu, ug/L)	ml of working stock #2 (2 ug/mL)	Dilution water (ml/100mL)
64	3.2	Brought up to a
32	1.6	final volume of
16	0.8	100 ml with
8	0.4	dilution water.
4	0.2	
2	0.1	
1	0.05	
0	0	

1st working stock made by 1:99 (1.0 mL ↑100mL) dilution of concentrated 1 mg/mL stock solution. Final concentration 10 ug/mL.

2nd working stock made (working stock #2) made by 20:80 (20 mL ↑100mL) dilution of 1st working stock. Final concentration 2 ug/mL.

Comments:

Test No. 999-3521 Client QC Test Investigator

WATER QUALITY DATA

Conc. (ug/L)	Date: 2-10-16 initials: Temp. (deg.C)	pH	Sal. (ppt)	DO (mg/L)	Date: 2-12-16 initials: Temp. (deg.C)	pH	Sal. (ppt)	DO (mg/L)
64	16.5	8.0	29.0	8.1	16.4	8.0	29.5	7.9
32	16.5	8.0	29.5	8.1	16.4	8.0	30.0	7.8
16	16.5	8.0	30.0	8.1	16.5	8.0	30.0	7.8
8	16.4	8.0	30.0	8.1	16.5	8.0	30.0	7.8
4	16.4	8.0	30.0	8.1	16.5	8.0	30.0	7.8
2	16.5	8.0	30.0	8.1	16.5	7.9	30.0	7.7
1	16.5	8.0	30.0	8.1	16.6	7.9	30.0	7.7
Control	16.5	8.0	30.0	8.1	16.5	7.9	30.0	7.7
Brine control	---	---	---	---	---	---	---	---

WATER QUALITY:

	Mean	SD	N
Temperature (°C):	16.5	0.1	16
pH:	8.0	0.0	16
Salinity (ppt):	29.9	0.3	16
DO (mg/L):	7.9	0.2	16

Room/ Water bath temperature: (°C)

Day 0: 16.6 Day 0: 16.5
Day 1: 16.4 Day 1: 16.6
Day 2: 16.4 Day 2: 16.5

LARVAL COUNT DATA

Conc. (ug/L)	Replicate 1 (2-15-16)		Replicate 2 (2-15-16)		Replicate 3 (2-15-16)		Replicate 4 (2-15-16)	
	N	A	N	A	N	A	N	A
64	Ø	Ø	Ø	Ø	Ø	1	0	1
32	Ø	131	Ø	167	Ø	145	0	133
16	3	209	Ø	207	5	198	10	195
8	190	48	165	60	177	69	152	68
4	235	17	236	10	243	12	229	13
2	203	10	192	11	219	9	232	20
1	246	11	224	12	216	12	235	9
Control	208	11	233	9	255	11	215	6
Brine control	---	---	---	---	---	---	---	---
Zero time	134	22 c	232	225	225	242	—	—

Zero time: Mean 230 SD 8 N 6 CV=(sd/mean)x100 3.4%

Remarks:

KAMILCHE
SEA FARMS

Kamilche Sea Farms, Inc.
2741 SE Bloomfield Road • Shelton, WA 98584
360 427 5774 • Fax 360 427 0610
WA Cert. #217-SS
Harvested: Totten Inlet, Puget Sound

35313

TO North West Aquatic Sciences
(Gerald)

DATE 2-9-16
CUSTOMER ORDER NO
SALESPERSON
VIA

TERMS

QUANTITY	DESCRIPTION		PRICE	AMOUNT
10 lbs.	**Mussels - Beard On**	1 @ 10 lbs.	[redacted]	[redacted]
			Total	[redacted]
	RECEIVED 2-9-16			
	-GJ			

Thank You!

Bivalve Larval Survival and Development Test — Northwestern Aquatic Sciences

Batch ID:	01-9994-3420	Test Type:	Development-Survival	Analyst:	
Start Date:	10 Feb-16 14:45	Protocol:	EPA/600/R-95/136 (1995)	Diluent:	Yaquina Bay Seawater
Ending Date:	12 Feb-16 14:45	Species:	Mytilis galloprovincialis	Brine:	
Duration:	48h	Source:	Kamilche Sea Farms, WA	Age:	

Sample ID:	15-7585-7746	Code:	5DEDAE52	Client:	Internal Lab
Sample Date:	12 Feb-16 14:45	Material:	Copper sulfate	Project:	
Receive Date:	12 Feb-16 14:45	Source:	Reference Toxicant		
Sample Age:	NA	Station:			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
01-9665-7087	Combined Proportion Norm	4	8	5.657	7.23%		Dunnett Multiple Comparison Test
10-4861-0942	Proportion Normal	4	8	5.657	6.39%		Bonferroni Adj t Test
09-0422-3868	Proportion Survived	8	16	11.31	4.85%		Steel Many-One Rank Sum Test

Point Estimate Summary

Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method
16-1101-9044	Combined Proportion Norm	EC25	8.321	6.977	9.235		Linear Interpolation (ICPIN)
14-7293-2864	Combined Proportion Norm	EC50	9.559	9.35	9.772		Spearman-Kärber
21-1976-5401	Proportion Normal	EC25	8.068	7.179	8.767		Linear Interpolation (ICPIN)
18-2643-9658	Proportion Normal	EC50	9.516	9.293	9.745		Trimmed Spearman-Kärber
18-7030-3643	Proportion Survived	EC50	32.45	31.59	33.34		Trimmed Spearman-Kärber

Combined Proportion Normal Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.9401	0.8974	0.9829	0.9043	0.9628	0.01344	0.02687	2.86%	0.0%
1		4	0.9583	0.9352	0.9815	0.9391	0.9739	0.007278	0.01456	1.52%	-1.94%
2		4	0.8976	0.817	0.9781	0.8348	0.9522	0.0253	0.0506	5.64%	4.53%
4		4	0.9601	0.9183	1	0.9325	0.9957	0.01315	0.0263	2.74%	-2.13%
8		4	0.7413	0.6269	0.8558	0.6609	0.8261	0.03596	0.07193	9.7%	21.15%
16		4	0.01957	0	0.04864	0	0.04348	0.009137	0.01827	93.4%	97.92%
32		4	0	0	0	0	0	0	0		100.0%
64		4	0	0	0	0	0	0	0		100.0%

Proportion Survived Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.9783	0.9379	1	0.9522	1	0.01268	0.02535	2.59%	0.0%
1		4	0.9978	0.9909	1	0.9913	1	0.002174	0.004348	0.44%	-2.0%
2		4	0.95	0.8613	1	0.8826	1	0.02787	0.05574	5.87%	2.89%
4		4	1	1	1	1	1	0	0	0.0%	-2.22%
8		4	0.9815	0.9465	1	0.9565	1	0.011	0.02199	2.24%	-0.33%
16		4	0.8989	0.8722	0.9256	0.8826	0.9217	0.008396	0.01679	1.87%	8.11%
32		4	0.6261	0.5117	0.7405	0.5696	0.7261	0.03594	0.07188	11.48%	36.0%
64		4	0.002174	0	0.006168	0	0.004348	0.001255	0.00251	115.5%	99.78%

Bivalve Larval Survival and Development Test — Northwestern Aquatic Sciences

Combined Proportion Normal Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9043	0.9628	0.9586	0.9348
1		0.9572	0.9739	0.9391	0.9631
2		0.8826	0.8348	0.9522	0.9206
4		0.9325	0.9593	0.9529	0.9957
8		0.8261	0.7087	0.7696	0.6609
16		0.01304	0	0.02174	0.04348
32		0	0	0	0
64		0	0	0	0

Proportion Survived Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9522	1	1	0.9609
1		1	1	0.9913	1
2		0.9261	0.8826	0.9913	1
4		1	1	1	1
8		1	0.9696	1	0.9565
16		0.9217	0.9	0.8826	0.8913
32		0.5696	0.7261	0.6304	0.5783
64		0	0	0.004348	0.004348

Combined Proportion Normal Binomials

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	208/230	233/242	255/266	215/230
1		246/257	224/230	216/230	235/244
2		203/230	192/230	219/230	232/252
4		235/252	236/246	243/255	229/230
8		190/230	163/230	177/230	152/230
16		3/230	0/230	5/230	10/230
32		0/230	0/230	0/230	0/230
64		0/230	0/230	0/230	0/230

Proportion Survived Binomials

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	219/230	230/230	230/230	221/230
1		230/230	230/230	228/230	230/230
2		213/230	203/230	228/230	230/230
4		230/230	230/230	230/230	230/230
8		230/230	223/230	230/230	220/230
16		212/230	207/230	203/230	205/230
32		131/230	167/230	145/230	133/230
64		0/230	0/230	1/230	1/230

CETIS Test Data Worksheet

Report Date: 15 Feb-16 14:47 (p 1 of 1)
Test Code: 18-2305-5641/999-3521

Bivalve Larval Survival and Development Test — Northwestern Aquatic Sciences

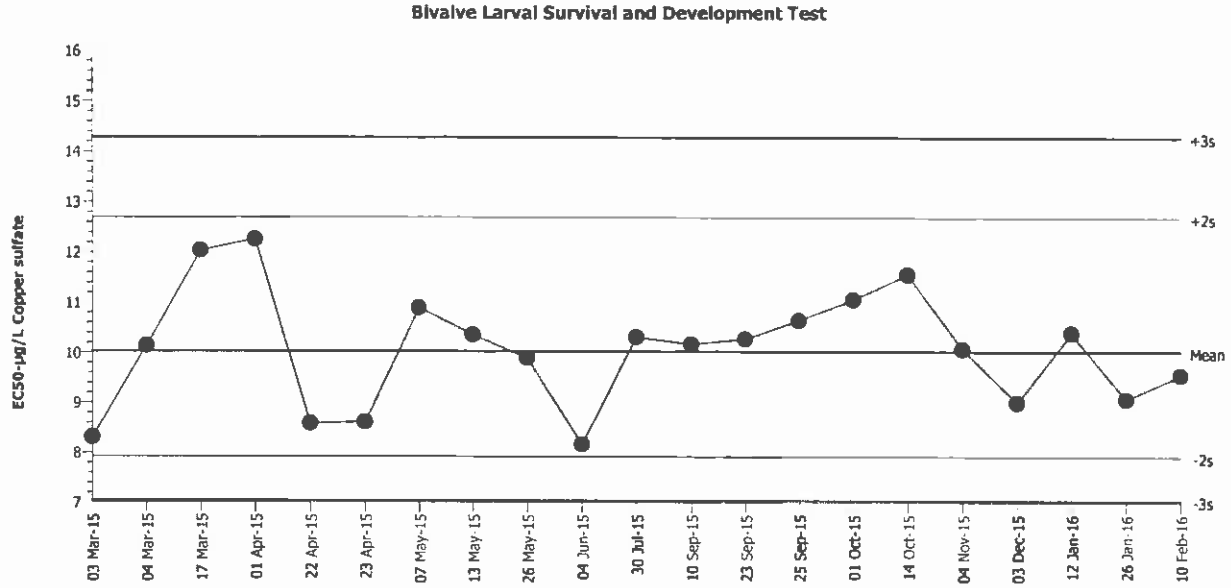
Start Date:	10 Feb-16 14:45	Species:	Mytilis galloprovincialis
End Date:	12 Feb-16 14:45	Protocol:	EPA/600/R-95/136 (1995)
Sample Date:	12 Feb-16 14:45	Material:	Copper sulfate
Sample Code:	5DEDAE52		
Sample Source:	Reference Toxicant		
Sample Station:			

C-µg/L	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	D	1	3	230	219	219	208	
0	D	2	4	230	242	242	233	
0	D	3	8	230	266	266	255	
0	D	4	26	230	221	221	215	
1		1	28	230	257	257	246	
1		2	9	230	236	236	224	
1		3	7	230	228	228	216	
1		4	10	230	244	244	235	
2		1	1	230	213	213	203	
2		2	6	230	203	203	192	
2		3	27	230	228	228	219	
2		4	14	230	252	252	232	
4		1	11	230	252	252	235	
4		2	13	230	246	246	236	
4		3	21	230	255	255	243	
4		4	32	230	242	242	229	
8		1	22	230	238	238	190	
8		2	25	230	223	223	163	
8		3	12	230	246	246	177	
8		4	30	230	220	220	152	
16		1	31	230	212	212	3	
16		2	20	230	207	207	0	
16		3	17	230	203	203	5	
16		4	23	230	205	205	10	
32		1	15	230	131	131	0	
32		2	2	230	167	167	0	
32		3	18	230	145	145	0	
32		4	19	230	133	133	0	
64		1	29	230	0	0	0	
64		2	16	230	0	0	0	
64		3	5	230	1	1	0	
64		4	24	230	1	1	0	

data entry verified against laboratory bench sheets 2-17-16 JRF

Bivalve Larval Survival and Development Test — **Northwestern Aquatic Sciences**

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



Mean:	10.02	**Count:**	20	**-2s Warning Limit:**	7.918	**-3s Action Limit:**	7.038
Sigma:	NA	**CV:**	12.50%	**+2s Warning Limit:**	12.69	**+3s Action Limit:**	14.28

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2015	Mar	3	13:25	8.311	-1.713	-1.59			04-6089-3353	10-0884-4050
2			4	14:10	10.14	0.1131	0.09519			11-1749-6172	02-6924-0562
3			17	14:00	12.03	2.007	1.548			18-5112-6398	01-9547-9299
4		Apr	1	16:30	12.26	2.233	1.705			13-0618-2511	09-3363-8398
5			22	13:40	8.585	-1.439	-1.314			00-3213-1743	14-0335-9169
6			23	14:55	8.612	-1.412	-1.288			04-5651-6084	07-9131-6184
7		May	7	15:35	10.89	0.8699	0.7059			00-3523-0479	12-8078-2374
8			13	13:45	10.35	0.3305	0.2752			16-6504-7989	11-4000-6150
9			26	12:40	9.895	-0.1288	-0.1097			15-2938-1576	00-3109-6336
10		Jun	4	16:30	8.168	-1.857	-1.737			17-2527-9288	05-3466-4089
11		Jul	30	16:35	10.31	0.2885	0.2407			09-9236-7237	16-6604-3815
12		Sep	10	14:20	10.17	0.1483	0.1246			14-2847-3680	18-2495-6117
13			23	15:20	10.27	0.2492	0.2083			07-5017-0556	12-5711-0160
14			25	14:45	10.64	0.6201	0.5091			08-8031-4805	17-8304-1379
15		Oct	1	15:00	11.05	1.03	0.8294			02-0435-7572	17-5283-9042
16			14	14:20	11.56	1.534	1.208			04-2701-8188	06-5641-7689
17		Nov	4	14:35	10.07	0.05007	0.04226			01-4945-0913	12-4167-7901
18		Dec	3	12:10	9.003	-1.022	-0.9117			03-1706-3107	08-0944-2928
19	2016	Jan	12	14:40	10.4	0.3742	0.3109			10-6038-5674	20-9220-6975
20			26	13:20	9.075	-0.9494	-0.844			18-1116-9330	06-8399-0866
21		Feb	10	14:45	9.559	-0.4655	-0.4033			18-2305-5641	14-7293-2864