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Safety of Spray-Dried Powder Formulated *Pseudomonas fluorescens* Strain CL145A Exposure to Subadult/Adult Unionid Mussels During Simulated Open-Water Treatments

By James A. Luoma, Kerry L. Weber, Diane L. Waller, Jeremy K. Wise, Denise A. Mayer, and Douglas B. Aloisi

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Conversion Factors

International System of Units to Inch/Pound

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
micrometer (µm)	3.937×10^{-5}	inch (in.)
millimeter (mm)	0.03937	inch (in.)
	Volume	
liter (L)	1.057	quart (qt)
milliliter (mL)	0.03382	ounce, fluid (fl. oz)
	Flow rate	
milliliter per minute (mL/min)	0.0002642	gallon per minute (gal/min)
	Mass	
milligram (mg)	3.527×10^{-5}	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as °F = (1.8 × °C) + 32.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L).

Abbreviations

AEH	Aquatic Ecosystem Health Branch
$CaCO_3$	calcium carbonate
DO	dissolved oxygen
ID	inner diameter
NH_3	un-ionized ammonia
SDP	spray dried powder
SDP/L	spray dried powder per liter
TAN	total ammonia nitrogen
TEMP	temperature
Pf	*Pseudomonas fluorescens*
µS/cm	microsiemens per centimeter

Safety of Spray-Dried Powder Formulated *Pseudomonas fluorescens* Strain CL145A Exposure to Subadult/Adult Unionid Mussels During Simulated Open-Water Treatments

By James A. Luoma,[1] Kerry L. Weber,[1] Diane L. Waller,[1] Jeremy K. Wise,[1] Denise A. Mayer,[2] and Douglas B. Aloisi[3]

Abstract

The exposure effects of a commercially prepared spray dried powder (SDP) formulation of *Pseudomonas fluorescens* (strain CL145A) on the survival of seven species of unionid mussels endemic to the Great Lakes and Mississippi River basins was evaluated in this study. The study exposures were completed within replicated 350-liter test tanks contained within a mobile bioassay laboratory sited on the shores of the Black River near La Crosse, Wisconsin. The test tanks were supplied with flowing, filtered river water which was interrupted during the exposure period.

Two groups of seven species of mussels were used in equal proportions in the study. The first group was exposed to SDP for 8 hours, and the second group was exposed to SDP for 24 hours. Individually tagged mussels were randomly allocated to test tanks until all test tanks contained 8 to 10 mussels of each species (dependent upon the number available for testing).

The experimental unit for the trial was the individual test tank, and treatment group was assigned using a randomized block design. The treatment groups for each exposure duration consisted of (1) an untreated control group, (2) a group that received an application of 50 milligrams SDP per liter (mg SDP/L), and (3) a group that received an application of 100 mg SDP/L. All mussel species and both exposure duration groups were exposed concurrently (that is, one-half of the mussels were removed after 8 hours of SDP exposure and the remaining mussels were removed after 24 hours of SDP exposure). All treatment concentrations are reported as active ingredient.

After exposure, the mussels were consolidated into wire mesh cages and placed in the Black River for a 27-28 day postexposure period, after which time survival of mussels was assessed. Of the 1,170 mussels tested in the study, 3 were confirmed dead and 5 were not recovered and treated as mortalities in the analysis. The effect and interactions of species, SDP exposure concentration, and SDP exposure duration were analyzed and did not affect mussel survival ($p > 0.98$). The results from this study indicate that SDP exposure at the maximum approved open-water concentration of 100 mg/L for up to 3 times the maximum approved open-water exposure duration of 8 hours (in other words for 24 hours of exposure) is unlikely to reduce survival of subadult or adult mussels.

[1] U.S. Geological Survey.

[2] New York State Education Department.

[3] U.S. Fish and Wildlife Service.

Introduction

Native freshwater mussels of North America were historically considered the most diverse in the world, with about 297 recognized taxa consisting of 281 species and 16 subspecies (Williams and others, 1993). Mussels are largely sedentary in nature, relying on movement of host fish during glochidial attachment as means of transport. Thus, they are particularly vulnerable to a variety of anthropogenic influences, including habitat degradation and alteration, pollution, and overharvest. Neves (2004) reported that 70 species of freshwater mussels in the United States are listed as threatened or endangered, and 40 are candidates for possible listing. The International Union for Conservation of Nature's Red List has 95 species of North American freshwater bivalves currently listed as vulnerable, endangered, or critically endangered and 29 listed as extinct or possibly extinct (http://www.iucnredlist.org/, accessed February, 2014). Ricciardi and Rasmussen (1999) suggested that 127 mussel species will become extinct in the next 100 years; this is claimed to be a conservative extinction rate of 6.4 percent per decade given that it did not take into account extirpations caused by invasive dreissenid mussels (zebra mussel, *Dreissena polymorpha*, and quagga mussel, *D. bugensis*). Concerns for native mussels in the Southeast are even greater given that only 25 percent of the 269 species historically present are reported as stable compared to the 13 percent presumed extinct and the 28, 14, and 18 percent listed, respectively, as endangered, threatened, or of special concern (Neves and others, 1997).

Many mussels endemic to North America were imperiled prior to epizoic colonization by zebra and quagga mussels. The introduction of these dreissenids, however, has dramatically heightened concerns for the continued survival of native mussel species. Zebra mussels were reported to be responsible for the extirpation of unionid mussels from waters in Europe as early as 1937 (Sebestyen, 1937; cited in Burlakova and others, 2000). Severe declines in unionid abundance in Europe (Karatayev and Burlakova, 1995; and Burlakova, 1998; cited in Burlakova and others, 2000) and North America (Haag and others, 1993; Nalepa, 1994; Ricciardi and others, 1996; Neves, 2004) have since been well documented in the literature.

The 1973 Endangered Species Act brought forth the need to recognize, protect, and recover rare mussels in the United States. The U.S. Fish and Wildlife Service is responsible for developing recovery plans for threatened and endangered species. Recovery plans can include restoring and acquiring critical habitat, removing introduced or invasive species, and captive propagation and release into historic ranges.

One potential tool for limited, open-water control of dreissenid mussels in critical, high-value habitats is a commercially prepared spray dried powder (SDP) formulation of a specific strain (CL145A) of the common soil bacterium *Pseudomonas fluorescens*. The SDP formulation is produced by Marrone Bio Innovations, Inc. (Davis, California) and it was registered by the U.S. Environmental Protection Agency (Zequanox®; registration # 84059-15) for controlling dreissenid mussels in industrial water conveyance systems (for example, cooling and service water systems) in 2012 and for controlling dreissenid mussels in open-water systems in 2014. Evaluation of SDP exposure effects on nontarget animals, particularly sedentary filter feeding animals such as native unionid mussels, is a critical step before SDP should be applied to control dreissenid mussels in open-water environments.

The study objective was to determine the survival of unionid mussels after exposure to SDP up to the maximum approved open-water application concentration (100 milligrams per liter [mg/L]) and up to 3 times the maximum approved open-water exposure duration (8 hours). The SDP exposures were completed within a mobile bioassay laboratory sited along the Black River (La Crosse, Wisconsin) and after the exposures the test animals were held in the Black River adjacent to the exposure location (fig. 1).

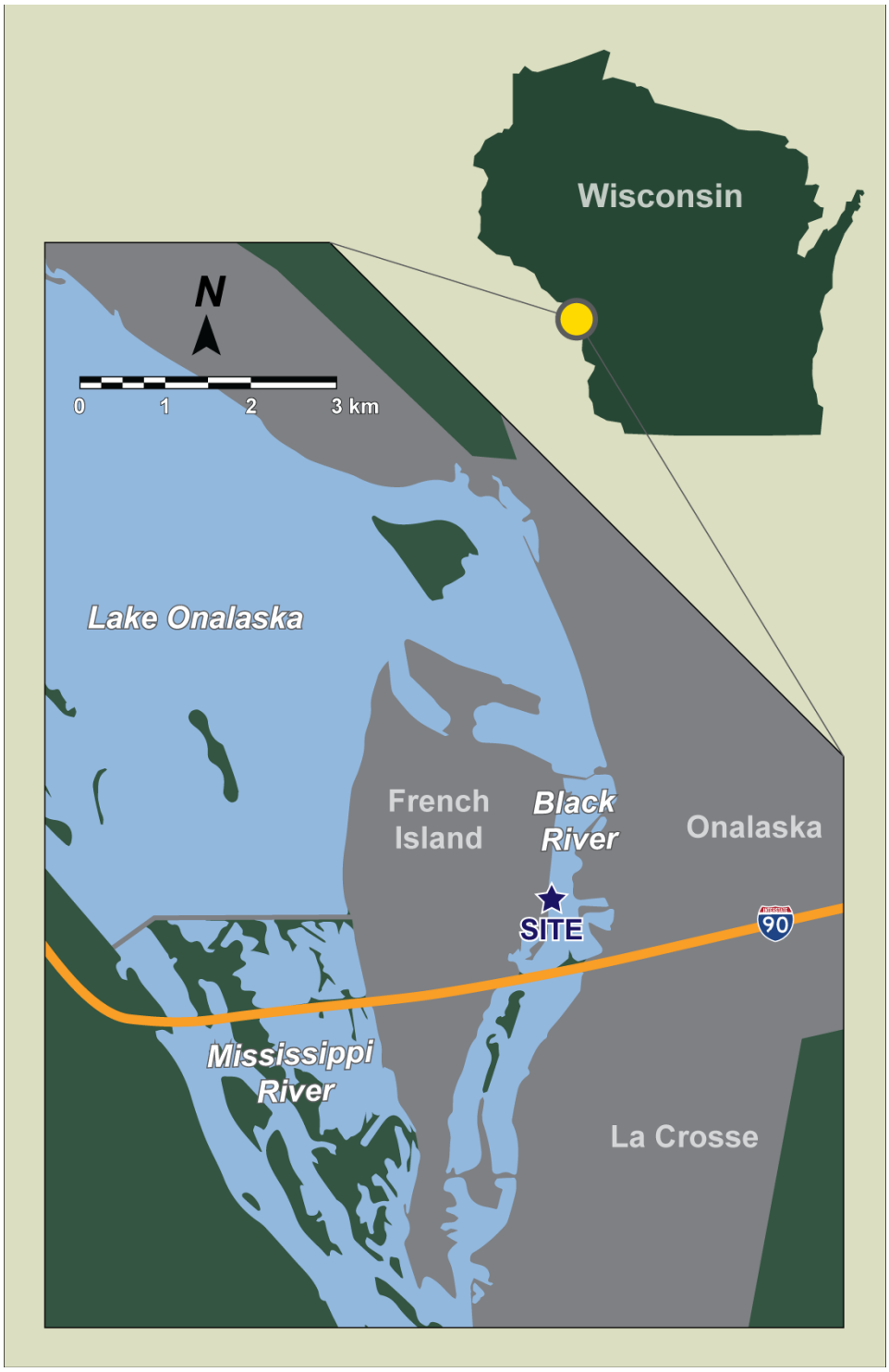

Figure 1. Exposure and postexposure test animal holding location.

Materials and Methods

The protocol and amendments for this study are contained in appendix 1 (items 1–2). All methods and materials followed the written protocol except those instances that were identified as deviations (appendix 2, items 1–3).

Experimental Design

The study was designed to assess the survival of unionid mussels after exposure to target concentrations of 50 and 100 mg/L of SDP for 8 and 24 hours. Five species of subadult and two species of adult unionid mussels were evaluated (table 1). A total of 1,170 mussels were individually tagged, measured, and randomly assigned (appendix 3, item 2) to test tanks in equal proportions. Each test tank contained two containment baskets, one to hold mussels for the 8-hour exposure group and one for the 24-hour exposure group. Each exposure group consisted of 8–10 mussels of each species.

Treatment was assigned to each test tank by using a randomized block design (appendix 3, item 1). Three treatment groups were tested in triplicate and included (1) an untreated control group, (2) a group that received an application of 50 milligrams SPD per liter (mg SDP/L), and (3) a group that received an application of 100 mg SDP/L. The experimental unit for the trial was the individual test tank. At the conclusion of the exposure period, the mussels were consolidated into wire mesh cages and placed in the Black River (La Crosse, Wis.) for a 27–28 day postexposure period, after which time survival was assessed.

Table 1. Scientific and common name, source, lifestage, mean (standard deviation) length, and total number of test animals used in the study.
[mm, millimeter]

Scientific name	Common name	Source	Lifestage	Mean length (mm)	Total number used
Megalonaias nervosa	Washboard	Propagated	Subadult	44.0 (3.8)	180
Lampsilis cardium	Plain pocketbook	Propagated	Subadult	39.2 (4.2)	162
Obovaria olivaria	Hickorynut	Propagated	Subadult	30.9 (2.2)	180
Lampsilis siliquoidea	Fatmucket	Propagated	Subadult	57.0 (4.8)	180
Lampsilis higginsii	Higgins eye	Propagated	Subadult	23.8 (2.3)	144
Amblema plicata	Threeridge	Wild	Adult	63.2 (8.3)	180
Fusconaia flava	Wabash pigtoe	Wild	Adult	51.1 (8.0)	144

Test Article

The test article was a commercially formulated SDP formulation of *Pseudomonas fluorescens*, strain CL145A (Zequanox®) containing 50 percent active ingredient (weight to weight ratio [w/w] *P. fluorescens*, strain CL145A); provided by Marrone Bio Innovations as a mixed lot [401P12163C and 401P12164C]; Certificates of Analysis, appendix 4, items 2 and 3). Test article use was documented in the test chemical log books (appendix 4, item 7). Concentrations of test article are reported as active

ingredient. Retention of test article biological activity was assessed after the study by the New York State Museum Field Research Laboratory, using their standard dreissenid mussel bioassay. Results of the test article biological activity verification bioassay demonstrated the retention of test article biological activity as indicated by a mean zebra mussel mortality of 98.7 ± 2.3 percent in the SDP-treated group compared with mean mortality of 0.0 ± 0.0 percent in the untreated control (appendix 4, item 6).

Test System

The test system was a series of nine independent circular test tanks (76.2 x 95.3 centimeters [cm], diameter × high; 350-L capacity [fig. 2]) contained within a mobile bioassay laboratory. The test system utilized filtered Black River water for the static exposures, containment baskets to confine the test animals, and substrate to allow for test animal positioning. River water was supplied to the test system using a 3-horsepower submersible pump (ITT Goulds Pumps, Seneca Falls, New York, model 18GS30). Water was filtered (200 micrometer) using an automatic backwashing microscreen filtration system (Forsta Filter Inc., Los Angeles, Calif.; model M2-90). Filtered water was delivered to a headbox (55.9 x 114.3 x 30.5 cm, width x length x height) positioned over each row of test tanks and gravity fed to each test tank at ≈6 liters per minute for approximately one tank-exchange per hour. Water flow was interrupted during the exposure period. Water during the preexposure period was discharged to the river; SDP treated exposure water was retained in portable frame tanks, collected by a state-licensed septic hauler, and discharged to the La Crosse, Wis., sanitary treatment system.

Two semi-rigid plastic mesh containment baskets were positioned within each test tank (fig. 2). The baskets were secured to a frame constructed with 1.9 and 2.5-cm wide × 0.3-cm-thick welded aluminum that had an attached aluminum rod handle (0.95 x 76.0 cm, diameter × length). The containment baskets were used to confine the test animals during the exposure period and to facilitate removal after exposure. Approximately 2.5 cm (≈11.4 kg) of washed sand substrate (River Run Products, Inc. Marathon, Wis.) was placed in the test tanks after the placement of the containment baskets. The substrate facilitated test animal positioning and normal behavior (that is, siphoning).

Figure 2. Test tanks positioned in the mobile bioassay laboratory (left) and containment baskets positioned in test tank (right).

Test Animals

A total of seven species of unionid mussels, composed of five species of subadult mussels and two species of adult mussels, were used as the test animals (table 1; fig. 3). Subadult mussels were propagated animals, ≤ 3 years of age, obtained from the U.S. Fish and Wildlife Service's Genoa National Fish Hatchery (NFH). The adult mussels were wild collected from the Upper Mississippi River at river mile 670.5 by Genoa NFH biologists. A Hallprint® shellfish tag with a unique alphanumeric code was fixed to each mussel shell with cyanoacrylate glue (fig. 3), and individual shell length was measured parallel to the hinge. The mussels were maintained at the Genoa NFH in flowing pond water then transported to the test location. Prior to distribution, the mussels were acclimated to Black River water by periodic additions of Black River water to the transportation coolers.

Figure 3. Example specimens of the seven unionid mussel species tested (left) and alphanumeric-tagged mussels (right).

Postexposure Handling

At exposure termination (8 and 24 hours), the assigned containment baskets were removed and the mussels were consolidated into one of six wire mesh cages, constructed according to Brady and others (2010; fig. 4), for the postexposure period. Mussels from one test tank replicate of each treatment group and exposure duration were placed into a single wire mesh (that is, mussels removed at the same exposure termination from a control, a 50 mg/L replicate and a 100 mg/L replicate were placed into the same wire mesh cage). The wire mesh cages were placed in ≈3 meters of water in the Black River (15 T 064099mE 4858943mN, fig. 1) for the postexposure period.

Survival Assessment

Survival of mussels was assessed at 27 or 28 days after exposure. Survival was defined as valve or foot movement in response to tactile stimuli or resistance to valve pressure by adductor muscle contraction. The mussels recovered from each wire mesh cage were sorted by species and individually assessed for survivorship.

Figure 4. Example wire mesh cage used to hold mussels during the postexposure period.

Dosing and Dose Verification

One of three treatments was assigned to each test tank according to a randomized design scheme (appendix 3, item 1). Three treatment groups were assigned in triplicate and consisted of (1) an untreated control group, (2) a 50-mg SDP/L group, and (3) a 100-mg SDP/L group. A dosing stock solution was prepared from the test article and immediately applied to each test tank. Depending on treatment assignment, a premeasured amount of SDP (0 grams [g] for control; 35 g for 50-mg SDP/L treatment; 70 g for 100-mg SDP/L treatment) was added to ≈12 L of test tank water and mechanically mixed for 3–5 minutes with a paint mixer attached to an electric drill. Immediately after mixing, the stock solution was poured through a strainer, and clumps of test article were macerated with a pestle and rinsed into the stock solution. The resulting stock solutions for each test tank contained the amount of SDP required to achieve the desired concentration. The SDP treatments were administered to the test tanks by gently pouring the stock solution into the test tank. The stock solution and water within the test tank were gently mixed by hand, using a polyvinyl chloride pipe. Care was used to minimize substrate disturbance.

Water samples were collected to verify SDP exposure and total ammonia nitrogen (TAN) concentrations. Water samples were collected by submersing a 50-mL beaker below the water surface of each test tank. The SDP exposure concentrations were determined by comparison to a linear regression curve created from known concentrations (0, 25, 50, 100 and 200 mg/L [as SDP active ingredient]) and absorbance of the test article. Sample absorbance was measured on a Beckman-Coulter model DU-800 spectrophotometer at 660 nanometers. A linear regression equation (appendix 7, items 1–2) was fit using the Statistical Analysis Software Proc Reg procedure (SAS® Version 9.3, SAS Institute, Inc.,

Cary, North Carolina), and the exposure concentrations were determined from the linear regression (appendix 7, item 1). Exposure concentrations are reported as active ingredient.

Water Chemistry

Dissolved oxygen, pH, and temperature were measured in each test tank before treatment and ≈1, 6, 12, 18 and 24 hours thereafter. Water hardness, alkalinity, and conductivity were measured prior to treatment on samples collected from each headbox and from water samples collected from each test tank ≈3 hours after administering the treatment. Immediately before the exposure period was terminated, water samples were collected and analyzed for total ammonia nitrogen content by the UMESC water quality laboratory, using the automated phenate method (Standard Method 4500G; American Public Health Association and others, 2012). The un-ionized ammonia fractions were calculated by using the sample pH and temperature measured at the time of sample collection according to the formula identified by Emerson and others (1975). Temperature loggers (Onset, Bourne, Massachusetts, HOBO® Pendent Temperature/Light Data Logger) were attached to each wire mesh cage and recorded water temperature every 6 hours during the postexposure period.

Data Analysis

Statistical comparisons of mussel survival were completed using Statistical Analysis Software (SAS® Version 9.3, SAS Institute, Inc., Cary, N.C.). Significance for all analyses was declared at $\alpha \leq 0.05$. A generalized linear mixed model was used to analyze the effect and interactions of species, SDP exposure concentration, and exposure duration on the survival of mussels. The proportion of mortalities ([number of dead + unrecovered mussels]/total number of mussels in the sample) were modeled by using the SAS Proc GLIMMIX procedure with a binomal distribution and a logit link function (appendix 8, item 1). A scale parameter was added to the model by using the "random_residual_" statement. Mussel survival in each active treatment group was individually compared to the mussel survival of the untreated control group by using a two-sided means comparison test.

Data analyses for water chemistry were limited to simple descriptive statistics. The SAS Software Proc Means procedure was used to determine the mean exposure concentration by individual test tank and by treatment group (appendix 7, items 1–2). All concentrations are reported as active ingredient.

Results

Statistical analyses for survival output are presented in appendix 8 (item 3), and the summarized data are presented in appendix 9 (items 1–8). Survival of mussels in each treatment group is summarized in table 2. Mean survival of all mussel species in both the 8- and the 24-hour exposure duration groups exceeded 95 percent for all treatment groups, and mussel survival exceeded 87 percent for all test replicates, regardless of species, treatment group, or exposure duration. Of the 1,170 mussels used in the study, there were a total of 3 confirmed mortalities and 5 test animals that were not recovered. The unrecovered mussels were treated as mortalities in the data analyses. No difference in mussel survival was detected ($p > 0.98$) when comparing the effects and interactions of species, exposure concentration, and exposure duration.

The water chemistry data are presented in appendix 6 (items 1-4). Water chemistry parameters (dissolved oxygen, pH, and temperature) observed during the study period are summarized in table 3. Dissolved oxygen in each test tank remained above the minimum level recommended (4.0 mg/L) for

laboratory tests with freshwater mussels (ASTM International, 2013) throughout the first 12 hours of exposure. The mean dissolved oxygen concentration of the untreated control tanks at 18 and 24 hours was 3.3 and 2.7 mg/L, respectively. The mean dissolved oxygen concentration of the treated tanks at 18 and 24 hours was < 1.0 mg/L. The test water hardness, alkalinity, conductivity, and ammonia observed during the study period are summarized in table 4. The mean alkalinity ranged from 42 to 45 mg/L as calcium carbonate ($CaCO_3$), hardness from 52 to 57 mg/L as $CaCO_3$, conductivity from 103 to 115 microsiemens per centimeter, pH from 6.05 to 7.19; and un-ionized ammonia concentrations were < 0.01 mg/L. The mean water temperature during the preexposure and exposure period ranged from 16.2 to 18.7 degrees Celsius (°C). The mean daily water temperature during the postexposure period ranged from 16.9 to 25.0 °C.

Table 2. Mean (standard deviation) percent survival of mussels exposed to SDP by treatment group and exposure duration.

[Means with the same letter are not significantly different ($\alpha > 0.05$); mg/L, milligram per liter]

Species	8-hour exposure			24-hour exposure		
	Control	50 mg/L	100 mg/L	Control	50 mg/L	100 mg/L
Megalonaias nervosa	100[a] (0)	96.7[a] (5.8)	100[a] (0)	100[a] (0)	100.0[a] (0.0)	100[a] (0)
Lampsilis cardium	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	96.3[a] (6.4)	96.3[a] (6.4)
Obovaria olivaria	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	96.7[a] (5.8)
Lampsilis siliquoidea	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)
Lampsilis higginsii	95.8[a] (7.2)	100[a] (0)	100[a] (0)	95.8[a] (7.2)	95.8[a] (7.2)	95.8[a] (7.2)
Amblema plicata	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)
Fusconaia flava	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)	100[a] (0)

The individual test tank SDP exposure concentrations and group means are presented in appendix 7 (items 1–2); the exposure concentrations for each treatment group are summarized in table 5. The mean SDP concentrations measured throughout the 24-hour exposure period were within 5 percent of the target concentrations of 50 and 100 mg SDP/L with the exception of the initial sample (≈1 hour after SDP application) and the 12-hour sample. The mean initial SDP exposure concentrations were 72.6 mg/L and 127.3 mg/L in the 50- and 100-mg/L treatment groups, respectively. The mean 12-hour exposure concentrations were 72.5 and 104.9 mg/L in the 50- and 100-mg/L treatment groups, respectively. The elevated concentrations were most likely caused by sediment disturbance that occurred (1) during initial mixing of the SDP stock solution with the test tank water and (2) when the

containment baskets were removed from the test tanks at the conclusion of the 8-hour exposure period. Sediment disturbance increased the turbidity which interfered (increased spectrophotometer readings) with the absorbance measurements.

Table 3. Mean (standard deviation) dissolved oxygen, temperature and pH range observed for each treatment group during the study period.
[mg/L, milligram per liter; °C, degree Celsius; pre, preexposure]

Time	Control			50 mg/L			100 mg/L		
	pH	DO (mg/L)	Temp (°C)	pH	DO (mg/L)	Temp (°C)	pH	DO (mg/L)	Temp (°C)
Pre	7.15-7.19	6.59 (0.06)	16.2 (0.0)	7.16-7.18	6.64 (0.03)	16.2 (0.0)	7.06-7.18	6.69 (0.09)	16.2 (0.0)
1	7.07-7.08	6.32 (0.01)	16.8 (0.0)	7.04-7.06	6.51 (0.04)	16.8 (0.0)	6.42-6.61	6.54 (0.09)	16.9 (0.0)
6	6.98-7.00	5.38 (0.09)	17.7 (0.1)	6.99-7.00	5.83 (0.03)	17.8 (0.2)	6.97-6.99	5.76 (0.04)	17.9 (0.1)
8	6.94-6.97	4.85 (0.14)	18.1 (0.0)	6.92-6.94	5.48 (0.04)	18.0 (0.1)	6.93	5.42 (0.07)	18.2 (0.1)
12	6.45-6.71	4.18 (0.08)	18.4 (0.2)	6.72-6.82	4.38 (0.14)	18.4 (0.2)	6.83-6.86	4.15 (0.09)	18.4 (0.1)
18	6.99-7.02	3.27 (0.13)	18.5 (0.1)	6.77-6.80	0.63 (0.14)	18.5 (0.1)	6.63-6.66	0.16 (0.01)	18.6 (0.1)
24	6.90-6.99	2.71 (0.19)	18.6 (0.1)	6.39-6.42	0.04 (0.00)	18.7 (0.1)	6.05-6.13	0.03 (0.00)	18.7 (0.1)

Table 4. Mean (standard deviation) alkalinity, hardness, conductivity, total ammonia nitrogen (TAN), and un-ionized ammonia (NH_3) observed during the exposure period.
[mg/L, milligram per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Treatment group	Alkalinity (mg/L)[1]	Hardness (mg/L)[1]	Conductivity (µS/cm)	TAN (mg NH_3-N/L)	NH3 (mg/L)
Control	42 (0)	52 (2)	103 (2)	0.25 (0.01)	<0.01 (<0.01)
50 mg/L	43 (1)	53 (1)	111 (0)	0.07 (0.01)	<0.01 (<0.01)
100 mg/L	44 (1)	53 (1)	115 (1)	0.07 (0.02)	<0.01 (<0.01)

[1] Reported as calcium carbonate ($CaCO_3$).

Table 5. Mean (standard deviation) exposure concentration for each treatment group throughout the exposure period.

[mg/L, milligram per liter; ND, not detectable/below detection limit]

Treatment group	Time (hours)				
	1	6	12	18	24
Control	ND	ND	5.0 (5.1)	ND	ND
50 mg/L	72.6 (3.7)	49.0 (4.1)	72.5 (12.6)	51.9 (2.9)	51.2 (3.7)
100 mg/L	127.3 (11.6)	99.3 (3.1)	104.9 (7.9)	95.0 (3.1)	95.7 (4.6)

Conclusions

Regardless of species, the application of Zequanox up to the maximum approved open-water application concentration of 100 mg/L (as active ingredient) for up three times the maximum approved open-water exposure duration (24 hours; the maximum approved open-water exposure duration is 8 hours) did not reduce the survival of the unionid mussels ($p > 0.98$). The results of this study indicate that exposure of up to 100 mg of SDP active ingredient/L for up to 24 hours is unlikely to reduce the survival of subadult or adult unionid mussels. Dissolved oxygen suppression was observed in treated tanks after 12 hours of exposure; however, the maximum approved exposure duration for open-water application is 8 hours.

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Appendix 1. Study Protocol With Data Forms

Item Number	Item Description	Number of Pages	Report Page Number
1	Protocol: "Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL 145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments"	32	14
2	Amendment 1 Revision of Study Protocol, Study # AEH-13-PSEUDO-06	12	46
3	Test Chemical Stock Preparation Datasheet	1	58
4	Alkalinity Datasheet	1	59
5	Conductivity and Hardness Datasheet	1	60
6	Water Quality Datasheet	1	61
7	Mussel Histology Samples Datasheet	1	62
8	Plain Pocketbook Survival Assessment	5	63
9	Hickorynut Survival Assessment	5	68
10	Washboard Survival Assessment	5	73
11	Higgins Eye Survival Assessment	5	78
12	Fatmucket Survival Assessment	5	83
13	Threeridge Survival Assessment	5	88
14	Wabash Pigtoe Survival Assessment	5	93
15	Native Mussel Lengths Datasheet (version 1)	1	98
16	Native Mussel Lengths Datasheet (version 2; revised)	1	99

Protocol Title:

Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments

Study Number: AEH-13-PSEUDO-06

Test Facilities and Study Sponsor
Upper Midwest Environmental Sciences Center (UMESC)
US Geological Survey
2630 Fanta Reed Rd.
La Crosse, Wisconsin 54603

Proposed Experimental Start Date: April 2013
Proposed Experimental Termination Date: December 2013

Protocol Approval
Reviewed by:

[redacted] 8 Apr 13
Mark P. Gaikowski, M.A. Date
Supervisory Biologist

[redacted] 4/11/2013
Michael D. Jawson, Ph.D. Date
Center Director

Approved by:

[redacted] 4/11/13
James A. Luoma, B.A. Date
Study Director

File Folder: 3

Item Number: 1

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1. INTRODUCTION

Native freshwater mussel populations of North America were historically considered the most diverse in the world with about 297 recognized taxa consisting of 281 species and 16 subspecies (Williams et al., 1993). Mussels are largely sedentary in nature, relying on movement of host fish during glochidial attachment as means of transport. They are thus particularly vulnerable to a variety of anthropogenic influences including habitat degradation and alteration, pollution and overharvest. A Nature Conservancy survey (Master, 1990) found 55% of North America's mussels as extinct or imperiled compared to 7% of terrestrial species, even though terrestrial species traditionally receive far greater attention. Projections in 1999 (Ricciadi and Rasmussen, 1999) suggested that at least 127 imperiled mussel species will be lost in the next 100 years – a conservative extinction rate of 6.4% per decade given it did not take into account extirpations caused by invasive dreissenid mussels (zebra mussel *Dreissena polymorpha* and quaqqa mussel *D. bugensis*).

Concerns for native mussels in the Southeast are potentially even greater given that only 25% of the 269 species historically present are reported as stable compared to the 13% presumed extinct and the 28, 14 and 18% listed, respectively, as endangered, threatened or of special concern. (Neves et al., 1997)

Many unionid mussels in North America were imperiled prior to epizoic colonization by zebra and quaqqa mussels though the introduction of dreissenid mussels have dramatically heightened concerns for the continued survival of native mussels. Zebra mussels were reported to be responsible for the extirpation of unionids from waters in Europe as early as 1937 (Sebestyen, 1937). Severe declines in unionid abundance in Europe (Karatayev and Burlakova, 1995; Burlakova, 1998) and North America (Haag et al., 1993; Nalepa, 1994; Ricciardi et al., 1996) have since been well documented in the literature.

The 1973 Endangered Species Act (ESA) brought forth the need to recognize, protect and recover rare mussels in the United States. The United States Fish and Wildlife Service (USFWS) develops recovery plans for threatened and endangered species which utilize a range of tools to promote recovery of the species including restoring and acquiring critical habitat, removing introduced or invasive species and captive propagation and release into historic ranges.

Biologists at the New York State Museum (NYSM) Field Research Laboratory have been researching dreissenid mussel control techniques since 1991. They discovered that cell components of a strain of common bacterium isolated from soils (*Pseudomonas fluorescens* [*Pf*-CL145A]) are capable of causing mortality when ingested by dreissenid mussels by degrading the epithelial cells lining the dreissenid digestive system. The NYSM also demonstrated that that efficacy for *Pf*-CL145A to induce dreissenid mussel mortality was retained when using dead vs. live cells.
Marrone Bio Innovations (MBI; Davis, CA) has developed a dead cell, spray dried formulation (SDP) of this bacterium called Zequanox®. Zequanox® is currently registered with the USEPA

for use within closed systems such as power generating plant cooling systems. The NYSM, USFWS (Genoa NFH) and United States Geological Survey's (USGS) Upper Midwest Environmental Sciences Center (UMESC) were awarded a grant from the US Environmental Protection Agency Great Lakes Restoration Initiative entitled "Safe *Dreissena* Control: Promise for Unionid Restoration". The goal of this grant is to determine the suitability of this product for limited open water zebra mussel control applications including treatment of native mussel propagation cages or native mussel beds. Reference to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by the United States government. Throughout the remainder of this document the formulated *Pf*-CL145A product (Zequanox®) will be referred to as sprayed dried powder (SDP).

Naturally occurring surface waters may be unique in their chemical and biological properties which may alter the effects of applied control agents such as SDP. The research to be completed according to this protocol will assess the non-target animal impacts of SDP exposure on sub-adult unionid mussels during simulated open water treatments. The exposures will be conducted in a mobile laboratory supplied with filtered river water. The exposures will simulate anticipated open water treatment concentrations and duration while allowing for replication treatment groups and control of treated water.

2. PROTOCOL OBJECTIVE

To assess the non-target animal impacts of SDP exposure on sub-adult unionid mussels during simulated open water treatments.

3. STUDY SCHEDULE

3.1 Proposed initiation: April 2013

3.2 Schedule of events: A proposed schedule of events is provided in Table 1.

3.3 Proposed completion date: December 2013

Table 1. Proposed Schedule of Events

Date	Activity
April 2013-May 2013	SDP field exposures
May 2013-June 2013	Post exposure assessment
December 2013	final report submission

4. STUDY DESIGN

4.1 General Description

Up to seven species (Table 2) of sub-adult unionid mussels will be exposed to one of two treatment concentrations of SDP in the UMESC mobile wet laboratory. The wet laboratory will be position stream-side in one of two locations (northern and southern) in the Upper Mississippi River system. The exposures will utilize river water to mimic in situ

treatment but allow the capture of treated effluent water for disposal. The mussels will be held in the river for approximately 30-d post exposure prior to evaluation for treatment related effects. Samples will be collected from no less than 1-2 species for histological examination to determine sub-lethal treatment related effects.

Table 2. Unionid mussel species that may be evaluated for formulated *Pseudomonas fluorescens* strain CL-145A (SDP) exposure effects.

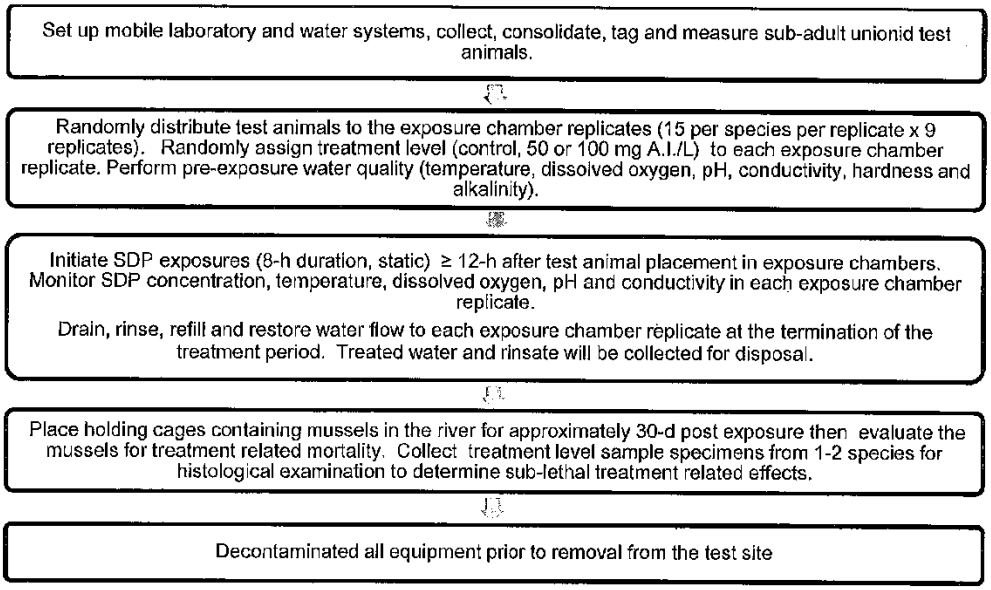
Common name	Scientific name
Fatmucket	*Lampsilis siliquoidea*
Hickorynut	*Obovaria olivaria*
Higgins eye	*Lampsilis higginsii*
Mucket	*Actinonaias ligamentina*
Plain pocketbook	*Lampsilis cardium*
Threeridge	*Amblema plicata*
Wabash Pigtoe	*Fusconaia flava*
Washboard	*Megalonaias nervosa*

4.2 Experimental Design

Major study activities are summarized in Figure 1.
To restrict the movement of test animals (sub-adult unionid mussels) within the Upper Mississippi River System, a northern and southern testing location will be utilized and only mussels cultured or collected from the surrounding watershed will be used in the appropriate exposure trial. The testing locations will be the St. Croix River near Stillwater, MN (northern) and the Black River, directly adjacent to the UMESC campus (southern).
The tests will be conducted in the UMESC mobile wet laboratory. The exposures will be conducted in nine 350 L cylindrical fiberglass tanks and each tank will be supplied with a washed sand substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. The 350 L fiberglass tanks will be the exposure chamber replicates and they will be the experimental unit.
Sub-adult native mussel test animals will be provided from Genoa National Fish Hatchery propagation stocks or wild collected from the Upper Mississippi River. Individual mussels will be uniquely tagged or marked and assigned to an exposure chamber replicate according to a randomized distribution scheme. Up to 135 native mussels (15 per replicate x 9 replicates) of each species will be randomly placed in each exposure chamber. Up to 4 species will be distributed to each exposure chamber replicate and exposed concurrently. If insufficient numbers of a particular species are available for testing, then the number of animals in each exposure chamber replicate may be reduced (e.g. from 15 to 10 animals) or the 50 mg/L A.I. treatment group may be excluded for that species. Deviations from the target number of test animals (15) for each exposure chamber replicate/species will be documented in the study records.

Native mussels will be subjected to one of three treatments levels, 1) a non-exposed control group, 2) a 50 mg/L A.I. treatment group, and 3) a 100 mg/L A.I. treatment group. There will be 3 replicates exposure chambers per treatment levels. Treatment level will be assigned to each replicate according to a randomized assignment scheme.
An appropriate amount of a freshly prepared SDP stock solution will be added and thoroughly mixed into the water within each exposure chamber replicate. The SDP concentration, temperature, dissolved oxygen, pH and conductivity will be monitored in each exposure chamber replicate.
Immediately following the 8-h exposure period, the SDP treated water will be drained from the exposure chambers, the exposure chambers will be rinsed with and refilled with clean river water. The SDP treated water and rinsate will be collected in frame tanks for disposal. Water flow will be restored to the exposure chambers until the mussels are transferred to wire mesh holding cages (~ 0.9 m long x 0.6 m wide x 0.45 m high; either 1.27-cm or 0.635-cm, dependent on animal size) for a post-exposure evaluation phase. The holding cages containing mussels and a washed sand substrate will be placed in the river for approximately 30-d post exposure prior to evaluating the mussels for treatment related mortality. Representative treatment level sample specimens will be collected during the mortality assessment from at least 1-2 species. The samples will be subjected to histological examination to determine sub-lethal treatment related effects as permitted by funding.

Figure 1. Flow chart of major study activities for each test location



5. STUDY PROCEDURES

5.1 Test Animals

5.1.1 Description

5.1.1.1 Age – Native mussels ≤ 3 yrs

5.1.1.2 Sex – Test animals will be used without regard to sex.

5.1.1.3 Species –see table 2

5.1.2 Number of animals: Approximately 135 native mussels of each species will be used (9 replicates x 15 mussels each = 135). If 135 mussels are not available, the number of animals in each replicate may be reduced to 10 and/or the species may be excluded from the low treatment level (50 mg/L A.I.). The number of test animals planned is consistent with the objective of the study and contemporary scientific standards.

5.1.3 Source of animals: Test animals will be provided from Genoa National Fish Hatchery production stocks or wild collected animals from the Upper Mississippi River. Collection of animals will be conducted by Genoa National Fish Hatchery mussel biologists.

5.1.4 Inclusion criterion: Native mussels in apparent good health will be used.

5.1.5 Acclimation: Mussels will be acclimated to treatment conditions for ≥12-h prior to exposure initiation.

5.1.6 Distribution to treatment replicates: Up to 15 uniquely identified and measured mussels will be distributed to each exposure replicate according to a predetermined randomization scheme. Five mussels will be placed in each exposure replicate in each distribution round. Three distribution rounds will be completed for each species.

5.1.7 Feeding: No supplemental feed will be offered throughout the acclimation, exposure and post-exposure holding periods.

5.2 Water Chemistry

5.2.1 Dissolved oxygen: Dissolved oxygen will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Dissolved oxygen will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 394 or equivalent).

5.2.2 Temperature: Temperature will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Temperature will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination.

5.2.3 pH: pH will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. pH will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 335 or equivalent).

5.2.4 Hardness: Hardness will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 712).

5.2.5 Alkalinity: Alkalinity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 706).

5.2.6 Conductivity: Conductivity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 188 or equivalent).

5.2.7 Ammonia: Samples for total ammonia-nitrogen will be collected at the termination of the exposure period for each exposure replicate. Ammonia samples will be filtered through a 0.45 micron syringe filter, acidified (~pH 2.5) with sulfuric acid and then stored at ~4°C until analyzed by the UMESC Long Term Resources Monitoring (LTRM) Water Quality Laboratory using the automated phenate method.

5.3 Disposal: All live mussels at the conclusion of the mortality assessment that are not subjected to histological examination will be returned to the custody of the Genoa NFH.

5.4 Study facilities

5.4.1 Test Facility

U.S. Geological Survey, Upper Midwest Environmental Sciences Center
Mobile Research Laboratory
2630 Fanta Reed Rd
La Crosse, Wisconsin 54603

5.4.1.1 Test location: Black River; La Crosse, WI; and St. Croix River; Stillwater, MN.

5.4.1.2 Exposure system: The test system consists of nine 76.2 cm diameter x 91.4 cm deep fiberglass circular exposure tanks in two rows of 4 or 5 tanks. The tanks are supplied surface water through a pump, filter and headbox system. Each exposure tank will be supplied 3-5 cm of wash sand for substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. Each tank will be uniquely identified to allow for identification treatment type and replicate number. Coding procedures will be documented in the study records.

5.4.1.3 Aeration: Supplemental aeration will not be supplied during the acclimation, SDP exposures and the post exposure observation periods.

5.4.1.4 Water supply: Filtered (200 µm) river water will be supplied continuously (~5 L/min) to achieve a ~ tank-volume exchange/h during the pre- and post-exposure periods. Water supply will be interrupted during the SDP exposures.

5.4.1.5 Water discharge: Untreated water will be returned to the water supply source. SDP treated water will be collected for disposal as required by DNR regulation.

5.4.1.6 Lighting: Overhead lighting will be provided during the exposure period. Light intensity will be measured using a Milwaukee photometer (AEH SOP 308 or equivalent) and recorded in the study records.

5.5 Observations

5.5.1 Mortality:

Unionid mussels that are gapping and do not respond to tactile stimuli by shell closure will be coded as a mortality. Unionid mussels that have closed shells (closed shells will be gently pried to assure that the anterior adductor muscle contraction is holding the shell closed) or respond to tactile stimuli by shell closure will be coded as alive.

5.6 Treatment administration

5.6.1 Treatment: Each treatment will consist of three SDP concentrations (ie: 0 [control], 50 mg/L A.I. or 100 mg/L A.I.) with a single 8-h exposure duration. All treatment concentrations will have three replicate exposure chambers. A minimum of 10 and a maximum of 15 unionid mussels of each species will be placed in each exposure chamber replicate. Up to 4 species will be used in each treatment.

5.6.2 Route of administration: Exposures will be initiated by addition of an appropriate amount of a SDP stock solution. The tank will be gently mixed to achieve a uniform distribution of test material.

5.6.3 Concentration verification: Concentration will be determined spectrophotometrically. A standard curve will be prepared using a known mass of SDP. The absorbance of exposure solutions will be compared to the standard curve to determine the exposure concentration. Absorbance will be determined using a Barnstead/Thermolyne Corporation Model: Turner SP-830 Plus Beckman spectrophotometer (UMESC SOP AEH 302).

6. DATA ANALYSIS

6.1 Experimental unit: The experimental unit will be the exposure chamber replicate.

6.2 Number of exposures and replicates: There will be a total of 3 treatment levels (0 [control], 50 and 100 mg SDP/L) and 1 treatment duration (8-h). There will be a total of 3 independent exposures chambers for each treatment level which will serve as the replicates. All treatment levels, replicates, and up to 4 species will be run concurrently.

6.3 Statistical methodology

Survival data will be analyzed using a generalized linear mixed model (SAS PROC GLIMMIX). In every analysis, the exposure will be treated as the experimental unit. The change in proportion of survivors will be analyzed using a generalized linear mixed model where the distribution is binomial and the link used is the logit function.
If a significant effect of treatment is identified then pairwise comparison tests will be completed to compare each treatment group to the control group using unadjusted least squares means.

6.4 Statistical significance: Statistical significance will be declared at $p < 0.05$.

6.5 Other data analyses: Statistical methods for other study data collected will include simple statistics such as the calculation of means, standard deviations and coefficients of variation. The statistical procedures used will be described in detail in the final study report.

7. PERSONNEL

7.1 Study Director: James A. Luoma, B.A.

7.1.1 Address: Upper Midwest Environmental Sciences Center, US Geological Survey, 2630 Fanta Reed Rd., La Crosse, Wisconsin 54603

7.1.2 Contact: Tel: (608) 781-6391, Fax: (608) 783-6066; jluoma@usgs.gov

7.1.3 Training and experience: CV on file at UMESC.

7.2 Other personnel involved in study: Technical staff involved in the study will be identified in the study raw data to include study function. UMESC technical staff training and experience will be documented in CVs included in the study raw data.

8. DISPOSITION/STORAGE

8.1 Study Records: All data generated in the study will be recorded in bound laboratory notebooks, electronic files or kept in file folders. All data sheets, file folders, laboratory notebooks and computer disks will be encoded with the study number when the data are generated. Raw data, laboratory notebooks and electronic files (including a CD-ROM containing the annotated SAS program used for the statistical analysis, the data files, SAS log and SAS output files) generated by UMESC and contract laboratory reports will be filed in the UMESC archives (SOP No. GEN 007) of the Upper Midwest Environmental Sciences Center, La Crosse Wisconsin, before the final report is signed by the Study Director. The final report will then be signed and archived.

9. AMENDMENT/DEVIATIONS TO THE PROTOCOL

9.1 Protocol amendments: A signed copy of the Study Protocol will be retained on-site. Proposed amendments to the protocol shall be brought to the attention of UMESC Management. When the Study Director and Management agree verbally, the study can proceed with the change. As soon as possible, the Study Director will then prepare a written protocol amendment that is signed by the Study Director and Branch Chief. The amendment then becomes an official part of the protocol.

9.2 Protocol deviations: All deviations from this approved protocol will be documented and reviewed by the Study Director. The Study Director will make a judgment on the impact of the deviations. The Study Director will notify Management, as soon as possible, of any deviations to the protocol, including their impact on the study.

10. INVESTIGATIONAL TEST ARTICLE

10.1 Test Substance(s): *Pseudomonas fluorescens* strain CL145A (*Pf*-CL145A), SDP formulation

10.1.1 Chemical name: *Pseudomonas fluorescens* strain CL145A (*Pf*-CL145A)

10.1.2 Trade name: Zequanox

10.1.3 Active ingredients: *Pseudomonas fluorescens* strain CL145A (*Pf*-CL145A), 50% active ingredient (A.I.) by weight.

10.1.4 Source: Marrone Bio Innovations (MBI); Davis, CA

10.1.5 Lot number: Lot number(s) will be included in the test chemical log books, lab notebook, and study files.

10.1.6 Expiration date: As determined by the manufacturer. An aliquot of each lot tested will be returned to the NYSM or MBI at the conclusion of exposures for post-exposure zebra mussel bioassay tests (the standard testing protocol to assess *Pseudomonas fluorescens* [*Pf*-CL145A] formulation activity). Results of these confirmation bioassays will be used to validate the retention of activity of the *Pseudomonas fluorescens* (*Pf*-CL145A) SDP and will be included in the study files when available.

10.1.7 Storage during study: The test chemical will be stored refrigerated. Test material will be transported in a cooler with ice packs to maintain proper storage temperature (4-10 °C)

10.1.8 Safety: A NIOSH approved respirator will be used when preparing stock solutions to avoid inhalation. Protective eyewear, gloves and lab coats will be worn at all times when working with the test substance.

11. ADVERSE EVENTS

Any adverse event will be recorded in the study logbook and the Study Director will be notified.

12. BIOSECURITY PROCEDURES

All personnel involved in the study will review the UMESC biosecurity (UMESC SOP APP 075) and project HACCP plans. Testing will be conducted in a field setting. All equipment will be thoroughly cleaned and disinfected prior to return to UMESC. Waste generated will be placed in plastic garbage bags and disposed of in accordance with local and state regulations. See Appendix 1 for the HACCP plan for this project.

13. STANDARD OPERATING PROCEDURES

A complete list of the standard operating procedures used in the study will be included in the study guide. The follow SOP's were cited in this protocol:

UMESC SOP APP 075 – Procedures to Minimize the Risk of Transfer of Pathogens and Invasive Species
UMESC SOP AEH 188 – Accumet Portable Waterproof Conductivity meter Model # AP75
UMESC SOP AEH 302 – Instrument Operating Procedure: Barnstead/Thermolyne Corporation Model: Turner SP-830 Plus Beckman spectrophotometer Serial # 1365070560781
UMESC SOP AEH 308 - Instrument Operating Procedure: Milwaukee light meter, model SM7000
UMESC SOP AEH 335 – Beckman Portable pH/mV Meter, Model 250
UMESC SOP AEH 394 – YSI Handheld Dissolved Oxygen Meter, Model 55/12FT, Serials 94C17261 & 97F0837AG
UMESC SOP AEH 706 – Determination of Total Alkalinity by the Titrimetric (pH 4.5) Method
UMESC SOP AEH 712 – Determination of Total Hardness

14. REFERENCES

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15. APPENDIX

15.1 Appendix 1: HACCP PLAN for the study Safety of Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) exposure to Sub-Adult Unionid Mussels

Step 1 – Activity Description

Facility: US Geological Survey-Upper Midwest Environmental Sciences Center	Site: Various – St. Croix River; Stillwater, WI UMR, Harpers Ferry, IA
Site Coordinator: Jim Luoma	Activity: Safety of Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) exposure to Sub-Adult Unionid Mussels
Site Manager: Mark Gaikowski	
Address: 2630 Fanta Reed Road La Crosse WI, 54601	
Phone: 608-781-6322	

Project Description
The objective of this study is to assess the non-target animal impacts of SDP exposure on sub-adult unionid mussels during simulated open water treatments.

Step 2 – Potential Hazards: Species which may potentially be moved/introduced

Vertebrates:
Multiple species of freshwater fish, eggs and gametes found in the Upper Mississippi River (UMR) Basin.

Invertebrates:
Zebra mussel (*Dreissena polymorpha*)
Asian clam (*Corbicula fluminea*)
Multiple other endemic species found in the UMR Basin

Plants:
Multiple endemic species found in the UMR Basin

Other biologicals (disease, pathogen, parasite):
Largemouth Bass Virus
Spring Viremia of Carp Virus
Bluegill Virus
Infectious Pancreatic Necrosis Virus
Viral Hemorrhagic Septicemia
Furunculosis *Aeromonas salmonicida*
Enteric Redmouth Disease *Yersinia ruckeri*
Bacterial Kidney Disease *Renibacterium salmoninarum*
Other Assorted parasites/pathogens found in the UMR Basin

Other:
NA

Step 3 – Flow Diagram

Flow diagram outlining sequential tasks to complete activity/project

Task 1	Exposure test sites identified and equipment deployed
↓	
Task 2	Sub-adult mussels are obtained from Genoa NFH propagation cages or wild collected, tagged and measured
↓	
Task 3	Native mussels are placed in exposures chambers and acclimated to test conditions
↓	
Task 4	Native mussels are exposed to test article for 8-h
↓	
Task 5	Treatment is terminated, treated water is disposed of and mussels are placed in holding cages for 30-d
↓	
Task 6	Equipment is decontaminated and returned to UMESC
↓	
Task 7	Mussels are removed from holding cages and assessed for survival
↓	
Task 8	Samples of mussels are collected for histology and the remaining returned to the custody of the Genoa NFH
↓	
Task 9	All remaining equipment and cages are decontaminated and returned to UMESC

1 Tasks (from HACCP Step 3 - Flow Diagram)	2 Potential hazards identified in HACCP Step 2	3 Are any potential hazards probable? (yes/no)	4 Justify evaluation for column 3	5 What control measures can be applied to prevent undesirable results?	6 Is this task a critical control point? (yes/no)
Task 1 Exposure test sites identified and equipment deployed	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Invertebrates	yes	Surface water contains multiple invertebrate species include AIS	Assure the thorough decontamination all equipment with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no
	Plants	yes	Surface water contains multiple plant species including AIS	Assure the thorough decontamination all equipment with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted. Do not proceed if any fish disease outbreak (i.e.: VHS) is documented in the waterbody	yes
Task 2 Sub-adult mussels are obtained from Genoa NFH propagation cages or wild collected, tagged and measured	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted. Do not proceed if any fish disease outbreak (i.e.: VHS) is documented in the waterbody	no
Task 3 Native mussels are placed in exposures chambers and acclimated to test conditions	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

Task 4 Mussels are exposed to test article for 8-h	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No
Task 5 Treatment is terminated, treated water is disposed of and mussels are placed in holding cages for 30-d	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	No

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again. Inspect all equipment prior to set up and repeat decontamination if warranted.	no

Task 6 Equipment is decontaminated and returned to UMESC	Vertebrates	yes	Surface water contains multiple vertebrate species	Physical removal of all visible vertebrates. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes
	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Physical removal of all visible invertebrates. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes

	Plants	yes	Surface water contains multiple plant species and may include AIS	Physical removal of all visible plants. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes
	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes
Task 7 Mussels are removed from the holding cages and assessed for survival	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no
	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no

Task 8 Samples of mussels are collected for histology and the remaining returned to the custody of the Genoa NFH	Vertebrates	yes	Surface water contains multiple vertebrate species	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no
	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no
	Plants	yes	Surface water contains multiple plant species and may include AIS	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no

	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	no
Task 9 All remaining equipment and cages are decontaminated and returned to UMESC	Vertebrates	yes	Surface water contains multiple vertebrate species	Physical removal of all visible vertebrates. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed aga Physical removal of all visible vertebrates. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes

	Invertebrates	yes	Surface water contains multiple invertebrate species and may include AIS	Physical removal of all visible invertebrates. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes
	Plants	yes	Surface water contains multiple plant species and may include AIS	Physical removal of all visible plants. Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	Yes
	Others	yes	Surface water has potential to transfer fish diseases	Assure the thorough decontamination all equipment including all internal and external potentially wetted surfaces with steam, chemosterilants, or other approved methods prior to removal from location, unless impractical, then decontamination shall be done as soon as possible and must be done before equipment is deployed again.	yes

HACCP Plan Form (all CCP's or "yes's" from column 6 of HACCP Step 4 – Hazard Analysis Worksheet)								
			Monitoring					
Critical Control Point (CCP)	**Significant Hazard(s)**	**Limits for each Control Measure**	**What**	**How**	**Frequency**	**Who**	**Evaluation & Corrective Action(s) (if needed)**	**Supporting Documentation (if any)**
Tasks 1, 2, 3,6,7,8 & 9	Transfer of endemic and AIS including vertebrates, invertebrates, plants and pathogens	Transfer of vertebrates, invertebrates, plants and pathogens must not occur. All equipment must be thoroughly inspected and disinfected as soon as possible and inspected and/or re-decontaminated prior to setup at new location.	Equipment disinfection	Mechanical cleaning/removal, pressure washing, steam cleaning, chemosterilant or other approved methods.	Prior to equipment arrival, upon deployment, prior to movement from location or asap	Technicians /lead field supervisor	Supervisor and staff are responsible for methodical decontamination using established procedures. Corrective actions required to complete decontamination must be performed prior to any equipment movement from test location or as soon as feasible. Decontamination and inspection must be completed asap	Records in log books all procedures used for decontamination

Facility: Upper Midwest Environmental Sciences Center Mobile Research Laboratory	**Activity:** Efficacy of *Pseudomonas fluorescens* (*Pf*-CL145A) SDP for controlling zebra mussels within field exposures
Address: 2630 Fanta Reed Road, La Crosse, WI 54601	
Signature: HACCP Plan was followed.	**Date:**

File Folder: 3

Item Number: 1

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Biological Resources Division
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603

Date: May 13, 2013

To: The Record Study Number AEH-13-PSEUDO-06

Subject: Amendment 1- Amendment to the study number AEH-13-PSEUDO-06 entitled "Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments"

Revision of Study Protocol, Study # AEH-13-PSEUDO-06 is proposed as detailed on page 2 of this amendment. Revised text is indicated **in bold.**

This amendment 1) eliminates the St. Croix River (Stillwater, MN) test location, 2) adds up to 5 additional test animals per test replicate, and 3) adds a 24-h exposure duration to evaluate the effects of an extended duration exposure.

Reviewed by:

[redacted] 13 May 13
Mark P. Gaikowski, M.A. Date
Supervisory Biologist
Aquatic Ecosystem Health,
UMESC[1]

[redacted] 5/13/2013
Michael Jawson, Ph.D. Date
Center Director, UMESC

Approved by:

[redacted] 5/15/13
James A. Luoma, B.A. Date
Study Director, UMESC

[1] UMESC: U.S. Geological Survey, Upper Midwest Environmental Sciences Center

This amendment eliminates the St. Croix River test location and adds a 24-h exposure duration to evaluate the effects of an extended duration exposure. When possible, up to 45 additional test animals per species will be added to increase the sample size. All species and treatment durations will be exposed concurrently with test animal removal at the prescribed exposure duration.
All changes to the protocol text are listed in bold.

CURRENT TEXT:

4. STUDY DESIGN

4.1 General Description

Up to seven species (Table 2) of sub-adult unionid mussels will be exposed to one of two treatment concentrations of SDP in the UMESC mobile wet laboratory. The wet laboratory will be position stream-side in one of two locations (northern and southern) in the Upper Mississippi River system. The exposures will utilize river water to mimic in situ treatment but allow the capture of treated effluent water for disposal. The mussels will be held in the river for approximately 30-d post exposure prior to evaluation for treatment related effects. Samples will be collected from no less than 1-2 species for histological examination to determine sub-lethal treatment related effects.

Table 2. Unionid mussel species that may be evaluated for formulated *Pseudomonas fluorescens* strain CL-145A (SDP) exposure effects.

Common name	Scientific name
Fatmucket	*Lampsilis siliquoidea*
Hickorynut	*Obovaria olivaria*
Higgins eye	*Lampsilis higginsii*
Mucket	*Actinonaias ligamentina*
Plain pocketbook	*Lampsilis cardium*
Threeridge	*Amblema plicata*
Wabash Pigtoe	*Fusconaia flava*
Washboard	*Megalonaias nervosa*

4.2 Experimental Design

Major study activities are summarized in Figure 1.
To restrict the movement of test animals (sub-adult unionid mussels) within the Upper Mississippi River System, a northern and southern testing location will be utilized and only mussels cultured or collected from the surrounding watershed will be used in the appropriate exposure trial. The testing locations will be the St. Croix River near Stillwater, MN (northern) and the Black River, directly adjacent to the UMESC campus (southern).
The tests will be conducted in the UMESC mobile wet laboratory. The exposures will be conducted in nine 350 L cylindrical fiberglass tanks and each tank will be

supplied with a washed sand substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. The 350 L fiberglass tanks will be the exposure chamber replicates and they will be the experimental unit.

Sub-adult native mussel test animals will be provided from Genoa National Fish Hatchery propagation stocks or wild collected from the Upper Mississippi River. Individual mussels will be uniquely tagged or marked and assigned to an exposure chamber replicate according to a randomized distribution scheme. Up to 135 native mussels (15 per replicate x 9 replicates) of each species will be randomly placed in each exposure chamber. Up to 4 species will be distributed to each exposure chamber replicate and exposed concurrently. If insufficient numbers of a particular species are available for testing, then the number of animals in each exposure chamber replicate may be reduced (e.g. from 15 to 10 animals) or the 50 mg/L A.I. treatment group may be excluded for that species. Deviations from the target number of test animals (15) for each exposure chamber replicate/species will be documented in the study records.

Native mussels will be subjected to one of three treatments levels, 1) a non-exposed control group, 2) a 50 mg/L A.I. treatment group, and 3) a 100 mg/L A.I. treatment group. There will be 3 replicates exposure chambers per treatment levels. Treatment level will be assigned to each replicate according to a randomized assignment scheme.

An appropriate amount of a freshly prepared SDP stock solution will be added and thoroughly mixed into the water within each exposure chamber replicate. The SDP concentration, temperature, dissolved oxygen, pH and conductivity will be monitored in each exposure chamber replicate.

Immediately following the 8-h exposure period, the SDP treated water will be drained from the exposure chambers, the exposure chambers will be rinsed with and refilled with clean river water. The SDP treated water and rinsate will be collected in frame tanks for disposal. Water flow will be restored to the exposure chambers until the mussels are transferred to wire mesh holding cages (~ 0.9 m long x 0.6 m wide x 0.45 m high; either 1.27-cm or 0.635-cm, dependent on animal size) for a post-exposure evaluation phase. The holding cages containing mussels and a washed sand substrate will be placed in the river for approximately 30-d post exposure prior to evaluating the mussels for treatment related mortality. Representative treatment level sample specimens will be collected during the mortality assessment from at least 1-2 species. The samples will be subjected to histological examination to determine sub-lethal treatment related effects as permitted by funding.

5. STUDY PROCEDURES

5.1 Test Animals

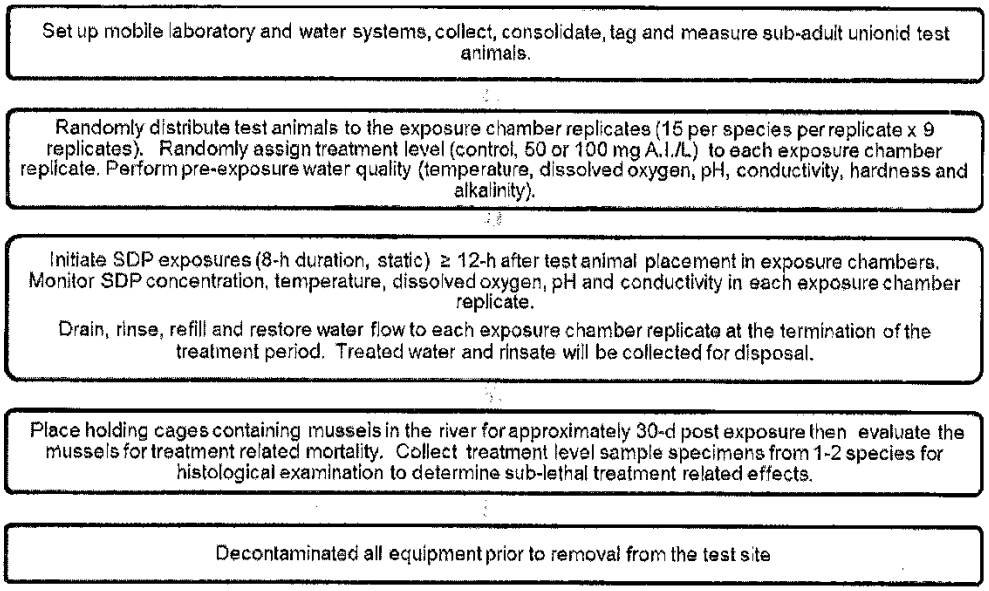
5.1.1 Description

5.1.1.1 Age – Native mussels ≤ 3 yrs

5.1.1.2 Sex – Test animals will be used without regard to sex.

5.1.1.3 Species –see table 2

Figure 1. Flow chart of major study activities for each test location



5.1.2 Number of animals: Approximately 135 native mussels of each species will be used (9 replicates x 15 mussels each = 135). If 135 mussels are not available, the number of animals in each replicate may be reduced to 10 and/or the species may be excluded from the low treatment level (50 mg/L A.I.). The number of test animals planned is consistent with the objective of the study and contemporary scientific standards.

5.1.3 Source of animals: Test animals will be provided from Genoa National Fish Hatchery production stocks or wild collected animals from the Upper Mississippi River. Collection of animals will be conducted by Genoa National Fish Hatchery mussel biologists.

5.1.4 Inclusion criterion: Native mussels in apparent good health will be used.

5.1.5 Acclimation: Mussels will be acclimated to treatment conditions for ≥12-h prior to exposure initiation.

5.1.6 Distribution to treatment replicates: Up to 15 uniquely identified and measured mussels will be distributed to each exposure replicate according to a predetermined randomization scheme. Five mussels will be placed in each exposure replicate in each distribution round. Three distribution rounds will be completed for each species.

5.1.7 Feeding: No supplemental feed will be offered throughout the acclimation, exposure and post-exposure holding periods.

5.2 Water Chemistry

5.2.1 Dissolved oxygen: Dissolved oxygen will be measured and recorded in

each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Dissolved oxygen will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 394 or equivalent).

5.2.2 Temperature: Temperature will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Temperature will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination.

5.2.3 pH: pH will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. pH will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 335 or equivalent).

5.2.4 Hardness: Hardness will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 712).

5.2.5 Alkalinity: Alkalinity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 706).

5.2.6 Conductivity: Conductivity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 188 or equivalent).

5.2.7 Ammonia: Samples for total ammonia-nitrogen will be collected at the termination of the exposure period for each exposure replicate. Ammonia samples will be filtered through a 0.45 micron syringe filter, acidified (~pH 2.5) with sulfuric acid and then stored at ~4°C until analyzed by the UMESC Long Term Resources Monitoring (LTRM) Water Quality Laboratory using the automated phenate method.

5.3 Disposal: All live mussels at the conclusion of the mortality assessment that are not subjected to histological examination will be returned to the custody of the Genoa NFH.

5.4 Study facilities

5.4.1 Test Facility

U.S. Geological Survey, Upper Midwest Environmental Sciences Center
Mobile Research Laboratory
2630 Fanta Reed Rd
La Crosse, Wisconsin 54603

5.4.1.1 Test location: Black River; La Crosse, WI; and St. Croix River; Stillwater, MN.

5.4.1.2 Exposure system: The test system consists of nine 76.2 cm diameter x 91.4 cm deep fiberglass circular exposure tanks in two rows of 4 or 5 tanks. The tanks are supplied surface water through a pump, filter and headbox system. Each exposure tank will be supplied 3-5 cm of wash sand for substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. Each tank will be uniquely identified to allow for identification treatment type and replicate number. Coding procedures will be documented in the study records.

5.4.1.3 Aeration: Supplemental aeration will not be supplied during the acclimation, SDP exposures and the post exposure observation periods.

5.4.1.4 Water supply: Filtered (200 µm) river water will be supplied continuously (~5 L/min) to achieve a ~ tank-volume exchange/h during the pre- and post-exposure periods. Water supply will be interrupted during the SDP exposures.

5.4.1.5 Water discharge: Untreated water will be returned to the water supply source. SDP treated water will be collected for disposal as required by DNR regulation.

5.4.1.6 Lighting: Overhead lighting will be provided during the exposure period. Light intensity will be measured using a Milwaukee photometer (AEH SOP 308 or equivalent) and recorded in the study records.

5.5 Observations

5.5.1 Mortality:

Unionid mussels that are gapping and do not respond to tactile stimuli by shell closure will be coded as a mortality. Unionid mussels that have closed shells (closed shells will be gently pried to assure that the anterior adductor muscle contraction is holding the shell closed) or respond to tactile stimuli by shell closure will be coded as alive.

5.6 Treatment administration

5.6.1 Treatment: Each treatment will consist of three SDP concentrations (ie: 0 [control], 50 mg/L A.I. or 100 mg/L A.I.) with a single 8-h exposure duration. All treatment concentrations will have three replicate exposure chambers. A minimum of 10 and a maximum of 15 unionid mussels of each species will be placed in each exposure chamber replicate. Up to 4 species will be used in each treatment.

5.6.2 Route of administration: Exposures will be initiated by addition of an appropriate amount of a SDP stock solution. The tank will be gently mixed to achieve a uniform distribution of test material.

5.6.3 Concentration verification: Concentration will be determined spectrophotometrically. A standard curve will be prepared using a known mass of SDP. The absorbance of exposure solutions will be compared to the

standard curve to determine the exposure concentration. Absorbance will be determined using a Barnstead/Thermolyne Corporation Model: Turner SP-830 Plus Beckman spectrophotometer (UMESC SOP AEH 302).

6. DATA ANALYSIS

6.1 Experimental unit: The experimental unit will be the exposure chamber replicate.

6.2 Number of exposures and replicates: There will be a total of 3 treatment levels (0 [control], 50 and 100 mg SDP/L) and 1 treatment duration (8-h). There will be a total of 3 independent exposures chambers for each treatment level which will serve as the replicates. All treatment levels, replicates, and up to 4 species will be run concurrently.

REVISED TEXT:

4. STUDY DESIGN

4.1 General Description

Up to seven species (Table 2) of sub-adult unionid mussels will be exposed to one of two treatment concentrations of SDP in the UMESC mobile wet laboratory. **The wet laboratory will be position stream-side along the Black River, adjacent to UMESC property.** The exposures will utilize river water to mimic in situ treatment but allow the capture of treated effluent water for disposal. The mussels will be held in the river for approximately 30-d post exposure prior to evaluation for treatment related effects. Samples will be collected from no less than 1-2 species for histological examination to determine sub-lethal treatment related effects.

Table 2. Unionid mussel species that may be evaluated for formulated *Pseudomonas fluorescens* strain CL-145A (SDP) exposure effects.

Common name	Scientific name
Fatmucket	*Lampsilis siliquoidea*
Hickorynut	*Obovaria olivaria*
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Plain pocketbook	*Lampsilis cardium*
Threeridge	*Amblema plicata*
Wabash Pigtoe	*Fusconaia flava*
Washboard	*Megalonaias nervosa*

4.2 Experimental Design

Major study activities are summarized in Figure 1.
Animals reared in the St. Croix River will be collected from propagation cages by Genoa NFH personnel and temporarily held at the Genoa NFH prior to testing. Only mussels cultured or collected from the Upper Mississippi River system will be used in the exposure trial. The testing

location will be the Black River, directly adjacent to the UMESC campus. The tests will be conducted in the UMESC mobile wet laboratory. The exposures will be conducted in nine 350 L cylindrical fiberglass tanks and each tank will be supplied with a washed sand substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. The 350 L fiberglass tanks will be the exposure chamber replicates and they will be the experimental unit.

Sub-adult native mussel test animals will be provided from Genoa National Fish Hatchery propagation stocks or wild collected from the Upper Mississippi River. Individual mussels will be uniquely tagged or marked and assigned to an exposure chamber replicate according to a randomized distribution scheme. Up to **180 native mussels (20 per replicate x 9 replicates)** of each species will be randomly placed in each exposure chamber. Up to **7** species will be distributed to each exposure chamber replicate and exposed concurrently. If insufficient numbers of a particular species are available for testing, then the number of animals in each exposure chamber replicate **and duration may be reduced (e.g. from 10 to 5 animals) or the 50 mg/L A.I. treatment group or 24-h exposure duration may be excluded for that species.** Deviations from the target number of test animals for each exposure chamber replicate/species **(ie: N = 20)** will be documented in the study records.

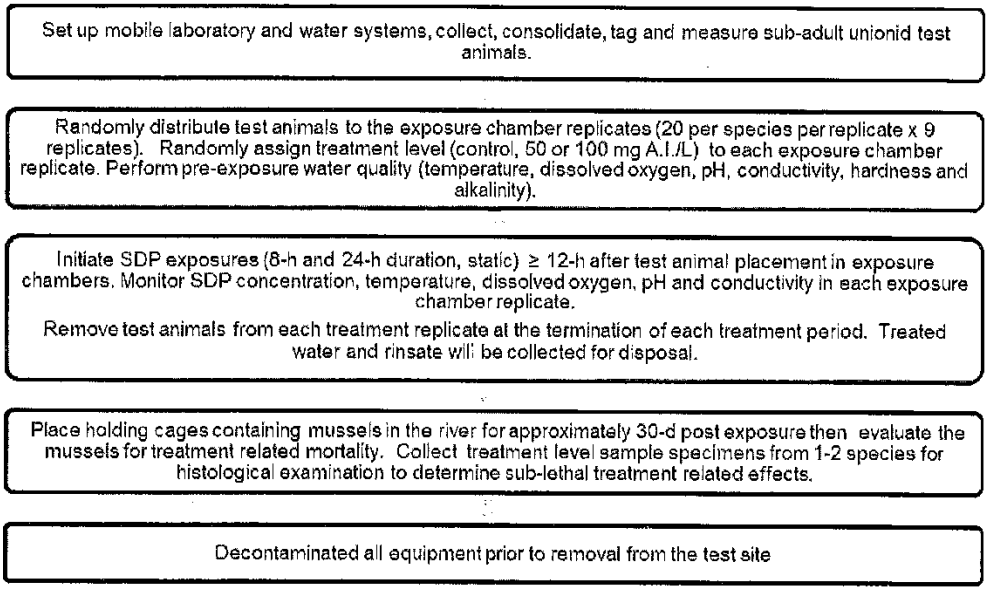
Native mussels will be subjected to one of three treatments levels, 1) a non-exposed control group, 2) a 50 mg/L A.I. treatment group, and 3) a 100 mg/L A.I. treatment group.

Additionally, each treatment level replicate will include an 8-h exposure and 24-h exposure duration. There will be 3 replicates exposure chambers per treatment levels. Treatment level will be assigned to each replicate according to a randomized assignment scheme. An appropriate amount of a freshly prepared SDP stock solution will be added and thoroughly mixed into the water within each exposure chamber replicate. The SDP concentration, temperature, dissolved oxygen, pH and conductivity will be monitored in each exposure chamber replicate.

Following the 8-h and 24-h exposure periods a basket containing a pre-determined number of mussels (i.e: 10 per species, depending on availability) will be removed and transferred to wire mesh holding cages (~0.9 m long x 0.6 m wide x 0.45 m high; either 1.27-cm or 0.635-cm, dependent on animal size) for a post-exposure evaluation phase.

The holding cages containing mussels and a washed sand substrate will be placed in the river for approximately 30-d post exposure prior to evaluating the mussels for treatment related mortality. Representative treatment level sample specimens will be collected during the mortality assessment from at least 1-2 species. The samples will be subjected to histological examination to determine sub-lethal treatment related effects as permitted by funding.

Figure 1. Flow chart of major study activities for each test location



5. STUDY PROCEDURES

5.1 Test Animals

5.1.1 Description

5.1.1.1 Age – Native mussels ≤ 3 yrs

5.1.1.2 Sex – Test animals will be used without regard to sex.

5.1.1.3 Species –see table 2

5.1.2 Number of animals: **Up to 180** native mussels of each species will be used (9 replicates x **20 mussels each = 180**). If **180** mussels are not available, the number of animals in each replicate may be reduced to **5** and/or the species may be excluded from the low treatment level (50 mg/L A.I.) **or the extended treatment duration**. The number of test animals planned is consistent with the objective of the study and contemporary scientific standards.

5.1.3 Source of animals: Test animals will be provided from Genoa National Fish Hatchery production stocks or wild collected animals from the Upper Mississippi River. Collection of animals will be conducted by Genoa National Fish Hatchery mussel biologists.

5.1.4 Inclusion criterion: Native mussels in apparent good health will be used.

5.1.5 Acclimation: Mussels will be acclimated to treatment conditions for ≥12-h prior to exposure initiation.

5.1.6 Distribution to treatment replicates: Up to **20** uniquely identified and

measured mussels will be distributed to each exposure replicate according to a predetermined randomization scheme. Five mussels will be placed in each exposure replicate in each distribution round. **Up to four** distribution rounds will be completed for each species.

5.1.7 Feeding: No supplemental feed will be offered throughout the acclimation, exposure and post-exposure holding periods.

5.2 Water Chemistry

5.2.1 Dissolved oxygen: Dissolved oxygen will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Dissolved oxygen will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 394 or equivalent).

5.2.2 Temperature: Temperature will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. Temperature will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure period with the last measurement observed ≤ 30 minutes prior to exposure termination.

5.2.3 pH: pH will be measured and recorded in each exposure chamber replicate during the acclimation, exposure and post-exposure holding periods. pH will be measured and recorded at least once during the pre- and post-exposure periods and at least twice during the exposure with the last measurement observed ≤ 30 minutes prior to exposure termination (UMESC SOP AEH 335 or equivalent).

5.2.4 Hardness: Hardness will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 712).

5.2.5 Alkalinity: Alkalinity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 706).

5.2.6 Conductivity: Conductivity will be measured and recorded prior to exposure initiation on the filtered water supply (UMESC SOP AEH 188 or equivalent).

5.2.7 Ammonia: Samples for total ammonia-nitrogen will be collected at the termination of **each** exposure period for each exposure replicate. Ammonia samples will be filtered through a 0.45 micron syringe filter, acidified (~pH 2.5) with sulfuric acid and then stored at ~4°C until analyzed by the UMESC Long Term Resources Monitoring (LTRM) Water Quality Laboratory using the automated phenate method.

5.3 Disposal: All live mussels at the conclusion of the mortality assessment that are not subjected to histological examination will be returned to the custody of the Genoa NFH.

5.4 Study facilities

5.4.1 Test Facility

U.S. Geological Survey, Upper Midwest Environmental Sciences Center
Mobile Research Laboratory
2630 Fanta Reed Rd
La Crosse, Wisconsin 54603

5.4.1.1 Test location: Black River; La Crosse, WI

5.4.1.2 Exposure system: The test system consists of nine 76.2 cm diameter x 91.4 cm deep fiberglass circular exposure tanks in two rows of 4 or 5 tanks. The tanks are supplied surface water through a pump, filter and headbox system. Each exposure tank will be supplied 3-5 cm of wash sand for substrate and flowing 200 µm filtered river water (≥ 1 tank exchange/h). The water flow will be interrupted during the exposure period. Each tank will be uniquely identified to allow for identification treatment type and replicate number. Coding procedures will be documented in the study records.

5.4.1.3 Aeration: Supplemental aeration will not be supplied during the acclimation, SDP exposures and the post exposure observation periods.

5.4.1.4 Water supply: Filtered (200 µm) river water will be supplied continuously (~5 L/min) to achieve a ~ tank-volume exchange/h during the pre- and post-exposure periods. Water supply will be interrupted during the SDP exposures.

5.4.1.5 Water discharge: Untreated water will be returned to the water supply source. SDP treated water will be collected for disposal as required by DNR regulation.

5.4.1.6 Lighting: Overhead lighting will be provided during the exposure period. Light intensity will be measured using a Milwaukee photometer (AEH SOP 308 or equivalent) and recorded in the study records.

5.5 Observations

5.5.1 Mortality:

Unionid mussels that are gapping and do not respond to tactile stimuli by shell closure will be coded as a mortality. Unionid mussels that have closed shells (closed shells will be gently pried to assure that the anterior adductor muscle contraction is holding the shell closed) or respond to tactile stimuli by shell closure will be coded as alive.

5.6 Treatment administration

5.6.1 Treatment: Each treatment will consist of three SDP concentrations (ie: 0 [control], 50 mg/L A.I. or 100 mg/L A.I.) with **exposure durations of 8-h and 24-h.** All treatment concentrations and durations will have three replicate exposure chambers. A minimum of **3 and a maximum of 10 unionid mussels of each species will be placed in each exposure chamber**

replicate for each exposure duration. Up to **7** species will be used in each treatment.

5.6.2 Route of administration: Exposures will be initiated by addition of an appropriate amount of a SDP stock solution. The tank will be gently mixed to achieve a uniform distribution of test material.

5.6.3 Concentration verification: Concentration will be determined spectrophotometrically. A standard curve will be prepared using a known mass of SDP. The absorbance of exposure solutions will be compared to the standard curve to determine the exposure concentration. Absorbance will be determined using a Barnstead/Thermolyne Corporation Model: Turner SP-830 Plus Beckman spectrophotometer (UMESC SOP AEH 302).

6. DATA ANALYSIS

6.1 Experimental unit: The experimental unit will be the exposure chamber replicate.

6.2 Number of exposures and replicates: There will be a total of 3 treatment levels (0 [control], 50 and 100 mg SDP/L) and **2 treatment duration (8-h and 24-h).** There will be a total of 3 independent exposures chambers for each treatment **level/exposure duration** which will serve as the replicates. All treatment levels, replicates, **exposure durations** and up to **7** species will be run concurrently.

Study Number: AEH-13-PSEUDO-06 Reviewed by: _____ Date: _____

File Folder: _____ Lab book/pgs: _____ Verified by: _____ Date: _____

Test Chemical Stock Preparation

Test Chemical: *Pseudomonas fluroescens* strain 145A

Test Chemical Lot #: 401P12163C and 401P12164C Mix Date Rec'd: 7-AUG-12 Exp. Date: 21-JUN-12

Test Location: _____ Instruments Used: _____

Weights of Chemical Samples:

Sample ID	Sample Weight	Comments	Date	Initials

NOTE: Chemical samples to be stored refrigerated until used for stock preparation.

Stock Solution Preparation:

Sample ID	Dilution Volume (mL)	Dilution Time	Use	Exposure Time	Date	Initials

Item Number: 1

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Study Number AEH-13-PSEUDO-06

Reviewed by: _____ Date: _____

Verified by: _____ Date: _____

Exposure Date: _____ Instruments: _____

Test Chemical: Pf-CL145A SDP Lot Number: 401P12163C and 401P12164C Mix Test Location: _____

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File Folder: 16

Alkalinity

Sample Location	Initial pH	Initial Temp (°C)	mL of 0.02 N H_2SO_4	Multiplication Factor	Alkalinity[1] (mg/L $CaCO_3$)	Sample Time	Date	Initials
				10				
				10				
				10				
				10				
				10				
				10				
				10				
				10				
				10				

[1] Alkalinity in mg/L CaCO3 = (mL 0.02N H2SO4 used) x (Multiplication Factor of 10)

Alkalinity Sample volume = 100 mL

Comments: _____

Study Number AEH-13-PSEUDO-06

Reviewed by: _____ Date: _____

Verified by: _____ Date: _____

Exposure Date: _____ Instruments: _____

Test Chemical: Pf-CL145A SDP Lot Number: 401P12163C and 401P12164C Mix Test Location: _____

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Conductivity and Hardness

Sample Location	Conductivity (µS/cm)	mL of 0.01 M EDTA	Multiplication Factor	Hardness[1] (mg/L $CaCO_3$)	Sample Time	Date	Initials
			20				
			20				
			20				
			20				
			20				
			20				
			20				
			20				
			20				

[1]Hardness in mg/L $CaCO_3$ = (mL of 0.01 M Na_2EDTA titrant added to the sample) x (multiplication factor of 20).

Hardness Sample volume = 50 mL

Comments: _____

Study Number: AEH-13-PSEUDO-06 Reviewed by: _____ Date: _____

File Folder: _____ Lab book/pgs: _____ Verified by: _____ Date: _____

Water Quality

Exposure Start Time/Date: _____ Test Location: _____

Test Chemical: Pf-CL145A SDP Lot Number: 401P12163C and 401P12164C Mix

Tank Volume (L): _____ Instruments Used: _____

Sampling Time: _____

Exposure Tank ID	Treatment Level (mg/L)	Dissolved Oxygen (mg/L)	pH	Temperature (°C)	Time	Date/Initials

Light Measurement	Measurement Location	Date/Initials

Comments: _____

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Study Number: AEH-13-PSEUDO-06
File Folder: _____ Lab book/pgs: _____

Reviewed by: _____ Date: _____
Verified by: _____ Date: _____

Mussel Histology Samples

Exposure Start Time/Date: _____ Test Location: _____
Test Chemical: Pf-CL145A SDP Lot Number: 401P12163C and 401P12164C Mix

Container Number	Exposure Tank	Treatment Level (mg/L)	Sampling Time	Mussel Species	Tag ID	Number of Cassettes	Date	Initials

Comments: _____

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Study Number: AEH-13-PSEUDO 06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Test Chemical: *Pseudomonas fluorescens* Pf-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2013

Plain Pocketbook Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PPB	1	100	8	A204	White	36.31				
PPB	1	100	8	A237	White	38.92				
PPB	1	100	8	A247	White	39.99				
PPB	1	100	8	A248	White	45.89				
PPB	1	100	8	A270	White	34.79				
PPB	1	100	8	A289	White	37.91				
PPB	1	100	8	A300	White	39.65				
PPB	1	100	8	A308	White	35.72				
PPB	1	100	8	A312	White	38.64				
PPB	1	100	24	A189	White	42.20				
PPB	1	100	24	A231	White	35.01				
PPB	1	100	24	A284	White	41.00				
PPB	1	100	24	A302	White	41.75				
PPB	1	100	24	A313	White	39.06				
PPB	1	100	24	A316	White	41.80				
PPB	1	100	24	A317	White	38.70				
PPB	1	100	24	A348	White	29.00				
PPB	1	100	24	A344	White	35.52				
PPB	2	100	8	A202	White	37.62				
PPB	2	100	8	A246	White	48.04				
PPB	2	100	8	A262	White	36.07				
PPB	2	100	8	A269	White	42.24				
PPB	2	100	8	A278	White	43.13				
PPB	2	100	8	A307	White	38.30				
PPB	2	100	8	A310	White	36.86				
PPB	2	100	8	A311	White	38.63				
PPB	2	100	8	A338	White	33.30				
PPB	2	100	24	A193	White	41.76				
PPB	2	100	24	A244	White	42.91				
PPB	2	100	24	A256	White	34.25				
PPB	2	100	24	A268	White	35.52				
PPB	2	100	24	A274	White	45.21				
PPB	2	100	24	A296	White	29.63				
PPB	2	100	24	A304	White	37.74				
PPB	2	100	24	A331	White	32.89				
PPB	2	100	24	A335	White	39.83				

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Study Number: AEH 13-PSEUDO-06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SCP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Plain Pocketbook Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PPB	3	50	8	A183	White	43.37				
PPB	3	50	8	A185	White	41.96				
PPB	3	50	8	A214	White	27.35				
PPB	3	50	8	A225	White	37.93				
PPB	3	50	8	A250	White	37.96				
PPB	3	50	8	A271	White	38.33				
PPB	3	50	8	A277	White	40.65				
PPB	3	50	8	A294	White	41.22				
PPB	3	50	8	A340	White	44.26				
PPB	3	50	24	A184	White	39.42				
PPB	3	50	24	A191	White	32.71				
PPB	3	50	24	A230	White	40.12				
PPB	3	50	24	A232	White	35.85				
PPB	3	50	24	A239	White	40.08				
PPB	3	50	24	A255	White	31.29				
PPB	3	50	24	A290	White	42.69				
PPB	3	50	24	A323	White	35.96				
PPB	3	50	24	A341	White	33.60				
PPB	4	50	8	A187	White	39.62				
PPB	4	50	8	A200	White	32.57				
PPB	4	50	8	A215	White	39.89				
PPB	4	50	8	A264	White	43.27				
PPB	4	50	8	A305	White	39.94				
PPB	4	50	8	A318	White	41.48				
PPB	4	50	8	A329	White	33.20				
PPB	4	50	8	A334	White	40.32				
PPB	4	50	8	A345	White	41.92				
PPB	4	50	24	A181	White	45.88				
PPB	4	50	24	A190	White	41.46				
PPB	4	50	24	A192	White	37.43				
PPB	4	50	24	A208	White	46.15				
PPB	4	50	24	A213	White	31.96				
PPB	4	50	24	A261	White	31.33				
PPB	4	50	24	A265	White	41.74				
PPB	4	50	24	A272	White	42.88				
PPB	4	50	24	A282	White	35.97				

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Study Number: AEH-18-PSEUDC-06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12168C and 401P12164C Mix
Exposure Date: 5/28/2012

Plain Pocketbook Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PPB	5	CONTROL	8	A207	White	37.27				
PPB	5	CONTROL	8	A210	White	36.22				
PPB	5	CONTROL	8	A211	White	38.36				
PPB	5	CONTROL	8	A242	White	44.85				
PPB	5	CONTROL	8	A257	White	43.38				
PPB	5	CONTROL	8	A279	White	34.57				
PPB	5	CONTROL	8	A285	White	31.69				
PPB	5	CONTROL	8	A298	White	39.76				
PPB	5	CONTROL	8	A325	White	30.58				
PPB	5	CONTROL	24	A186	White	37.94				
PPB	5	CONTROL	24	A197	White	39.26				
PPB	5	CONTROL	24	A212	White	42.41				
PPB	5	CONTROL	24	A251	White	41.92				
PPB	5	CONTROL	24	A273	White	39.44				
PPB	5	CONTROL	24	A275	White	44.51				
PPB	5	CONTROL	24	A301	White	42.03				
PPB	5	CONTROL	24	A336	White	45.83				
PPB	5	CONTROL	24	A339	White	39.64				
PPB	6	50	8	A219	White	30.72				
PPB	6	50	8	A221	White	41.31				
PPB	6	50	8	A233	White	44.14				
PPB	6	50	8	A236	White	36.93				
PPB	6	50	8	A240	White	41.81				
PPB	6	50	8	A320	White	31.10				
PPB	6	50	8	A332	White	36.78				
PPB	6	50	8	A346	White	40.70				
PPB	6	50	8	A347	White	36.35				
PPB	6	50	24	A182	White	39.56				
PPB	6	50	24	A199	White	38.70				
PPB	6	50	24	A201	White	36.96				
PPB	6	50	24	A203	White	42.46				
PPB	6	50	24	A216	White	44.83				
PPB	6	50	24	A229	White	42.95				
PPB	6	50	24	A267	White	40.67				
PPB	6	50	24	A287	White	38.15				
PPB	6	50	24	A314	White	37.79				

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Study Number: AEH-13-PSEUDO-06
Musse species: Plain Pocketbook (*Lampsilis cardium*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical Lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Plain Pocketbook Length Summary

Species	Tank ID	Treatment Concentration (mg/l)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PPB	7	CONTROL	8	A188	White	40.79				
PPB	7	CONTROL	8	A198	White	37.49				
PPB	7	CONTROL	8	A227	White	31.86				
PPB	7	CONTROL	8	A241	White	40.97				
PPB	7	CONTROL	8	A258	White	36.74				
PPB	7	CONTROL	8	A283	White	40.35				
PPB	7	CONTROL	8	A287	White	34.91				
PPB	7	CONTROL	8	A321	White	42.67				
PPB	7	CONTROL	8	A337	White	46.16				
PPB	7	CONTROL	24	A194	White	38.24				
PPB	7	CONTROL	24	A195	White	40.76				
PPB	7	CONTROL	24	A209	White	43.08				
PPB	7	CONTROL	24	A252	White	41.67				
PPB	7	CONTROL	24	A276	White	44.01				
PPB	7	CONTROL	24	A291	White	43.03				
PPB	7	CONTROL	24	A292	White	41.25				
PPB	7	CONTROL	24	A305	White	37.88				
PPB	7	CONTROL	24	A327	White	29.54				
PPB	8	CONTROL	8	A205	White	41.90				
PPB	8	CONTROL	8	A226	White	39.02				
PPB	8	CONTROL	8	A245	White	42.64				
PPB	8	CONTROL	8	A249	White	39.42				
PPB	8	CONTROL	8	A253	White	35.34				
PPB	8	CONTROL	8	A281	White	44.80				
PPB	8	CONTROL	8	A293	White	34.26				
PPB	8	CONTROL	8	A342	White	46.05				
PPB	8	CONTROL	8	A348	White	40.58				
PPB	8	CONTROL	24	A217	White	34.45				
PPB	8	CONTROL	24	A224	White	41.35				
PPB	8	CONTROL	24	A234	White	41.48				
PPB	8	CONTROL	24	A266	White	40.07				
PPB	8	CONTROL	24	A288	White	37.54				
PPB	8	CONTROL	24	A295	White	42.13				
PPB	8	CONTROL	24	A299	White	46.27				
PPB	8	CONTROL	24	A309	White	45.51				
PPB	8	CONTROL	24	A326	White	30.45				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2017

Plain Pocketbook Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PPB	9	100	8	A196	White	48.05				
PPB	9	100	8	A218	White	38.84				
PPB	9	100	8	A228	White	35.17				
PPB	9	100	8	A263	White	42.73				
PPB	9	100	8	A280	White	33.81				
PPB	9	100	8	A303	White	39.07				
PPB	9	100	8	A315	White	37.68				
PPB	9	100	8	A322	White	41.21				
PPB	9	100	8	A330	White	42.80				
PPB	9	100	24	A206	White	43.81				
PPB	9	100	24	A220	White	42.85				
PPB	9	100	24	A238	White	29.33				
PPB	9	100	24	A243	White	42.22				
PPB	9	100	24	A254	White	38.58				
PPB	9	100	24	A260	White	41.81				
PPB	9	100	24	A319	White	41.40				
PPB	9	100	24	A324	White	41.95				
PPB	9	100	24	A333	White	41.46				
PPB				A222	White	41.44		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PPB				A228	White	41.39		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PPB				A235	White	38.84		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PPB				A259	White	35.06		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PPB				A286	White	40.80		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PPB				A328	White	38.59		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

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Item Number ____
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Study Number: AEH-13-PSEUDO-06
Mussel species: Hickorynut (*Obovaria olivaria*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Hickorynut Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HIC	1	100	8	D004	Blue	33.91				
HIC	1	100	8	D007	Blue	30.94				
HIC	1	100	8	D028	Blue	31.78				
HIC	1	100	8	D031	Blue	26.12				
HIC	1	100	8	D043	Blue	25.94				
HIC	1	100	8	D044	Blue	32.56				
HIC	1	100	8	D048	Blue	28.92				
HIC	1	100	8	D059	Blue	28.19				
HIC	1	100	8	D159	Blue	29.66				
HIC	1	100	8	D172	Blue	27.98				
HIC	1	100	24	D014	Blue	29.58				
HIC	1	100	24	D050	Blue	30.60				
HIC	1	100	24	D080	Blue	31.84				
HIC	1	100	24	D100	Blue	31.89				
HIC	1	100	24	D103	Blue	32.64				
HIC	1	100	24	D114	Blue	27.21				
HIC	1	100	24	D116	Blue	29.37				
HIC	1	100	24	D119	Blue	32.72				
HIC	1	100	24	D137	Blue	30.83				
HIC	1	100	24	D183	Blue	30.66				
HIC	2	100	8	D013	Blue	31.56				
HIC	2	100	8	D022	Blue	28.65				
HIC	2	100	8	D029	Blue	33.38				
HIC	2	100	8	D034	Blue	33.31				
HIC	2	100	8	D035	Blue	34.45				
HIC	2	100	8	D082	Blue	30.22				
HIC	2	100	8	D102	Blue	33.42				
HIC	2	100	8	D135	Blue	31.93				
HIC	2	100	8	D155	Blue	29.48				
HIC	2	100	8	D168	Blue	32.70				
HIC	2	100	24	D010	Blue	31.54				
HIC	2	100	24	D015	Blue	32.15				
HIC	2	100	24	D019	Blue	31.71				
HIC	2	100	24	D063	Blue	26.75				
HIC	2	100	24	D071	Blue	31.91				
HIC	2	100	24	D118	Blue	30.48		This number is difficult to read in the paper data.		
HIC	2	100	24	D132	Blue	34.14				
HIC	2	100	24	D166	Blue	31.67				
HIC	2	100	24	D170	Blue	28.49				
HIC	2	100	24	D174	Blue	30.15				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Hickorynut (*Obovaria olivaria*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/26/2012

Hickorynut Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HIC	3	50	8	D005	Blue	29.77				
HIC	3	50	8	D045	Blue	31.08				
HIC	3	50	8	D073	Blue	31.55				
HIC	3	50	8	D107	Blue	33.12				
HIC	3	50	8	D128	Blue	30.49				
HIC	3	50	8	D153	Blue	29.77				
HIC	3	50	8	D160	Blue	31.68				
HIC	3	50	8	D177	Blue	32.47				
HIC	3	50	8	D182	Blue	32.95				
HIC	3	50	8	D186	Blue	26.78				
HIC	3	50	24	D021	Blue	32.02				
HIC	3	50	24	D037	Blue	28.30				
HIC	3	50	24	D056	Blue	34.12				
HIC	3	50	24	D077	Blue	28.85				
HIC	3	50	24	D095	Blue	28.93				
HIC	3	50	24	D099	Blue	32.89				
HIC	3	50	24	D101	Blue	31.94				
HIC	3	50	24	D133	Blue	31.02				
HIC	3	50	24	D136	Blue	28.39				
HIC	3	50	24	D175	Blue	30.18				
HIC	4	50	8	D006	Blue	31.29				
HIC	4	50	8	D033	Blue	32.42				
HIC	4	50	8	D065	Blue	33.11				
HIC	4	50	8	D086	Blue	30.50				
HIC	4	50	8	D093	Blue	29.48				
HIC	4	50	8	D094	Blue	30.90				
HIC	4	50	8	D110	Blue	29.04				
HIC	4	50	8	D129	Blue	33.03				
HIC	4	50	8	D150	Blue	30.83				
HIC	4	50	8	D171	Blue	30.98				
HIC	4	50	24	D003	Blue	28.50				
HIC	4	50	24	D018	Blue	30.17				
HIC	4	50	24	D026	Blue	29.58				
HIC	4	50	24	D057	Blue	26.70				
HIC	4	50	24	D066	Blue	31.90				
HIC	4	50	24	D113	Blue	31.43				
HIC	4	50	24	D122	Blue	32.50				
HIC	4	50	24	D148	Blue	31.88				
HIC	4	50	24	D169	Blue	32.63				
HIC	4	50	24	D184	Blue	30.84				

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Study Number: AEH-13-PSEUDO C6
Mussel species: Hickorynut (*Obovaria olivaria*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Hickorynut Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HIC	5	CONTROL	8	D012	Blue	34.18				
HIC	5	CONTROL	8	D016	Blue	31.22				
HIC	5	CONTROL	8	D017	Blue	32.12				
HIC	5	CONTROL	8	D032	Blue	27.89				
HIC	5	CONTROL	8	D042	Blue	29.54				
HIC	5	CONTROL	8	D053	Blue	27.80				
HIC	5	CONTROL	8	D090	Blue	32.16				
HIC	5	CONTROL	8	D092	Blue	32.86				
HIC	5	CONTROL	8	D125	Blue	33.88				
HIC	5	CONTROL	8	D149	Blue	30.45				
HIC	5	CONTROL	24	D020	Blue	28.02				
HIC	5	CONTROL	24	D038	Blue	30.77				
HIC	5	CONTROL	24	D058	Blue	32.45				
HIC	5	CONTROL	24	D064	Blue	31.68				
HIC	5	CONTROL	24	D067	Blue	27.26				
HIC	5	CONTROL	24	D069	Blue	30.71				
HIC	5	CONTROL	24	D096	Blue	31.72				
HIC	5	CONTROL	24	D131	Blue	30.97				
HIC	5	CONTROL	24	D139	Blue	31.50				
HIC	5	CONTROL	24	D146	Blue	35.26				
HIC	6	50	8	DC55	Blue	26.88				
HIC	6	50	8	D084	Blue	31.36				
HIC	6	50	8	D097	Blue	29.74				
HIC	6	50	8	D111	Blue	30.10				
HIC	6	50	8	D123	Blue	31.12				
HIC	6	50	8	D130	Blue	28.00				
HIC	6	50	8	D134	Blue	32.93				
HIC	6	50	8	D154	Blue	31.11				
HIC	6	50	8	D162	Blue	31.28				
HIC	6	50	8	D180	Blue	21.33				
HIC	6	50	24	D023	Blue	30.05				
HIC	6	50	24	D051	Blue	31.03				
HIC	6	50	24	D074	Blue	30.64				
HIC	6	50	24	D091	Blue	32.65				
HIC	6	50	24	D141	Blue	28.23				
HIC	6	50	24	D152	Blue	34.45				
HIC	6	50	24	D161	Blue	32.00				
HIC	6	50	24	D165	Blue	32.89				
HIC	6	50	24	D178	Blue	32.82				
HIC	6	50	24	D185	Blue	32.93				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Hickorynut (*Obovaria olivaria*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2013

Hickorynut Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HIC	7	CONTROL	8	D001	Blue	34.01				
HIC	7	CONTROL	8	D041	Blue	28.95				
HIC	7	CONTROL	8	D052	Blue	31.72				
HIC	7	CONTROL	8	D054	Blue	29.11				
HIC	7	CONTROL	8	D076	Blue	33.27				
HIC	7	CONTROL	8	D085	Blue	32.98				
HIC	7	CONTROL	8	D140	Blue	33.90				
HIC	7	CONTROL	8	D151	Blue	29.62				
HIC	7	CONTROL	8	D157	Blue	30.48				
HIC	7	CONTROL	8	D183	Blue	32.97				
HIC	7	CONTROL	24	D009	Blue	34.73				
HIC	7	CONTROL	24	D011	Blue	30.58				
HIC	7	CONTROL	24	D024	Blue	31.16				
HIC	7	CONTROL	24	D039	Blue	31.70				
HIC	7	CONTROL	24	D072	Blue	30.68				
HIC	7	CONTROL	24	D083	Blue	30.96				
HIC	7	CONTROL	24	D112	Blue	29.67				
HIC	7	CONTROL	24	D117	Blue	28.16				
HIC	7	CONTROL	24	D121	Blue	31.17				
HIC	7	CONTROL	24	D143	Blue	29.51				
HIC	8	CONTROL	8	D027	Blue	32.03				
HIC	8	CONTROL	8	D047	Blue	37.15				
HIC	8	CONTROL	8	D049	Blue	33.74				
HIC	8	CONTROL	8	D061	Blue	28.93				
HIC	8	CONTROL	8	D104	Blue	29.96				
HIC	8	CONTROL	8	D126	Blue	32.97				
HIC	8	CONTROL	8	D142	Blue	27.87				
HIC	8	CONTROL	8	D164	Blue	34.55				
HIC	8	CONTROL	8	D176	Blue	29.78				
HIC	8	CONTROL	8	D179	Blue	29.30				
HIC	8	CONTROL	24	D002	Blue	34.36				
HIC	8	CONTROL	24	D075	Blue	29.51				
HIC	8	CONTROL	24	D081	Blue	32.71				
HIC	8	CONTROL	24	D087	Blue	33.29				
HIC	8	CONTROL	24	D109	Blue	24.99				
HIC	8	CONTROL	24	D127	Blue	34.41				
HIC	8	CONTROL	24	D138	Blue	32.84				
HIC	8	CONTROL	24	D156	Blue	29.96				
HIC	8	CONTROL	24	D167	Blue	32.84				
HIC	8	CONTROL	24	D181	Blue	30.47				

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Study Number: AEH-13-PSEUDO-06

Mussel species: Hickorynut (*Obovaria olivaria*)

Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical Lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/26/2012

Hickorynut Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HIC	9	100	8	D025	Blue	29.36				
HIC	9	100	8	D036	Blue	32.82				
HIC	9	100	8	D050	Blue	32.53				
HIC	9	100	8	D078	Blue	28.55				
HIC	9	100	8	D088	Blue	29.78				
HIC	9	100	8	D098	Blue	30.52				
HIC	9	100	8	D115	Blue	29.70				
HIC	9	100	8	D124	Blue	30.48				
HIC	9	100	8	D145	Blue	29.80				
HIC	9	100	8	D158	Blue	30.16				
HIC	9	100	24	D040	Blue	34.17				
HIC	9	100	24	D045	Blue	33.38				
HIC	9	100	24	D062	Blue	30.57				
HIC	9	100	24	D068	Blue	30.39				
HIC	9	100	24	D089	Blue	31.38				
HIC	9	100	24	D105	Blue	32.73				
HIC	9	100	24	D106	Blue	28.89				
HIC	9	100	24	D108	Blue	29.45				
HIC	9	100	24	D120	Blue	27.78				
HIC	9	100	24	D144	Blue	27.11				
HIC				D008	Blue	30.90		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HIC				D030	Blue	29.07		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HIC				D070	Blue	28.70		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HIC				D079	Blue	31.75		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HIC				D147	Blue	27.71		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HIC				D173	Blue	29.35		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

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Study Number: AEH-13-PSIUDD-CG
Mussel species: Washboard (*Megalonaias nervosa*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Washboard Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
WAS	1	100	8	A024	White	40.02				
WAS	1	100	8	A032	White	40.73				
WAS	1	100	8	A066	White	44.93				
WAS	1	100	8	A094	White	42.19				
WAS	1	100	8	A110	White	42.12				
WAS	1	100	8	A111	White	39.72				
WAS	1	100	8	A112	White	36.56				
WAS	1	100	8	A143	White	40.94				
WAS	1	100	8	A163	White	44.95				
WAS	1	100	8	A176	White	44.38				
WAS	1	100	24	A014	White	39.83				
WAS	1	100	24	A053	White	43.12				
WAS	1	100	24	A061	White	49.83				
WAS	1	100	24	A090	White	38.10				
WAS	1	100	24	A095	White	39.43				
WAS	1	100	24	A117	White	45.68				
WAS	1	100	24	A123	White	39.37				
WAS	1	100	24	A140	White	45.67				
WAS	1	100	24	A169	White	43.14				
WAS	1	100	24	A177	White	36.05				
WAS	2	100	8	A004	White	48.72				
WAS	2	100	8	A010	White	46.81				
WAS	2	100	8	A015	White	43.71				
WAS	2	100	8	A087	White	41.39				
WAS	2	100	8	A101	White	49.07				
WAS	2	100	8	A125	White	44.25				
WAS	2	100	8	A141	White	40.68				
WAS	2	100	8	A157	White	42.25				
WAS	2	100	8	A172	White	40.45				
WAS	2	100	8	A179	White	42.02				
WAS	2	100	24	A030	White	40.63				
WAS	2	100	24	A042	White	40.05				
WAS	2	100	24	A051	White	43.84				
WAS	2	100	24	A060	White	45.35				
WAS	2	100	24	A091	White	44.02				
WAS	2	100	24	A114	White	41.66				
WAS	2	100	24	A121	White	47.12				
WAS	2	100	24	A139	White	46.31				
WAS	2	100	24	A158	White	46.65				
WAS	2	100	24	A180	White	42.40				

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Study Number: AEH-18-PSEUDO-06
Mussel species: Washboard (*Megalonaias nervosa*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Washboard Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
WAS	3	50	8	A003	White	46.72				
WAS	3	50	8	A007	White	42.94				
WAS	3	50	8	A023	White	41.50				
WAS	3	50	8	A046	White	44.11				
WAS	3	50	8	A065	White	50.45				
WAS	3	50	8	A070	White	44.15				
WAS	3	50	8	A085	White	41.01				
WAS	3	50	8	A093	White	47.36				
WAS	3	50	8	A128	White	42.32				
WAS	3	50	8	A175	White	48.51				
WAS	3	50	24	A013	White	42.92				
WAS	3	50	24	A025	White	48.68				
WAS	3	50	24	A035	White	47.70				
WAS	3	50	24	A099	White	48.96				
WAS	3	50	24	A108	White	47.25				
WAS	3	50	24	A126	White	46.53				
WAS	3	50	24	A135	White	40.80				
WAS	3	50	24	A162	White	43.67				
WAS	3	50	24	A170	White	41.76				
WAS	3	50	24	A172	White	39.30				
WAS	4	50	8	A002	White	44.11				
WAS	4	50	8	A008	White	42.84				
WAS	4	50	8	A011	White	40.85				
WAS	4	50	8	A075	White	38.79				
WAS	4	50	8	A109	White	42.37				
WAS	4	50	8	A130	White	42.71				
WAS	4	50	8	A149	White	42.83				
WAS	4	50	8	A150	White	45.21				
WAS	4	50	8	A164	White	45.31				
WAS	4	50	8	A165	White	45.31				
WAS	4	50	24	A001	White	50.15				
WAS	4	50	24	A005	White	46.51				
WAS	4	50	24	A019	White	44.50				
WAS	4	50	24	A026	White	49.81				
WAS	4	50	24	A036	White	48.53				
WAS	4	50	24	A048	White	42.58				
WAS	4	50	24	A058	White	41.21				
WAS	4	50	24	A073	White	44.55				
WAS	4	50	24	A113	White	42.27				
WAS	4	50	24	A156	White	46.87				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Washboard (*Megalonaias nervosa*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Washboard Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
WAS	5	CONTROL	8	A016	White	48.96				
WAS	5	CONTROL	8	A020	White	42.97				
WAS	5	CONTROL	8	A028	White	42.54				
WAS	5	CONTROL	8	A034	White	46.97				
WAS	5	CONTROL	8	A043	White	40.64				
WAS	5	CONTROL	8	A072	White	46.46				
WAS	5	CONTROL	8	A074	White	39.01				
WAS	5	CONTROL	8	A119	White	39.09				
WAS	5	CONTROL	8	A120	White	44.10				
WAS	5	CONTROL	8	A174	White	42.95				
WAS	5	CONTROL	24	A047	White	45.99				
WAS	5	CONTROL	24	A054	White	42.55				
WAS	5	CONTROL	24	A055	White	47.51				
WAS	5	CONTROL	24	A056	White	47.02				
WAS	5	CONTROL	24	A077	White	46.49				
WAS	5	CONTROL	24	A079	White	45.74				
WAS	5	CONTROL	24	A082	White	47.10				
WAS	5	CONTROL	24	A092	White	52.52				
WAS	5	CONTROL	24	A133	White	43.72				
WAS	5	CONTROL	24	A148	White	43.86				
WAS	6	50	8	A009	White	43.53				
WAS	6	50	8	A018	White	43.85				
WAS	6	50	8	A039	White	41.47				
WAS	6	50	8	A040	White	42.42				
WAS	6	50	8	A053	White	44.06				
WAS	6	50	8	A089	White	41.40				
WAS	6	50	8	A098	White	49.86				
WAS	6	50	8	A124	White	47.02				
WAS	6	50	8	A134	White	39.20				
WAS	6	50	8	A138	White	45.74				
WAS	6	50	24	A021	White	51.77				
WAS	6	50	24	A057	White	43.75				
WAS	6	50	24	A067	White	38.57				
WAS	6	50	24	A068	White	56.97				
WAS	6	50	24	A081	White	49.37				
WAS	6	50	24	A102	White	41.67				
WAS	6	50	24	A105	White	44.11				
WAS	6	50	24	A137	White	43.13				
WAS	6	50	24	A152	White	49.93				
WAS	6	50	24	A165	White	42.00				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Washboard (*Megalonaias nervosa*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Washboard Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
WAS	7	CONTROL	8	A037	White	47.80				
WAS	7	CONTROL	8	A038	White	40.34				
WAS	7	CONTROL	8	A041	White	42.52				
WAS	7	CONTROL	8	A050	White	40.27				
WAS	7	CONTROL	8	A076	White	41.85				
WAS	7	CONTROL	8	A078	White	54.89				
WAS	7	CONTROL	8	A127	White	45.02				
WAS	7	CONTROL	8	A132	White	40.18				
WAS	7	CONTROL	8	A151	White	40.08				
WAS	7	CONTROL	8	A159	White	42.92				
WAS	7	CONTROL	24	A012	White	40.82				
WAS	7	CONTROL	24	A017	White	38.94				
WAS	7	CONTROL	24	A052	White	43.66				
WAS	7	CONTROL	24	A062	White	40.73				
WAS	7	CONTROL	24	A064	White	39.56				
WAS	7	CONTROL	24	A080	White	56.48				
WAS	7	CONTROL	24	A084	White	51.25				
WAS	7	CONTROL	24	A100	White	42.96				
WAS	7	CONTROL	24	A107	White	44.87				
WAS	7	CONTROL	24	A155	White	45.29				
WAS	8	CONTROL	8	A049	White	44.55				
WAS	8	CONTROL	8	A106	White	47.59				
WAS	8	CONTROL	8	A116	White	39.11				
WAS	8	CONTROL	8	A136	White	42.02				
WAS	8	CONTROL	8	A142	White	42.62				
WAS	8	CONTROL	8	A144	White	43.83				
WAS	8	CONTROL	8	A146	White	42.73				
WAS	8	CONTROL	8	A153	White	43.02				
WAS	8	CONTROL	8	A168	White	40.60				
WAS	8	CONTROL	8	A173	White	41.29				
WAS	8	CONTROL	24	A059	White	40.49				
WAS	8	CONTROL	24	A069	White	46.83				
WAS	8	CONTROL	24	A086	White	39.60				
WAS	8	CONTROL	24	A104	White	47.91				
WAS	8	CONTROL	24	A115	White	41.69				
WAS	8	CONTROL	24	A145	White	44.01				
WAS	8	CONTROL	24	A160	White	39.83				
WAS	8	CONTROL	24	A161	White	50.36				
WAS	8	CONTROL	24	A167	White	43.55				
WAS	8	CONTROL	24	A178	White	35.21				

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Study Number: AEH-13-PSEUDO-06

Mussel species: Washboard (*Megalonaias nervosa*)

Test Chemical: *Pseudomonas fluorescens Pf* -CL 14SA (SDP) Chemical lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/28/2012

Washboard Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
WAS	9	100	8	A006	White	49.57				
WAS	9	100	8	A022	White	45.37				
WAS	9	100	8	A031	White	41.68				
WAS	9	100	8	A033	White	42.57				
WAS	9	100	8	A044	White	47.62				
WAS	9	100	8	A097	White	44.34				
WAS	9	100	8	A118	White	48.24				
WAS	9	100	8	A122	White	47.54				
WAS	9	100	8	A129	White	40.18				
WAS	9	100	8	A154	White	41.80				
WAS	9	100	24	A027	White	46.73				
WAS	9	100	24	A029	White	41.32				
WAS	9	100	24	A045	White	45.71				
WAS	9	100	24	A071	White	45.81				
WAS	9	100	24	A083	White	51.81				
WAS	9	100	24	A088	White	41.09				
WAS	9	100	24	A096	White	51.97				
WAS	9	100	24	A103	White	42.51				
WAS	9	100	24	A131	White	39.59				
WAS	9	100	24	A147	White	48.69				

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Study Number: ASI-13-PSEUDO-06
Mussel species: Higgins Eye (*Lampsilis higginsii*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical ot #: 401P12163E and 401P12164C Mix
Exposure Date: 5/28/2012

Higgins Eye Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HGE	1	100	8	8023	Yellow	25.92				
HGE	1	100	8	8033	Yellow	21.01				
HGE	1	100	8	8043	Yellow	23.58				
HGE	1	100	8	8053	Yellow	26.32				
HGE	1	100	8	8088	Yellow	26.32				
HGE	1	100	8	8097	Yellow	24.76				
HGE	1	100	8	8120	Yellow	22.28				
HGE	1	100	8	8158	Yellow	19.81				
HGE	1	100	24	8005	Yellow	24.29				
HGE	1	100	24	8034	Yellow	24.24				
HGE	1	100	24	8057	Yellow	22.57				
HGE	1	100	24	8067	Yellow	24.62				
HGE	1	100	24	8127	Yellow	21.55				
HGE	1	100	24	8129	Yellow	23.88				
HGE	1	100	24	8152	Yellow	20.70				
HGE	1	100	24	8156	Yellow	23.90				
HGE	2	100	8	8007	Yellow	26.00				
HGE	2	100	8	8020	Yellow	22.44				
HGE	2	100	8	8069	Yellow	26.12				
HGE	2	100	8	8102	Yellow	21.28				
HGE	2	100	8	8126	Yellow	23.91				
HGE	2	100	8	8147	Yellow	24.56				
HGE	2	100	8	8157	Yellow	22.15				
HGE	2	100	8	8159	Yellow	17.22				
HGE	2	100	24	8004	Yellow	25.06				
HGE	2	100	24	8013	Yellow	23.76				
HGE	2	100	24	8014	Yellow	25.83				
HGE	2	100	24	8022	Yellow	26.01				
HGE	2	100	24	8049	Yellow	26.02				
HGE	2	100	24	8054	Yellow	23.01				
HGE	2	100	24	8134	Yellow	22.85				
HGE	2	100	24	8138	Yellow	28.18				

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Study Number: ABR 13 PSEUDO-06
Mussel species: Higgins Eye (*Lorasilis higginsii*)
Test Chemical: *Pseudomonas fluorescens Pf*-Cl 145A (SDP) Chemical lot #: 400P12163C and 400P12154C Mix
Exposure Date: 5/28/2012

Higgins Eye Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HGE	3	50	8	B011	Yellow	24.10				
HGE	3	50	8	B012	Yellow	26.13				
HGE	3	50	8	B019	Yellow	25.89				
HGE	3	50	8	B050	Yellow	24.99				
HGE	3	50	8	B081	Yellow	25.22				
HGE	3	50	8	B086	Yellow	23.54				
HGE	3	50	8	B098	Yellow	24.55				
HGE	3	50	8	B125	Yellow	23.01				
HGE	3	50	24	B005	Yellow	24.01				
HGE	3	50	24	B021	Yellow	24.77				
HGE	3	50	24	B052	Yellow	26.62				
HGE	3	50	24	B071	Yellow	28.97				
HGE	3	50	24	B080	Yellow	24.53				
HGE	3	50	24	B118	Yellow	22.81				
HGE	3	50	24	B123	Yellow	23.48				
HGE	3	50	24	B153	Yellow	17.81				
HGE	4	50	8	B026	Yellow	20.59				
HGE	4	50	8	B061	Yellow	25.10				
HGE	4	50	8	B064	Yellow	22.97				
HGE	4	50	8	B090	Yellow	20.80				
HGE	4	50	8	B124	Yellow	24.41				
HGE	4	50	8	B128	Yellow	23.83				
HGE	4	50	8	B135	Yellow	24.04				
HGE	4	50	8	B150	Yellow	22.89				
HGE	4	50	24	B010	Yellow	24.88				
HGE	4	50	24	B015	Yellow			Mussel was not measured during initial measuring.		
HGE	4	50	24	B037	Yellow	23.74				
HGE	4	50	24	B038	Yellow	24.95				
HGE	4	50	24	B039	Yellow	26.24				
HGE	4	50	24	B078	Yellow	25.90				
HGE	4	50	24	B087	Yellow	22.67				
HGE	4	50	24	B112	Yellow	23.67				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Higgins Eye (*Lampsilis higginsi*)
Test Chemical: *Pseudomonas fluorescens* Pf -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Higgins Eye Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HGE	5	CONTROL	8	B018	Yellow	23.86				
HGE	5	CONTROL	8	B047	Yellow	25.28				
HGE	5	CONTROL	8	B066	Yellow	26.27				
HGE	5	CONTROL	8	B095	Yellow	24.55				
HGE	5	CONTROL	8	B114	Yellow	25.90				
HGE	5	CONTROL	8	B138	Yellow	20.96				
HGE	5	CONTROL	8	B142	Yellow	20.44				
HGE	5	CONTROL	8	B149	Yellow	19.90				
HGE	5	CONTROL	24	B046	Yellow	21.42				
HGE	5	CONTROL	24	B051	Yellow	21.60				
HGE	5	CONTROL	24	B075	Yellow	24.93				
HGE	5	CONTROL	24	B094	Yellow	25.77				
HGE	5	CONTROL	24	B111	Yellow	24.07				
HGE	5	CONTROL	24	B143	Yellow	24.82				
HGE	5	CONTROL	24	B145	Yellow	22.96				
HGE	5	CONTROL	24	B154	Yellow	27.84				
HGE	6	50	8	B032	Yellow	24.31				
HGE	6	50	8	B059	Yellow	25.32				
HGE	6	50	8	B076	Yellow	25.13				
HGE	6	50	8	B079	Yellow	26.57				
HGE	6	50	8	B101	Yellow	23.38				
HGE	6	50	8	B107	Yellow	24.03				
HGE	6	50	8	B115	Yellow	25.54				
HGE	6	50	8	B121	Yellow	21.89				
HGE	6	50	24	B038	Yellow	26.44				
HGE	6	50	24	B041	Yellow	24.50				
HGE	6	50	24	B061	Yellow	27.73				
HGE	6	50	24	B068	Yellow	24.99				
HGE	6	50	24	B092	Yellow	19.39				
HGE	6	50	24	B117	Yellow	24.83				
HGE	6	50	24	B137	Yellow	25.19				
HGE	6	50	24	B140	Yellow	20.81				

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Study Number: ASH-13-PSEUDO-05
Mussel species: Higgins Eye (*Lampsilis higginsii*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Higgins Eye Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HGE	7	CONTROL	8	8016	Yellow	28.59				
HGE	7	CONTROL	8	8017	Yellow	25.00				
HGE	7	CONTROL	8	8045	Yellow	23.55				
HGE	7	CONTROL	8	8077	Yellow	25.11				
HGE	7	CONTROL	8	8091	Yellow	27.51				
HGE	7	CONTROL	8	8106	Yellow	25.84				
HGE	7	CONTROL	8	8119	Yellow	27.43				
HGE	7	CONTROL	8	8130	Yellow	21.69				
HGE	7	CONTROL	24	8002	Yellow	19.58				
HGE	7	CONTROL	24	8036	Yellow	24.33				
HGE	7	CONTROL	24	8058	Yellow	26.14				
HGE	7	CONTROL	24	8094	Yellow	19.54				
HGE	7	CONTROL	24	8103	Yellow	24.13				
HGE	7	CONTROL	24	8104	Yellow	21.80				
HGE	7	CONTROL	24	8132	Yellow	28.92				
HGE	7	CONTROL	24	8141	Yellow	18.19				
HGE	8	CONTROL	8	8008	Yellow	22.10				
HGE	8	CONTROL	8	8024	Yellow	26.17				
HGE	8	CONTROL	8	8031	Yellow	25.96				
HGE	8	CONTROL	8	8065	Yellow	26.48				
HGE	8	CONTROL	8	8096	Yellow	21.03				
HGE	8	CONTROL	8	8100	Yellow	23.13				
HGE	8	CONTROL	8	8110	Yellow	28.50				
HGE	8	CONTROL	8	8135	Yellow	23.20				
HGE	8	CONTROL	24	8001	Yellow	26.15				
HGE	8	CONTROL	24	8044	Yellow	28.41				
HGE	8	CONTROL	24	8070	Yellow	25.08				
HGE	8	CONTROL	24	8074	Yellow	20.00				
HGE	8	CONTROL	24	8089	Yellow	21.44				
HGE	8	CONTROL	24	8108	Yellow	24.02				
HGE	8	CONTROL	24	8113	Yellow	27.82				
HGE	8	CONTROL	24	8116	Yellow	22.81				

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Study Number: AEH-13-PSEUDO-06

Mussel species: Higgins Eye (*Lampsilis higginsi*)

Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SSP) Chemical lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/28/2012

Higgins Eye Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
HGE	9	100	8	B023	Yellow	21.92				
HGE	9	100	8	B027	Yellow	24.09				
HGE	9	100	8	B083	Yellow	22.87				
HGE	9	100	8	B085	Yellow	20.00				
HGE	9	100	8	B122	Yellow	26.08				
HGE	9	100	8	B139	Yellow	28.58				
HGE	9	100	8	B144	Yellow	25.65				
HGE	9	100	8	B148	Yellow	20.51				
HGE	9	100	24	B029	Yellow	24.06				
HGE	9	100	24	B045	Yellow	24.73				
HGE	9	100	24	B048	Yellow	23.45				
HGE	9	100	24	B056	Yellow	20.80				
HGE	9	100	24	B098	Yellow	24.41				
HGE	9	100	24	B099	Yellow	20.98				
HGE	9	100	24	B151	Yellow	21.07				
HGE	9	100	24	B155	Yellow	18.97				
HGE				B003	Yellow	24.47		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B009	Yellow	22.61		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B028	Yellow	23.95		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B040	Yellow	23.30		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B042	Yellow	22.36		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B055	Yellow	20.71		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B060	Yellow	23.28		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B068	Yellow	24.29		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B072	Yellow	20.90		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B073	Yellow	24.54		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B082	Yellow	23.83		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B103	Yellow	24.84		Tag ID B103 occurs twice. First measurement is 24.84, second measurement is 25.42 - must have been inadvertantly measured twice		
HGE				B103	Yellow	25.42		Tag ID B103 occurs twice. First measurement is 24.84, second measurement is 25.42 - must have been inadvertantly measured twice		
HGE				B108	Yellow	23.95		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B136	Yellow	21.60		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
HGE				B146	Yellow	22.35		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

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Study Number: AEH-13-PSEUDO-06
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
Test Chemical: *Pseudomonas fluorescens* Pf -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Fatmucket Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
FAM	1	100	8	D199	Blue	54.86				
FAM	1	100	8	D209	Blue	58.36				
FAM	1	100	8	D226	Blue	52.97				
FAM	1	100	8	D262	Blue	63.21				
FAM	1	100	8	D269	Blue	61.71				
FAM	1	100	8	D270	Blue	55.62				
FAM	1	100	8	D273	Blue	55.31				
FAM	1	100	8	D302	Blue	53.29				
FAM	1	100	8	D310	Blue	50.46				
FAM	1	100	8	D336	Blue	57.79				
FAM	1	100	24	D196	Blue	50.29				
FAM	1	100	24	D197	Blue	48.33				
FAM	1	100	24	D203	Blue	64.51				
FAM	1	100	24	D251	Blue	61.49				
FAM	1	100	24	D264	Blue	58.27				
FAM	1	100	24	D277	Blue	51.18				
FAM	1	100	24	D294	Blue	64.60				
FAM	1	100	24	D313	Blue	53.6C				
FAM	1	100	24	D335	Blue	50.16				
FAM	1	100	24	D340	Blue	52.35				
FAM	2	100	8	D198	Blue	42.50				
FAM	2	100	8	D220	Blue	56.60				
FAM	2	100	8	D235	Blue	54.68				
FAM	2	100	8	D242	Blue	63.22				
FAM	2	100	8	D256	Blue	55.01				
FAM	2	100	8	D265	Blue	51.02				
FAM	2	100	8	D304	Blue	56.36				
FAM	2	100	8	D318	Blue	66.37				
FAM	2	100	8	D326	Blue	54.41				
FAM	2	100	8	D354	Blue	52.92				
FAM	2	100	24	D193	Blue	57.81				
FAM	2	100	24	D267	Blue	62.22				
FAM	2	100	24	D291	Blue	56.58				
FAM	2	100	24	D299	Blue	50.88				
FAM	2	100	24	D316	Blue	56.04				
FAM	2	100	24	D319	Blue	58.93				
FAM	2	100	24	D329	Blue	58.72				
FAM	2	100	24	D338	Blue	42.27				
FAM	2	100	24	D339	Blue	50.03				
FAM	2	100	24	D348	Blue	58.21				

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Study Number: AEH-12-PSEUDO-05
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12162C and 401P12164C Mix
Exposure Date: 5/28/2012

Fatmucket Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
FAM	3	50	8	D211	Blue	49.40				
FAM	3	50	8	D229	Blue	54.02				
FAM	3	50	8	D263	Blue	54.54				
FAM	3	50	8	D265	Blue	63.43				
FAM	3	50	8	D271	Blue	58.15				
FAM	3	50	8	D282	Blue	61.56				
FAM	3	50	8	D300	Blue	53.85				
FAM	3	50	8	D306	Blue	55.20				
FAM	3	50	8	D332	Blue	53.83				
FAM	3	50	8	D350	Blue	58.98				
FAM	3	50	24	D189	Blue	46.55				
FAM	3	50	24	D221	Blue	60.60				
FAM	3	50	24	D227	Blue	53.26				
FAM	3	50	24	D232	Blue	54.09				
FAM	3	50	24	D278	Blue	59.08				
FAM	3	50	24	D281	Blue	58.66				
FAM	3	50	24	D288	Blue	58.17				
FAM	3	50	24	D311	Blue	56.01				
FAM	3	50	24	D351	Blue	62.81				
FAM	3	50	24	D353	Blue	66.47				
FAM	4	50	8	D190	Blue	56.43				
FAM	4	50	8	D215	Blue	51.43				
FAM	4	50	8	D222	Blue	54.61				
FAM	4	50	8	D245	Blue	59.64				
FAM	4	50	8	D247	Blue	48.41				
FAM	4	50	8	D255	Blue	55.25				
FAM	4	50	8	D309	Blue	65.25				
FAM	4	50	8	D315	Blue	61.60				
FAM	4	50	8	D349	Blue	49.17				
FAM	4	50	8	D365	Blue	57.63				
FAM	4	50	24	D204	Blue	57.14				
FAM	4	50	24	D228	Blue	54.25				
FAM	4	50	24	D272	Blue	51.93				
FAM	4	50	24	D287	Blue	60.17				
FAM	4	50	24	D289	Blue	51.58				
FAM	4	50	24	D298	Blue	58.50				
FAM	4	50	24	D307	Blue	53.30				
FAM	4	50	24	D323	Blue	58.97				
FAM	4	50	24	D325	Blue	58.97				
FAM	4	50	24	D337	Blue	55.52				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL14SA (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Fatmucket Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
FAM	5	CONTROL	8	D214	Blue	49.82				
FAM	5	CONTROL	8	D225	Blue	58.39				
FAM	5	CONTROL	8	D257	Blue	62.97				
FAM	5	CONTROL	8	D259	Blue	58.50				
FAM	5	CONTROL	8	D288	Blue	60.29				
FAM	5	CONTROL	8	D296	Blue	62.69				
FAM	5	CONTROL	8	D321	Blue	54.82				
FAM	5	CONTROL	8	D327	Blue	55.61				
FAM	5	CONTROL	8	D334	Blue	49.99				
FAM	5	CONTROL	8	D347	Blue	60.39				
FAM	5	CONTROL	24	D188	Blue	62.01				
FAM	5	CONTROL	24	D207	Blue	54.87				
FAM	5	CONTROL	24	D218	Blue	63.55				
FAM	5	CONTROL	24	D254	Blue	64.89				
FAM	5	CONTROL	24	D276	Blue	60.60				
FAM	5	CONTROL	24	D286	Blue	60.70				
FAM	5	CONTROL	24	D292	Blue	67.51				
FAM	5	CONTROL	24	D297	Blue	58.12				
FAM	5	CONTROL	24	D357	Blue	54.47				
FAM	5	CONTROL	24	D358	Blue	60.98				
FAM	6	50	8	D205	Blue	52.21				
FAM	6	50	8	D216	Blue	60.07				
FAM	6	50	8	D241	Blue	54.25				
FAM	6	50	8	D249	Blue	58.90				
FAM	6	50	8	D250	Blue	54.01				
FAM	6	50	8	D308	Blue	49.62				
FAM	6	50	8	D320	Blue	51.72				
FAM	6	50	8	D322	Blue	61.86				
FAM	6	50	8	D328	Blue	56.75				
FAM	6	50	8	D367	Blue	50.40				
FAM	6	50	24	D195	Blue	59.28				
FAM	6	50	24	D201	Blue	58.00				
FAM	6	50	24	D248	Blue	55.75				
FAM	6	50	24	D298	Blue	57.51				
FAM	6	50	24	D305	Blue	63.96				
FAM	6	50	24	D303	Blue	55.45				
FAM	6	50	24	D330	Blue	46.63				
FAM	6	50	24	D342	Blue	62.45				
FAM	6	50	24	D364	Blue	68.73				
FAM	6	50	24	D365	Blue	57.03				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 3/28/2012

Fatmucket Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
FAM	7	CONTROL	8	D192	Blue	57.28				
FAM	7	CONTROL	8	D212	Blue	59.46				
FAM	7	CONTROL	8	D238	Blue	60.27				
FAM	7	CONTROL	8	D237	Blue	62.20				
FAM	7	CONTROL	8	D259	Blue	61.44				
FAM	7	CONTROL	8	D268	Blue	58.00				
FAM	7	CONTROL	8	D344	Blue	53.92				
FAM	7	CONTROL	8	D345	Blue	63.67				
FAM	7	CONTROL	8	D362	Blue	56.87				
FAM	7	CONTROL	8	D369	Blue	60.42				
FAM	7	CONTROL	24	D194	Blue	57.90				
FAM	7	CONTROL	24	D200	Blue	58.46				
FAM	7	CONTROL	24	D213	Blue	54.35				
FAM	7	CONTROL	24	D228	Blue	57.41				
FAM	7	CONTROL	24	D234	Blue	53.05				
FAM	7	CONTROL	24	D240	Blue	58.83				
FAM	7	CONTROL	24	D244	Blue	58.79				
FAM	7	CONTROL	24	D261	Blue	55.88				
FAM	7	CONTROL	24	D295	Blue	55.70				
FAM	7	CONTROL	24	D355	Blue	56.92				
FAM	8	CONTROL	8	D210	Blue	59.82				
FAM	8	CONTROL	8	D217	Blue	55.68				
FAM	8	CONTROL	8	D238	Blue	56.42				
FAM	8	CONTROL	8	D251	Blue	60.13				
FAM	8	CONTROL	8	D274	Blue	65.08				
FAM	8	CONTROL	8	D284	Blue	57.90				
FAM	8	CONTROL	8	D290	Blue	58.31				
FAM	8	CONTROL	8	D314	Blue	58.15				
FAM	8	CONTROL	8	D348	Blue	59.95				
FAM	8	CONTROL	8	D360	Blue	65.56				
FAM	8	CONTROL	24	D206	Blue	58.39				
FAM	8	CONTROL	24	D208	Blue	62.05				
FAM	8	CONTROL	24	D236	Blue	56.76				
FAM	8	CONTROL	24	D280	Blue	45.32				
FAM	8	CONTROL	24	D305	Blue	57.01				
FAM	8	CONTROL	24	D331	Blue	55.71				
FAM	8	CONTROL	24	D341	Blue	61.16				
FAM	8	CONTROL	24	D356	Blue	60.00				
FAM	8	CONTROL	24	D361	Blue	63.28				
FAM	8	CONTROL	24	D363	Blue	47.56				

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Study Number: AEH-13-PSEUDO-06

Mussel species: Fatmucket (*Lampsilis siliquoidea*)

Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/28/2012

Fatmucket Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
FAM	9	100	8	D191	Blue	49.85				
FAM	9	100	8	D219	Blue	50.12				
FAM	9	100	8	D224	Blue	52.13				
FAM	9	100	8	D230	Blue	62.53				
FAM	9	100	8	D239	Blue	53.70				
FAM	9	100	8	D246	Blue	50.88				
FAM	9	100	8	D252	Blue	62.19				
FAM	9	100	8	D258	Blue	59.00				
FAM	9	100	8	D359	Blue	57.29				
FAM	9	100	8	D368	Blue	55.64				
FAM	9	100	24	D187	Blue	58.57				
FAM	9	100	24	D202	Blue	55.09				
FAM	9	100	24	D248	Blue	62.64				
FAM	9	100	24	D260	Blue	63.00				
FAM	9	100	24	D275	Blue	56.24				
FAM	9	100	24	D285	Blue	63.51				
FAM	9	100	24	D312	Blue	50.79				
FAM	9	100	24	D317	Blue	59.70				
FAM	9	100	24	D324	Blue	58.24				
FAM	9	100	24	D352	Blue	50.57				
FAM				D279	Blue	54.99		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
FAM				D333	Blue	46.34		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
FAM				D346	Blue	66.68		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

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Study Number: AEH-13-PSEUDO-06
Mussel species: Three ridge (*Amblema plicata*)
Test Chemical: *Pseudomonas fluorescens* Pf -C- 145A (SDP) Chemical 'oc #: 401P12163C and 4C1P12164C Mix
Exposure Date: 5/28/2012

Three Ridge Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
THR	1	100	8	C002	Green	68.46				
THR	1	100	8	C020	Green	76.36				
THR	1	100	8	C022	Green	57.91				
THR	1	100	8	C033	Green	61.58				
THR	1	100	8	C062	Green	60.54				
THR	1	100	8	C073	Green	61.88				
THR	1	100	8	C096	Green	66.65				
THR	1	100	8	C108	Green	77.39				
THR	1	100	8	C126	Green	66.59				
THR	1	100	8	C170	Green	54.45				
THR	1	100	24	C014	Green	58.87				
THR	1	100	24	C024	Green	62.60				
THR	1	100	24	C037	Green	66.28				
THR	1	100	24	C046	Green	64.82				
THR	1	100	24	C047	Green	73.29				
THR	1	100	24	C058	Green	53.80				
THR	1	100	24	C059	Green	62.47				
THR	1	100	24	C098	Green	63.42				
THR	1	100	24	C102	Green	59.51				
THR	1	100	24	C158	Green	55.25				
THR	2	100	8	C005	Green	59.60				
THR	2	100	8	C023	Green	80.82				
THR	2	100	8	C025	Green	56.22				
THR	2	100	8	C031	Green	71.93				
THR	2	100	8	C032	Green	73.03				
THR	2	100	8	C056	Green	64.55				
THR	2	100	8	C079	Green	57.54				
THR	2	100	8	C103	Green	50.31				
THR	2	100	8	C113	Green	51.78				
THR	2	100	8	C163	Green	74.95				
THR	2	100	24	C003	Green	66.60				
THR	2	100	24	C007	Green	65.33				
THR	2	100	24	C042	Green	62.50				
THR	2	100	24	C105	Green	62.92				
THR	2	100	24	C114	Green	53.55				
THR	2	100	24	C125	Green	57.00				
THR	2	100	24	C131	Green	68.24				
THR	2	100	24	C134	Green	70.04				
THR	2	100	24	C141	Green	59.04				
THR	2	100	24	C180	Green	59.09				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Three ridge (*Amblema plicata*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12159C and 401P12164C Mix
Exposure Date: 5/28/2012

Three Ridge Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Initials	Date	Comments
THR	3	50	8	C008	Green	54.07				
THR	3	50	8	C020	Green	55.75				
THR	3	50	8	C045	Green	48.68				
THR	3	50	8	C087	Green	52.59				
THR	3	50	8	C101	Green	71.53				
THR	3	50	8	C104	Green	68.74				
THR	3	50	8	C118	Green	50.86				
THR	3	50	8	C138	Green	62.54				
THR	3	50	8	C155	Green	55.62				
THR	3	50	8	C159	Green	54.79				
THR	3	50	24	C004	Green	69.61				
THR	3	50	24	C009	Green	59.84				
THR	3	50	24	C088	Green	55.65				
THR	3	50	24	C041	Green	68.67				
THR	3	50	24	C060	Green	53.98				
THR	3	50	24	C127	Green	68.16				
THR	3	50	24	C143	Green	81.61				
THR	3	50	24	C149	Green	62.99				
THR	3	50	24	C154	Green	62.15				
THR	3	50	24	C174	Green	62.12				
THR	4	50	8	C067	Green	58.89				
THR	4	50	8	C074	Green	49.98				
THR	4	50	8	C082	Green	49.76				
THR	4	50	8	C086	Green	74.45				
THR	4	50	8	C110	Green	60.39				
THR	4	50	8	C128	Green	70.68				
THR	4	50	8	C133	Green	67.38				
THR	4	50	8	C140	Green	68.31				
THR	4	50	8	C156	Green	61.24				
THR	4	50	8	C175	Green	62.41				
THR	4	50	24	C016	Green	75.91				
THR	4	50	24	C053	Green	67.14				
THR	4	50	24	C063	Green	63.85				
THR	4	50	24	C091	Green	63.23				
THR	4	50	24	C112	Green	69.91				
THR	4	50	24	C121	Green	86.40				
THR	4	50	24	C135	Green	74.78				
THR	4	50	24	C148	Green	74.70				
THR	4	50	24	C169	Green	65.94				
THR	4	50	24	C184	Green	68.23				

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Study Number: AEH 13 PSEUDO-06
Mussel species: Three ridge (*Amblema plicata*)
Test Chemical: *Pseudomonas fluorescens Pf* -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Three Ridge Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Initials	Date	Comments
THR	5	CONTROL	8	C015	Green	67.68				
THR	5	CONTROL	8	C026	Green	60.89				
THR	5	CONTROL	8	C034	Green	70.07				
THR	5	CONTROL	8	C043	Green	49.80				
THR	5	CONTROL	8	C094	Green	73.09				
THR	5	CONTROL	8	C111	Green	52.83				
THR	5	CONTROL	8	C161	Green	62.53				
THR	5	CONTROL	8	C162	Green	55.02				
THR	5	CONTROL	8	C178	Green	74.82				
THR	5	CONTROL	8	C183	Green	58.85				
THR	5	CONTROL	24	C001	Green	68.99				
THR	5	CONTROL	24	C011	Green	67.66				
THR	5	CONTROL	24	C018	Green	58.98				
THR	5	CONTROL	24	C021	Green	52.73				
THR	5	CONTROL	24	C069	Green	69.25				
THR	5	CONTROL	24	C081	Green	56.43				
THR	5	CONTROL	24	C116	Green	66.59				
THR	5	CONTROL	24	C142	Green	65.74				
THR	5	CONTROL	24	C147	Green	73.59				
THR	5	CONTROL	24	C160	Green	44.92				
THR	6	50	8	C025	Green	68.51				
THR	6	50	8	C052	Green	65.38				
THR	6	50	8	C071	Green	53.17				
THR	6	50	8	C076	Green	61.62				
THR	6	50	8	C088	Green	58.74				
THR	6	50	8	C089	Green	50.85				
THR	6	50	8	C122	Green	60.88				
THR	6	50	8	C150	Green	63.47				
THR	6	50	8	C167	Green	76.40				
THR	6	50	8	C182	Green	70.66				
THR	6	50	24	C028	Green	63.66				
THR	6	50	24	C054	Green	66.41				
THR	6	50	24	C077	Green	63.56				
THR	6	50	24	C095	Green	58.54				
THR	6	50	24	C126	Green	53.10				
THR	6	50	24	C145	Green	62.87				
THR	6	50	24	C171	Green	59.40				
THR	6	50	24	C173	Green	55.90				
THR	6	50	24	C177	Green	63.80				
THR	6	50	24	C181	Green	53.06				

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Study Number: AEH-13-PSEUDC-06
Mussel species: Three ridge (*Amblema plicata*)
Test Chemical: *Pseudomonas fluorescens* Pf -CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Three Ridge Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Initials	Date	Comments
THR	7	CONTROL	8	C036	Green	54.33				
THR	7	CONTROL	8	C057	Green	66.77				
THR	7	CONTROL	8	C065	Green	55.31				
THR	7	CONTROL	8	C078	Green	72.92				
THR	7	CONTROL	8	C085	Green	64.40				
THR	7	CONTROL	8	C092	Green	82.67				
THR	7	CONTROL	8	C109	Green	75.08				
THR	7	CONTROL	8	C130	Green	88.56				
THR	7	CONTROL	8	C144	Green	55.73				
THR	7	CONTROL	8	C179	Green	78.60				
THR	7	CONTROL	24	C006	Green	64.31				
THR	7	CONTROL	24	C017	Green	54.95				
THR	7	CONTROL	24	C027	Green	67.00				
THR	7	CONTROL	24	C040	Green	59.72				
THR	7	CONTROL	24	C044	Green	54.61				
THR	7	CONTROL	24	C117	Green	56.86				
THR	7	CONTROL	24	C120	Green	74.97				
THR	7	CONTROL	24	C137	Green	62.15				
THR	7	CONTROL	24	C146	Green	64.40				
THR	7	CONTROL	24	C164	Green	61.22				
THR	8	CONTROL	8	C019	Green	60.87				
THR	8	CONTROL	8	C029	Green	63.56				
THR	8	CONTROL	8	C039	Green	46.93				
THR	8	CONTROL	8	C049	Green	66.94				
THR	8	CONTROL	8	C068	Green	63.28				
THR	8	CONTROL	8	C083	Green	50.04				
THR	8	CONTROL	8	C090	Green	66.37				
THR	8	CONTROL	8	C124	Green	61.80				
THR	8	CONTROL	8	C129	Green	59.96				
THR	8	CONTROL	8	C165	Green	44.08				
THR	8	CONTROL	24	C070	Green	52.17				
THR	8	CONTROL	24	C072	Green	55.54				
THR	8	CONTROL	24	C097	Green	61.86				
THR	8	CONTROL	24	C132	Green	56.32				
THR	8	CONTROL	24	C151	Green	57.90				
THR	8	CONTROL	24	C152	Green	66.20				
THR	8	CONTROL	24	C153	Green	68.12				
THR	8	CONTROL	24	C157	Green	60.74				
THR	8	CONTROL	24	C172	Green	70.38				
THR	8	CONTROL	24	C185	Green	66.09				

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Study Number: AEH-13-PSEUDO-06

Mussel species: Three ridge (*Amblema plicata*)

Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/28/2017

Three Ridge Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Initials	Date	Comments
THR	9	100	8	C013	Green	56.01				
THR	9	100	8	C048	Green	58.46				
THR	9	100	8	C050	Green	56.58				
THR	9	100	8	C051	Green	50.43				
THR	9	100	8	C080	Green	77.98				
THR	9	100	8	C099	Green	70.23				
THR	9	100	8	C106	Green	66.96				
THR	9	100	8	C130	Green	76.42				
THR	9	100	8	C168	Green	69.58				
THR	9	100	8	C176	Green	77.14				
THR	9	100	24	C030	Green	68.32				
THR	9	100	24	C055	Green	63.00				
THR	9	100	24	C066	Green	58.82				
THR	9	100	24	C075	Green	61.21				
THR	9	100	24	C084	Green	56.92				
THR	9	100	24	C098	Green	65.38				
THR	9	100	24	C100	Green	82.30				
THR	9	100	24	C107	Green	69.86				
THR	9	100	24	C115	Green	62.22				
THR	9	100	24	C119	Green	65.40				
THR				C012	Green	62.19		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
THR				C061	Green	62.05		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
THR				C064	Green	55.70		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
THR				C123	Green	62.91		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
THR				C166	Green	50.39		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

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Study Number: AEH-13-PSEUDO-05
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
Test Chemical: *Pseudomonas fluorescens* Pf-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2013

Wabash Pigtoe Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PIG	1	100	8	8165	Yellow	73.50				
PIG	1	100	8	8179	Yellow	47.31				
PIG	1	100	8	8188	Yellow	47.99				
PIG	1	100	8	8251	Yellow	46.76				
PIG	1	100	8	8260	Yellow	39.97				
PIG	1	100	8	8264	Yellow	53.75				
PIG	1	100	8	8272	Yellow	45.34				
PIG	1	100	8	8301	Yellow	64.24				
PIG	1	100	24	8204	Yellow	48.65				
PIG	1	100	24	8214	Yellow	63.08				
PIG	1	100	24	8242	Yellow	42.55				
PIG	1	100	24	8246	Yellow	64.19				
PIG	1	100	24	8256	Yellow	52.92				
PIG	1	100	24	8278	Yellow	44.19				
PIG	1	100	24	8295	Yellow	60.47				
PIG	1	100	24	8308	Yellow	42.65				
PIG	2	100	8	8187	Yellow	52.82				
PIG	2	100	8	8196	Yellow	48.53				
PIG	2	100	8	8206	Yellow	55.11				
PIG	2	100	8	8210	Yellow	42.87				
PIG	2	100	8	8233	Yellow	55.86				
PIG	2	100	8	8238	Yellow	50.41				
PIG	2	100	8	8248	Yellow	59.11				
PIG	2	100	8	8283	Yellow	62.48				
PIG	2	100	24	8181	Yellow	41.91				
PIG	2	100	24	8184	Yellow	47.80				
PIG	2	100	24	8185	Yellow	50.89				
PIG	2	100	24	8192	Yellow	44.95				
PIG	2	100	24	8237	Yellow	62.15				
PIG	2	100	24	8237	Yellow	40.96				
PIG	2	100	24	8250	Yellow	52.07				
PIG	2	100	24	8265	Yellow	58.41				

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Study Number: AEH-13-PSEUDO-06
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SOP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Wabash Pigtoe Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PIG	3	50	8	B162	Yellow	58.23				
PIG	3	50	8	B197	Yellow	51.00				
PIG	3	50	8	B208	Yellow	45.11				
PIG	3	50	8	B208	Yellow	40.49				
PIG	3	50	8	B222	Yellow	38.16				
PIG	3	50	8	B229	Yellow	49.87				
PIG	3	50	8	B270	Yellow	46.60				
PIG	3	50	8	B289	Yellow	61.40				
PIG	3	50	24	B163	Yellow	54.57				
PIG	3	50	24	B166	Yellow	53.11				
PIG	3	50	24	B186	Yellow	40.64				
PIG	3	50	24	B191	Yellow	56.75				
PIG	3	50	24	B218	Yellow	40.57				
PIG	3	50	24	B228	Yellow	63.07				
PIG	3	50	24	B261	Yellow	50.83				
PIG	3	50	24	B280	Yellow	55.00				
PIG	4	50	8	B158	Yellow	51.47				
PIG	4	50	8	[redacted]	[redacted]	[redacted]		B170 is recorded twice in distributions data (Tank 4, 8hour & Tank 8, 8hour).		
PIG	4	50	8	B231	Yellow	38.05				
PIG	4	50	8	B236	Yellow	44.87				
PIG	4	50	8	B252	Yellow	41.40				
PIG	4	50	8	B271	Yellow	48.83				
PIG	4	50	8	B294	Yellow	36.07				
PIG	4	50	8	B299	Yellow	43.10				
PIG	4	50	24	B167	Yellow	55.78				
PIG	4	50	24	B178	Yellow	48.80				
PIG	4	50	24	B183	Yellow	57.18				
PIG	4	50	24	B215	Yellow	42.47				
PIG	4	50	24	B257	Yellow	50.95				
PIG	4	50	24	[redacted]	[redacted]	[redacted]		B274 is recorded twice in distributions data (Tank 4, 24hour & Tank 7, 8hour).		
PIG	4	50	24	B276	Yellow	53.61				
PIG	4	50	24	B278	Yellow	33.82				

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Study Number: AEH-12 PSEUDO 06
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
Test Chemical: *Pseudomonas fluorescens* PF-CL 145A (SOP) Chemical lot # 401P12169C and 401P12164C Mix
Exposure Date: 5/28/2012

Wabash Pigtoe Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PIG	5	CONTROL	8	B184	Yellow	43.64				
PIG	5	CONTROL	8	B175	Yellow	52.73				
PIG	5	CONTROL	8	B239	Yellow	51.21				
PIG	5	CONTROL	8	B244	Yellow	38.47				
PIG	5	CONTROL	8	B254	Yellow	55.96				
PIG	5	CONTROL	8	B258	Yellow	47.33				
PIG	5	CONTROL	8	B285	Yellow	51.09				
PIG	5	CONTROL	8	B297	Yellow	51.93				
PIG	5	CONTROL	24	B177	Yellow	44.16				
PIG	5	CONTROL	24	B182	Yellow	46.25				
PIG	5	CONTROL	24	B200	Yellow	59.24				
PIG	5	CONTROL	24	B225	Yellow	53.97				
PIG	5	CONTROL	24	B249	Yellow	55.21				
PIG	5	CONTROL	24	B266	Yellow	52.84				
PIG	5	CONTROL	24	B281	Yellow	52.23				
PIG	5	CONTROL	24	B284	Yellow	53.27				
PIG	6	50	8	B198	Yellow	55.31				
PIG	6	50	8	B213	Yellow	45.93				
PIG	6	50	8	B235	Yellow	49.32				
PIG	6	50	8	B241	Yellow	53.96				
PIG	6	50	8	B243	Yellow	49.57				
PIG	6	50	8	B262	Yellow	54.41				
PIG	6	50	8	B287	Yellow	41.13				
PIG	6	50	8	B290	Yellow	57.66				
PIG	6	50	24	B173	Yellow	47.80				
PIG	6	50	24	B195	Yellow	66.71				
PIG	6	50	24	B212	Yellow	64.22				
PIG	6	50	24	B230	Yellow	57.79				
PIG	6	50	24	B286	Yellow	51.06				
PIG	6	50	24	B292	Yellow	49.88				
PIG	6	50	24	B298	Yellow			Did not find this tag in length data		
PIG	6	50	24	B302	Yellow	48.36				

Item Number ____
Page ___ of ____

File Folder: 16

Study Number: AEH-12-PSEUDO-06
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
Test Chemical: *Pseudomonas fluorescens Pf*-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/28/2012

Wabash Pigtoe Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PIG	7	CONTROL	8	B189	Yellow	50.71				
PIG	7	CONTROL	8	B205	Yellow	55.84				
PIG	7	CONTROL	8	B211	Yellow	57.60				
PIG	7	CONTROL	8	B217	Yellow	49.05				
PIG	7	CONTROL	8	B227	Yellow	37.05				
PIG	7	CONTROL	8	B269	Yellow	73.64				
PIG	7	CONTROL	8	[redacted]	[redacted]	[redacted]		B274 is recorded twice at distribution due Tank 6, 24hour & Tank 7, 8hour.		
PIG	7	CONTROL	8	B282	Yellow	40.90				
PIG	7	CONTROL	24	B161	Yellow	50.74				
PIG	7	CONTROL	24	B190	Yellow	45.42				
PIG	7	CONTROL	24	B194	Yellow	55.91				
PIG	7	CONTROL	24	B224	Yellow	69.95				
PIG	7	CONTROL	24	B232	Yellow	49.06				
PIG	7	CONTROL	24	B255	Yellow	45.76				
PIG	7	CONTROL	24	B268	Yellow	39.90				
PIG	7	CONTROL	24	B291	Yellow	48.83				
PIG	8	CONTROL	8	B219	Yellow	48.23				
PIG	8	CONTROL	8	B240	Yellow	58.62				
PIG	8	CONTROL	8	B245	Yellow	43.16				
PIG	8	CONTROL	8	B258	Yellow	55.20				
PIG	8	CONTROL	8	B275	Yellow	58.60				
PIG	8	CONTROL	8	B279	Yellow	52.78				
PIG	8	CONTROL	8	B287	Yellow	38.55				
PIG	8	CONTROL	8	B296	Yellow	48.87				
PIG	8	CONTROL	24	B169	Yellow	43.68				
PIG	8	CONTROL	24	B202	Yellow	53.09				
PIG	8	CONTROL	24	B221	Yellow	57.92				
PIG	8	CONTROL	24	B223	Yellow	64.72				
PIG	8	CONTROL	24	B263	Yellow	56.53				
PIG	8	CONTROL	24	B277	Yellow	47.95				
PIG	8	CONTROL	24	B288	Yellow	49.68				
PIG	8	CONTROL	24	B293	Yellow	45.26				

Item Number
Page ___ of ___

File Folder: 16

Study Number: AEH-13-PSEUDO-06

Mussel species: Wabash Pigtoe (*Fusconaia flava*)

Test Chemical: *Pseudomonas fluorescens* Pf-CL 145A (SDP) Chemical lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/28/2012

Wabash Pigtoe Length Summary

Species	Tank ID	Treatment Concentration (mg/L)	Exposure Duration (hours)	Tag ID	Tag Color	Length (mm)	Status (Alive/Dead/ Unrecovered)	Comments	Initials	Date
PIG	9	100	8	[redacted]	[redacted]			B130 is recorded twice in distribution data (Tank 4, 8hour & Tank 9, 8hour.		
PIG	9	100	8	B103	Yellow	67.05				
PIG	9	100	8	B196	Yellow	46.08				
PIG	9	100	8	B201	Yellow	68.26				
PIG	9	100	8	B226	Yellow	52.51				
PIG	9	100	8	B247	Yellow	50.83				
PIG	9	100	8	B258	Yellow	47.38				
PIG	9	100	8	B304	Yellow	50.55				
PIG	9	100	24	B160	Yellow	61.51				
PIG	9	100	24	B172	Yellow	57.92				
PIG	9	100	24	B176	Yellow	49.64				
PIG	9	100	24	B130	Yellow	40.82				
PIG	9	100	24	B216	Yellow	59.58				
PIG	9	100	24	B220	Yellow	51.56				
PIG	9	100	24	B234	Yellow	51.45				
PIG	9	100	24	B300	Yellow	43.11				
PIG				B171	Yellow	75.65		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PIG				B174	Yellow	43.44		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		
PIG				B209	Yellow	51.28		This mussel was not on the distribution list, but was measured. Perhaps one of the extras		

Item Number ____
Page ____ of ____

Item Number: 12

Page 5 of 5

File Folder: 16

Study Number: AEH-13-PSEUDO-06 Reviewed by: _____ Date: _____

File Folder: _____ Lab book/pgs: _____ Verified by: _____ Date: _____

Native Mussel Lengths

Exposure Date: _____ Test Location: _____

Test Chemical: Pf-CL145A SDP Lot #: 401P12163C and 401P12164C Mix

Mussel Species	Mussel Number	Tag Number	Tag Color	Glue Dot (Y/N)	Shell Length (mm)	Comments	Date/Initials

Item Number: 13

File Folder: 16 Page 1 of 1

Study Number: AEH-13-PSEUDO-06 Reviewed by: _____ Date: _____

File Folder: _____ Lab book/pgs: _____ Verified by: _____ Date: _____

Native Mussel Lengths

Exposure Date: _____ Test Location: _____

Test Chemical: Pf-CL145A SDP Lot #: 401P12163C and 401P12164C Mix

Mussel Species	Mussel Number	Tag Number	Tag Color	Shell Length (mm)	Tank ID	Sampling Time	Date/Initials

Item Number: 14

File Folder: 16 Page 1 of 1

Appendix 2. Deviations From the Study Protocol

Item Number	Item Description	Number of Pages	Report Page Number
1	Deviation #1 – Native mussels recovered from tanks/equipment after the termination of the assigned treatment period	1	101
2	Deviation #2 – Native mussels not recovered after 30 day holding period	1	102
3	Deviation #3 – Native mussel used in exposure >3 years of age	1	103

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Biological Resources Division
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603

MEMORANDUM

Date: January 29, 2014

To: The Record of Study Number AEH-13-PSEUDO-06

Subject: Deviation 1 to study AEH-13-PSEUDO-06 "Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments"

Deviation #1 – Native mussels recovered from tanks/equipment after the termination of the assigned treatment period

After exposure termination, the tanks were emptied for cleaning and two mussels were found buried in the sediment of their respective tanks. Mussel A296 (*L. cardium;* 100 mg/L 24-h treatment group) from Tank 2 and mussel B089 (*L. higginsii;* 0 mg/L 24-h treatment group) from Tank 8 were recovered alive and placed into the appropriate replicate wire mesh holding cage for the post-exposure period. Both mussels were alive upon assessment at the conclusion of the 30 day post-exposure holding period.

Upon study breakdown mussel B150 (*L. higginsii;* 50mg/L 8-h treatment group) from Tank 4 was discovered in a corner of retention basket used to contain the mussels during the treatment. The retention basket had been removed from study tank 4 for ~16 h before the mussel was discovered alive and placed into a wire mesh holding cage for the post-exposure period. During the survival assessment (June 26-27, 2013) mussel B150 was originally thought to have been unrecovered, however, mussel B150 was recovered alive in the wire mesh holding cage housing the test animals from 50 mg/L 24-h treatment group during the post-exposure holding period.

There are no adverse impacts as a result of this deviation as all animals were recovered alive at the termination of the post-exposure holding period and there are sufficient numbers of other test animals from the affected treatment groups to perform statistical analyses.

[redacted] 1/29/2014
Written by Date
Jeremy K. Wise, B.S.
Bio. Science Tech. II, UMESC

[redacted] 1/29/14
Approved by Date
James A. Luoma, B.A.
Study Director, UMESC

cc: UMESC QAU

File Folder: 3

Item Number: 3

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Biological Resources Division
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603

MEMORANDUM

Date: January 29, 2014

To: The Record of Study Number AEH-13-PSEUDO-06

Subject: Deviation 2 to study AEH-13-PSEUDO-06 "Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments"

Deviation #2 – Native mussels not recovered after 30 day holding period

During the native mussel survival assessment conducted after 30 day holding period, five mussels from 3 treatment groups and 4 replicates were not recovered from the wire mesh holding cages. The unrecovered mussels species, corresponding tag numbers, treatment group and treatment replicate (i.e. tank) are identified in table 1.

Table 1. Mussels not recovered during survival assessment.

Species	Tag number	Treatment group	Treatment Tank
L. cardium	A193	100 mg/L 24h	2
L. cardium	A191	50 mg/L 24	3
L. higginsii	B051	0 mg/L 24h	5
L. higginsii	B117	50 mg/L 24h	6
O. olivaria	D010	100 mg/L 24h	2

These mussels are identified as unrecovered in the study records and if they are used in the statistical analysis they will be treated conservatively as mortalities.

No adverse impacts are anticipated as a result of this deviation. Any impacts to the study as a result of this deviation will be addressed in the final report.

[redacted] 1-29-14
Written by Date
Jeremy K. Wise, B.S.
Bio. Science Tech. II, UMESC

[redacted] 1/29/14
Approved by Date
James A. Luoma, B.A.
Study Director, UMESC

cc: UMESC QAU

File Folder: 3

Item Number: 4

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Biological Resources Division
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Road
La Crosse, Wisconsin 54603

MEMORANDUM

Date: March 7, 2014

To: The Record of Study Number AEH-13-PSEUDO-06

Subject: Deviation 3 to study AEH-13-PSEUDO-06 "Safety of Spray Dried Powder (SDP) Formulated *Pseudomonas fluorescens* strain CL145A (Zequanox) Exposure to Sub-Adult Unionid Mussels During Simulated Open Water Treatments"

Deviation #3 – Native mussel >3 years of age

Wabash pigtoe (*Fusconaia flava*) and threeridge (*Amblema plicata*) mussels used in study were wild collected on May 10, 2013 from the Upper Mississippi River (RM 670.5), at Black Hawk Park, Vernon County, Wisconsin by Genoa National Fish Hatchery Biologist. Although not confirmed, the age of these mussels appeared to be greater than three years old and many appeared to be sexually mature individuals. These mussels would be more appropriately classified as adult specimens and not sub-adult specimens.

No adverse impacts are anticipated as a result of this deviation. Any impacts to the study as a result of this deviation will be addressed in the final report.

[redacted] 07MAR14
Written by Date
Jeremy K. Wise, B.S.
Bio. Science Tech. II, UMESC

[redacted] 3/7/2014
Approved by Date
James A. Luoma, B.A.
Study Director, UMESC

cc: UMESC QAU

Item Number: 5

~~**Item Number:**~~ _____ **File Folder:** 3
Illegible. JKW 07MAR14

Appendix 3. Randomization Assignments

Item Number	Item Description	Number of Pages	Report Page Number
1	SAS generated random assignment of treatment to experimental tanks.	5	105
2	SAS generated random assignment of mussels to test tanks/time sections.	6	110
3	Hickorynut assignment to treatment tanks	1	116
4	Washboard assignment to treatment tanks	1	117
5	Higgins eye assignment to treatment tanks	1	118
6	Fatmucket assignment to treatment tanks	1	129
7	Threeridge assignment to treatment tanks	1	120
8	Wabash Pigtoe assignment to treatment tanks	1	121
9	Plain Pocketbook assignment to treatment tanks	1	122

Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult unionid mussel species
AEH-13-PSUEDO-06
Random assignment of treatment to experimental tanks
Black River, LaCrosse, WI

Obs	block	tank	x	tankn	trt
1	1	8	0.06424	Tank 8	control
2	1	5	0.19799	Tank 5	control
3	1	7	0.22193	Tank 7	control
4	1	6	0.30198	Tank 6	50
5	1	3	0.41943	Tank 3	50
6	1	4	0.72009	Tank 4	50
7	1	2	0.78188	Tank 2	100
8	1	9	0.87611	Tank 9	100
9	1	1	0.96355	Tank 1	100

Analysis performed by J. Luoma SAS version 9.3 07:36 28MAY13 JL

AEH-13-PSEUDO-06

File Folder: 14

Item Number: 1 Page 1 of 5

```
/*********************************************************************
*  Study Number  : AEH-13-PSUEDO-06
*  Study Director: Jim Luoma
*  date created  : May 28, 2013 - JAL JM
*  Verified by:  _______ (Date:_______)                    page ____ of ____
*  Random allocation of treatment to tank.sas
*********************************************************************/
DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;

FOOTNOTE1 'Analysis performed by J. Luoma SAS version ' &SYSVER &SYSTIME &SYSDATE;

options /*ls=85 ps=40 formdlim='-' */ pageno = 1 nocenter nodate nosource2;

/*Random assignment of treatment to experimental tanks*/
/*AEH-PSEUDO-06; Subadult/adult mussels; Black River, LaCrosse, WI*/
data MUS;
do block = 1 to 1 by 1;
do tank = 1 to 9 by 1;
     x = ranuni(-1);
   output;
  end;
 end;
run;
data MUS2; set MUS;
 if block = 1 and tank = 1 then tankn = 'Tank 1';
  if block = 1 and tank = 2 then tankn = 'Tank 2';
   if block = 1 and tank = 3 then tankn = 'Tank 3';
    if block = 1 and tank = 4 then tankn = 'Tank 4';
     if block = 1 and tank = 5 then tankn = 'Tank 5';
      if block = 1 and tank = 6 then tankn = 'Tank 6';
       if block = 1 and tank = 7 then tankn = 'Tank 7';
        if block = 1 and tank = 8 then tankn = 'Tank 8';
         if block = 1 and tank = 9 then tankn = 'Tank 9';

if block = 2 and tank = 1 then tankn = 'Tank 1';
  if block = 2 and tank = 2 then tankn = 'Tank 2';
   if block = 2 and tank = 3 then tankn = 'Tank 3';
    if block = 2 and tank = 4 then tankn = 'Tank 4';
     if block = 2 and tank = 5 then tankn = 'Tank 5 ';
      if block = 2 and tank = 6 then tankn = 'Tank 6';
       if block = 2 and tank = 7 then tankn = 'Tank 7';
        if block = 2 and tank = 8 then tankn = 'Tank 8';
         if block = 2 and tank = 9 then tankn = 'Tank 9';

if block = 3 and tank = 1 then tankn = 'Tank 1';
  if block = 3 and tank = 2 then tankn = 'Tank 2';
   if block = 3 and tank = 3 then tankn = 'Tank 3';
    if block = 3 and tank = 4 then tankn = 'Tank 4';
     if block = 3 and tank = 5 then tankn = 'Tank 5 ';
      if block = 3 and tank = 6 then tankn = 'Tank 6';
       if block = 3 and tank = 7 then tankn = 'Tank 7';
        if block = 3 and tank = 8 then tankn = 'Tank 8';
         if block = 3 and tank = 9 then tankn = 'Tank 9';

    run;
proc sort data=MUS2;
```

```
 by x;
run;

data assign_trt_MUS; set MUS2;
 if _n_ = 1 then trt = 'control';
  if _n_ = 2 then trt = 'control';
   if _n_ = 3 then trt = 'control';
    if _n_ = 4 then trt = '50';
 if _n_ = 5 then trt = '50';
  if _n_ = 6 then trt = '50';
   if _n_ = 7 then trt = '100';
    if _n_ = 8 then trt = '100';
     if _n_ = 9 then trt = '100';
    run;
proc print data= assign_trt_MUS;
title1 h=2 'Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult unionid mussel species';
title2 h=1.5 'AEH-13-PSUEDO-06';
title3 h=1 'Random assignment of treatment to experimental tanks';
title4 h=1 'Black River, LaCrosse, WI';
run;
```

```
4     *  date created  : May 28, 2013 - JAL
5     *  Verified by:  _______ (Date:_______)                    page ____ of ____
6     *  Random allocation of treatment to tank.sas
7     ************************************************************************/
8     DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;
9
10    FOOTNOTE1 'Analysis performed by J. Luoma SAS version ' &SYSVER &SYSTIME &SYSDATE;
WARNING: The FOOTNOTE statement is ambiguous due to invalid options or unquoted text.
11
12    options /*ls=85 ps=40 formdlim='-' */ pageno = 1 nocenter nodate nosource2;
13
14    /*Random assignment of treatment to experimental tanks*/
15    /*AEH-PSEUDO-06; Subadult/adult mussels; Black River, LaCrosse, WI*/
16    data MUS;
17    do block = 1 to 1 by 1;
18    do tank = 1 to 9 by 1;
19         x = ranuni(-1);
20       output;
21      end;
22     end;
23    run;

NOTE: The data set WORK.MUS has 9 observations and 3 variables.
NOTE: DATA statement used (Total process time):
      real time           0.10 seconds
      cpu time            0.01 seconds


24    data MUS2; set MUS;
25     if block = 1 and tank = 1 then tankn = 'Tank 1';
26      if block = 1 and tank = 2 then tankn = 'Tank 2';
27       if block = 1 and tank = 3 then tankn = 'Tank 3';
28        if block = 1 and tank = 4 then tankn = 'Tank 4';
29         if block = 1 and tank = 5 then tankn = 'Tank 5';
30          if block = 1 and tank = 6 then tankn = 'Tank 6';
31           if block = 1 and tank = 7 then tankn = 'Tank 7';
32            if block = 1 and tank = 8 then tankn = 'Tank 8';
33             if block = 1 and tank = 9 then tankn = 'Tank 9';
34
35    if block = 2 and tank = 1 then tankn = 'Tank 1';
36      if block = 2 and tank = 2 then tankn = 'Tank 2';
37       if block = 2 and tank = 3 then tankn = 'Tank 3';
38        if block = 2 and tank = 4 then tankn = 'Tank 4';
39         if block = 2 and tank = 5 then tankn = 'Tank 5';
40          if block = 2 and tank = 6 then tankn = 'Tank 6';
41           if block = 2 and tank = 7 then tankn = 'Tank 7';
42            if block = 2 and tank = 8 then tankn = 'Tank 8';
43             if block = 2 and tank = 9 then tankn = 'Tank 9 ';
44
45    if block = 3 and tank = 1 then tankn = 'Tank 1';
46      if block = 3 and tank = 2 then tankn = 'Tank 2';
47       if block = 3 and tank = 3 then tankn = 'Tank 3';
48        if block = 3 and tank = 4 then tankn = 'Tank 4';
49         if block = 3 and tank = 5 then tankn = 'Tank 5';
50          if block = 3 and tank = 6 then tankn = 'Tank 6';
51           if block = 3 and tank = 7 then tankn = 'Tank 7';
```

```
52          if block = 3 and tank = 8 then tankn = 'Tank 8';
53           if block = 3 and tank = 9 then tankn = 'Tank 9';
54
55       run;

NOTE: There were 9 observations read from the data set WORK.MUS.
NOTE: The data set WORK.MUS2 has 9 observations and 4 variables.
NOTE: DATA statement used (Total process time):
      real time           0.03 seconds
      cpu time            0.03 seconds


56   proc sort data=MUS2;
57    by x;
58   run;

NOTE: There were 9 observations read from the data set WORK.MUS2.
NOTE: The data set WORK.MUS2 has 9 observations and 4 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.03 seconds
      cpu time            0.00 seconds


59
60   data assign_trt_MUS; set MUS2;
61    if _n_ = 1 then trt = 'control';
62     if _n_ = 2 then trt = 'control';
63      if _n_ = 3 then trt = 'control';
64       if _n_ = 4 then trt = '50';
65    if _n_ = 5 then trt = '50';
66     if _n_ = 6 then trt = '50';
67      if _n_ = 7 then trt = '100';
68       if _n_ = 8 then trt = '100';
69        if _n_ = 9 then trt = '100';
70       run;

NOTE: There were 9 observations read from the data set WORK.MUS2.
NOTE: The data set WORK.ASSIGN_TRT_MUS has 9 observations and 5 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


71   proc print data= assign_trt_MUS;
NOTE: Writing HTML Body file: sashtml.htm
72   title1 h=2 'Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult unionid mussel
72 ! species';
73   title2 h=1.5 'AEH-13-PSUEDO-06';
74   title3 h=1 'Random assignment of treatment to experimental tanks';
75   title4 h=1 'Black River, LaCrosse, WI';
76   run;

NOTE: There were 9 observations read from the data set WORK.ASSIGN_TRT_MUS.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.67 seconds
      cpu time            0.29 seconds
```

AEH-13-PSEUDO-06

FF # 14
Item No. 1
Pg 5 of 5

Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult mussels
AEH-13-PSUEDO-06
Random assignment of mussels to test tanks/time sections
Combined species/time exposures-Black River, LaCrosse, WI JN

Obs	round	time	tank	x	_time_	tankn	
1	1	2	9	0.05215	24	Tank 9-24h	✓ X o Δ □ ⊕ •
2	1	2	4	0.06122	24	Tank 4-24h	✓ X o Δ □ ⊕ •
3	1	1	9	0.07230	8h	Tank 9-8h	✓ X o Δ □ ⊕ •
4	1	1	7	0.19025	8h	Tank 7-8h	✓ X o Δ □ ⊕ •
5	1	1	2	0.22608	8h	Tank 2-8h	✓ X o Δ □ ⊕ •
6	1	2	5	0.30340	24	Tank 5-24h	✓ X o Δ □ ⊕ •
7	1	2	8	0.37828	24	Tank 8-24h	✓ X o Δ □ ⊕ •
8	1	2	2	0.38032	24	Tank 2-24h	✓ X o Δ □ ⊕ •
9	1	1	1	0.43904	8h	Tank 1-8h	✓ X o Δ □ ⊕ •
10	1	1	3	0.45261	8h	Tank 3-8h	✓ X o Δ □ ⊕ •
11	1	1	6	0.57931	8h	Tank 6-8h	✓ X o Δ □ ⊕ •
12	1	2	7	0.69493	24	Tank 7-24h	✓ X o Δ □ ⊕ •
13	1	2	6	0.71406	24	Tank 6-24h	✓ X o Δ □ ⊕ •
14	1	2	3	0.73105	24	Tank 3-24h	✓ X o Δ □ ⊕ •
15	1	1	5	0.74554	8h	Tank 5-8h	✓ X o Δ □ ⊕ •
16	1	2	1	0.78346	24	Tank 1-24h	✓ X o Δ □ ⊕ •
17	1	1	8	0.80125	8h	Tank 8-8h	✓ X o Δ □ ⊕ •
18	1	1	4	0.84428	8h	Tank 4-8h	✓ X o Δ □ ⊕ •
19	2	2	5	0.14035	24	Tank 5-24h	✓ X o Δ □ ⊕ •
20	2	2	6	0.18111	24	Tank 6-24h	✓ X o Δ □ ⊕ •
21	2	2	9	0.19451	24	Tank 9-24h	✓ X o Δ □ ⊕ •
22	2	1	8	0.26810	8h	Tank 8-8h	✓ X o Δ □ ⊕ •
23	2	1	7	0.26833	8h	Tank 7-8h	✓ X o Δ □ ⊕ •
24	2	2	1	0.35685	24	Tank 1-24h	✓ X o Δ □ ⊕ •
25	2	1	6	0.36778	8h	Tank 6-8h	✓ X o Δ □ ⊕ •
26	2	1	3	0.40863	8h	Tank 3-8h	✓ X o Δ □ ⊕ •
27	2	1	9	0.41480	8h	Tank 9-8h	✓ X o Δ □ ⊕ •
28	2	2	7	0.41865	24	Tank 7-24h	✓ X o Δ □ ⊕ •
29	2	2	3	0.54706	24	Tank 3-24h	✓ X o Δ □ ⊕ •
30	2	2	8	0.55941	24	Tank 8-24h	✓ X o Δ □ ⊕ •
31	2	1	2	0.61097	8h	Tank 2-8h	✓ X o Δ □ ⊕ •

A mark was placed next to the tank as mussels were distributed.
✓ = Three ridge mussels
X = Fatmucket mussels
o = Wabash Pigtoe mussels
Δ = Hickorynut mussels
□ = Washboard mussels
⊕ = Plain Pocketbook mussels
• = Higgins Eye Mussels
KW
13 FEB 2014

(1) Write over. Should be 6 23APR2014

AEH-13-PSEUDO-06

Item Number: 2

File Folder: [illegible]

Page 1 of 45 (6)
incorrect # of pages. KW 23APR2014

32	2	1	1	0.62183	8h	Tank 1-8h
33	2	2	4	0.69710	24	Tank 4-24h
34	2	1	5	0.73459	8h	Tank 5-8h
35	2	2	2	0.76445	24	Tank 2-24h
36	2	1	4	0.90646	8h	Tank 4-8h

AEH-13-PSEUDO-06

Analysis performed by J. Luoma SAS version 9.3 08:17 28MAY13

Item Number: 2

File Folder: 14 ~~Table 1 of 1~~

Page 2 **of** 46

```
/*******************************************************************
*  Study Number  : AEH-13-PSUEDO-06
*  Study Director: Jim Luoma
*  date created  : MAY 27, 2013 - JAL
*  date revised  : MAY 27, 2013 - JAL
*  Verified by:  _______ (Date:_______)                   page ____ of ____
*  Random allocation of glochidia to tank.sas
*******************************************************************/
DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;

FOOTNOTE1 'Analysis performed by J. Luoma SAS version ' &SYSVER &SYSTIME &SYSDATE;

options /*ls=85 ps=40 formdlim='-' */ pageno = 1 nocenter nodate nosource2;

/*Random distribution of mussels to experimental tanks*/
/* tanks 1 to 9 = time 1 = 8h; time 2 = 24h
   round = distribution rounds 1 to 4, place one group of up to 5 mussels of each species per tank/tim

/*****************************************************************************************************

/*Subadult/adult mussel tests*/
data mussel;
 do round = 1 to 2 by 1;
  do time = 1 to 2 by 1;
   do tank = 1 to 9 by 1;
   x = ranuni(-1);
   output;
  end;
  end;
 end;
run;
data musseldist; set mussel;
if time = 1 then _time_ = '8h';
if time = 2 then _time_ = '24h';

 if time = 1 and tank = 1 then tankn = 'Tank 1-8h ';
  if time = 1 and tank = 2 then tankn = 'Tank 2-8h ';
   if time = 1 and tank = 3 then tankn = 'Tank 3-8h ';
    if time = 1 and tank = 4 then tankn = 'Tank 4-8h ';
     if time = 1 and tank = 5 then tankn = 'Tank 5-8h ';
      if time = 1 and tank = 6 then tankn = 'Tank 6-8h ';
       if time = 1 and tank = 7 then tankn = 'Tank 7-8h ';
        if time = 1 and tank = 8 then tankn = 'Tank 8-8h ';
         if time = 1 and tank = 9 then tankn = 'Tank 9-8h ';

if time = 2 and tank = 1 then tankn = 'Tank 1-24h';
  if time = 2 and tank = 2 then tankn = 'Tank 2-24h';
   if time = 2 and tank = 3 then tankn = 'Tank 3-24h';
    if time = 2 and tank = 4 then tankn = 'Tank 4-24h';
     if time = 2 and tank = 5 then tankn = 'Tank 5-24h';
      if time = 2 and tank = 6 then tankn = 'Tank 6-24h';
       if time = 2 and tank = 7 then tankn = 'Tank 7-24h';
        if time = 2 and tank = 8 then tankn = 'Tank 8-24h';
         if time = 2 and tank = 9 then tankn = 'Tank 9-24h';
 run;
proc sort data= musseldist;
```

AEH-13-PSEUDO-06

Page 23 of 26

(1) wrong page numbers 23APR2014

```
 by round x;
 run;
proc print data = musseldist;
title1 h=2 'Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult mussels';
title2 h=1.5 'AEH-13-PSUEDO-06';
title3 h=1 'Random assignment of mussels to test tanks/time sections';
title4 h=1 'Combined species/time exposures-Black River, LaCrosse, WI';
run;
```

```
5     *  date revised  : MAY 27, 2013 - JAL
6     *  Verified by:  _______ (Date:_______)                    page ____ of ____
7     *  Random allocation of glochidia to tank.sas
8     ****************************************************************/
9     DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;
10
11    FOOTNOTE1 'Analysis performed by J. Luoma SAS version ' &SYSVER &SYSTIME &SYSDATE;
WARNING: The FOOTNOTE statement is ambiguous due to invalid options or unquoted text.
12
13    options /*ls=85 ps=40 formdlim='-' */ pageno = 1 nocenter nodate nosource2;
14
15    /*Random distribution of mussels to experimental tanks*/
16    /* tanks 1 to 9 = time 1 = 8h; time 2 = 24h
17       round = distribution rounds 1 to 4, place one group of up to 5 mussels of each species per
17 !   tank/time section */
18
19    /*************************************************************************************************
19 !  *********/
20
21    /*Subadult/adult mussel tests*/
22    data mussel;
23     do round = 1 to 2 by 1;
24      do time = 1 to 2 by 1;
25       do tank = 1 to 9 by 1;
26       x = ranuni(-1);
27       output;
28      end;
29      end;
30     end;
31    run;

NOTE: The data set WORK.MUSSEL has 36 observations and 4 variables.
NOTE: DATA statement used (Total process time):
      real time          0.01 seconds
      cpu time           0.01 seconds


32    data musseldist; set mussel;
33    if time = 1 then _time_ = '8h';
34    if time = 2 then _time_ = '24h';
35
36     if time = 1 and tank = 1 then tankn = 'Tank 1-8h ';
37      if time = 1 and tank = 2 then tankn = 'Tank 2-8h ';
38       if time = 1 and tank = 3 then tankn = 'Tank 3-8h ';
39        if time = 1 and tank = 4 then tankn = 'Tank 4-8h ';
40         if time = 1 and tank = 5 then tankn = 'Tank 5-8h ';
41          if time = 1 and tank = 6 then tankn = 'Tank 6-8h ';
42           if time = 1 and tank = 7 then tankn = 'Tank 7-8h ';
43            if time = 1 and tank = 8 then tankn = 'Tank 8-8h ';
44             if time = 1 and tank = 9 then tankn = 'Tank 9-8h ';
45
46    if time = 2 and tank = 1 then tankn = 'Tank 1-24h';
47      if time = 2 and tank = 2 then tankn = 'Tank 2-24h';
48       if time = 2 and tank = 3 then tankn = 'Tank 3-24h';
49        if time = 2 and tank = 4 then tankn = 'Tank 4-24h ';
50         if time = 2 and tank = 5 then tankn = 'Tank 5-24h';
```

AEH-13-PSEUDO-06

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0 wrong page numbers
KW 23APR 2014

```
51          if time = 2 and tank = 6 then tankn = 'Tank 6-24h';
52           if time = 2 and tank = 7 then tankn = 'Tank 7-24h';
53            if time = 2 and tank = 8 then tankn = 'Tank 8-24h';
54             if time = 2 and tank = 9 then tankn = 'Tank 9-24h';
55     run;

NOTE: There were 36 observations read from the data set WORK.MUSSEL.
NOTE: The data set WORK.MUSSELDIST has 36 observations and 6 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


56   proc sort data= musseldist;
57    by round x;
58    run;

NOTE: There were 36 observations read from the data set WORK.MUSSELDIST.
NOTE: The data set WORK.MUSSELDIST has 36 observations and 6 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


59   proc print data = musseldist;
NOTE: Writing HTML Body file: sashtml.htm
60   title1 h=2 'Effects of Psuedomonas fluorescens (Pf-CL145A) to subadult/adult mussels';
61   title2 h=1.5 'AEH-13-PSUEDO-06';
62   title3 h=1 'Random assignment of mussels to test tanks/time sections';
63   title4 h=1 'Combined species/time exposures-Black River, LaCrosse, WI';
64   run;

NOTE: There were 36 observations read from the data set WORK.MUSSELDIST.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.35 seconds
      cpu time            0.24 seconds
```


FF # 14
Item No. 2
Pg 056 of 58
① wrong page numbers
kw 23APR04

⑤ Wrong study # printed on datasheet originally. JKW 29 JAN 14

~~AEH-13-PSEUDO-03~~ ⑤ AEH-13-PSEUDO-06

Species: Hickory nut

Tag Color: Blue

Mark on Randomization: A

Lab book/pgs: e-log p 6

Reviewed By
Initials: KW Date: 27 JAN 2014
Verified By
Initials: JK Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	D043, D172, D007, D028, D159 D031, D057, D004, D048, D044	D116, D114, D163, D119, D100 D103, D080, ~~D097~~ ③, D059, D014	28 MAY 13 KW
2	D135, D155, D168, D035, D082 D022, D102, D034, D029, D013	D015, D166, D170, D010, D130 D019, D118, D174, D063, D071	
3	D160, D107, D005, D182, D128 D045, D153, D177, D186, D073	D101, D175, D037, D095, D077 D099, D021, D036, D176, D133	
4	D033, D150, D 094, D171, D093 D065, D129, D110, ~~D056~~ ④, D006	D122, D169, D018, D184, D003 D057, D113, D166, D148, D096	
5	D016, D040, D144, D053, D017 D082, D070, D125, D060, D092	D139, D020, D067, D069, D146 D076, D131, D064, D038, D088	
6	D084, ~~D074~~ ③, D090, D162, D123 D154, D134, D055, D180, D111	D023, D185, D178, D011, D152 D141, D051, D161, D074, D165	
7	D140, D157, D151, D054, D085 D001, D052, D076, D041, D183	D024, D039, D072, D009, D112 D117, D121, D143, ~~D007~~ D011, D083	
8	D179, D047, D027, D061, D049 D104, D124, D176, D142, D164	D167, D138, D109, D127, D002 D181, D087, D081, D156, D075	
9	D060, D124, D088, D036, D115 D158, D005, D078, D145, D098	D008, D046, D 062, D108, D144 D106, D089, D120, D103, D040	28 MAY 13 KW

① Incorrect mussel tag #. D011. KW 28 MAY 13
② NL. D137. KW 20 JAN 2013
③ NL. D 097. KW 20 JAN 2013
④ NL. D086. KW 21 JAN 2013

Item Number: 4

File Folder: 14 Page 1 of 1

⑤ Wrong study # printed on data sheet originally JKW 29JAN14

~~AEH-13-PSEUDO-03~~ ⑤ AEH-13-PSEUDO-06

Lab book/pgs: e-log p.6

Species: Washboard

Tag Color: White

Mark on Randomization: ☐

Reviewed By
Initials: KW Date: 27JAN2014

Verified By
Initials: JK Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	A143, A094, A024, ~~A052~~ ①, A110 A176, A066, A112, A111, A163	A001, A095, A070, A140, ~~A169~~ ② A177, A123, A117, A053, A014	28MAY13 KW
2	A010, A101, A179, A172, A087 A125, A157, A141, A004, A015	NL. A158 KW 28MAY13 A114, A021, ~~A169~~, A060, A139 A051, A030, A180, A012, A091	
3	A070, A003, A007, A065, A085 A016, A175, A093, A128, A023	A013, A126, A162, A171, A035 A135, A170, A025, ~~A109~~ ③, A099	
4	A109, A011, A164, A149, A075 A008, A165, A159, A002, A130	write over KW 28MAY13 A113, A156, ~~A049~~ A019, A058, A073 ~~A048~~, A021, A036, A005, A020 write over A048 KW 28MAY13	
5	A020, A032, A074, A016, A120 A119, A028, A174, A043, A034	A082, A047, A092, A055, A054 A146, A133, A079, A056, A077	
6	④ ~~A063~~, A040, A039, A088, A018 A138, A124, A089, A009, A134	A067, A137, A105, A152, A068 A166, A022, A081, A057, A102	
7	A050, A076, A038, A041, A078 A132, A127, A159, A037, A151	A062, A064, A109, A080, A052 A155, A017, A012, A167, A084	
8	A136, A049, A153, A144, A106 A173, A168, A146, A142, A116	A167, A069, A086, A059, A164 A161, A115, A145, A160, A178	
9	A033, A097, A129, A044, A006 A022, A118, A031, A122, A154	A027, A021, A045, A083, A096 A131, A068, A071, A103, A147	28MAY13 KW

① NL. A032. KW 20JUN2013

② NL. A169. KW 20JUN2013

③ wrong number. Should be A108. KW 20JUN2013

④ NL. A063. KW 19JUL2013

Item Number: 5

File Folder: 14 Page 1 of 1

~~AEH-13-PSEUDO-03~~ ② AEH-13-PSEUDO-06 Lab book/pgs: 2-leg p.6

③ Wrong study # printed on datasheet originally JKW 29JAN14

Species: Higgins eye

Tag Color:

Mark on Randomization: •

Reviewed By
Initials: KW Date: 27JAN2014
Verified By
Initials: JKL Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	B053, B043, B025, ~~B0~~ B158 wrong ID KW 28MAY13 B088, B033, B017, B120	B034, B067, B057, B129 B152, B006, B156, B127	28MAY13 KW
2	B080, B007, B159, B147 B069, B102, B126, B157	B054, B004, B022, B138 B049, B013, B014, B134	
3	B093, B019, B081, B012 B050, B125, B086, B011	B118, B005, B052, B123 B153, B071, B021, B080	
4	B090, B026, B150 ②, B064 B062, B124, B133, B128	B112, B037, B078, B010 B039, B087, B038, B015	
5	B047, B142, B018, B045 B131, B149, B066, B114	B094, B046, B075, B111 B051, B157, B143, B145	
6	B101, B107, B121, B059 B115, B076, B032, B079	B137, B092, B117, B063 B140, B061, B030, B041	
7	B106, B091, B130, B119 B077, B045, B017, B016	B036, B104, B058, B132 B054, B002, B141, ~~B107~~ wrong ID B103 KW 28MAY13	
8	B135, B027, B096, B065 B008, B110, B031, B100	B116, B001, B113, B044 B074, B108, B079, B087 ①	
9	B146, B144, B139, B122 B085, B083, B023, B037	B098, B151, B035, B029 B155, B056, B048, B099	28MAY13 KW

① Mussel B089 recovered from bottom of the tank upon draining @ ~1035 KW 30MAY13KW

② found in basket during clean-up. KW 30MAY13 @ ~1150

Item Number: 6

File Folder: 14 Page 1 of 1

~~AEH-13-PSEUDO-03~~ ②

② Wrong study # printed on datasheet originally. JKW 29JAN14 AEH-13-PSEUDO-06

Species: Fatmucket

Lab book/pgs: e-log p.6

Tag Color: Blue

Mark on Randomization: X

Reviewed By
Initials: KW Date: 27 JAN 2014
Verified By
Initials: JK Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	D270, D262, D336, D199, D273 D269 D224, D209, D310, D302	D264, D277, D231, D294, D340 D196, D313, D203, D197, ~~D385~~ NL D335 KW 28JAN14	28 MAY 13 KW
2	D220, D256, D235, D318, D265 D314, D242, D326, D198, D354	D319, D193, D291, D316, D299 D267, D339, D343, D338, D321	
3	D266, D350, D300, D306, D282 D332, D229, D263, D271, D241	D281, D189, D278, D283, D353 D232, D227, D311, D351, D221	
4	D365, D222, D247, D190, D349 ~~D295~~ D301, D255, D245, D215 NL D315 KW 28JAN13	D323, D337, D204, D289, D270 D307, D293, D228, D325, D287	
5	D296, D214, D334, D321, D257 D225, D347, D288, D329, D257	D286, D207, D357, D254, D218 D297, D292, D188, D358, D276	
6	D249, D216, D250, D320, D367 D308, D328, D322, D241, D205	D342, D248, D364, D298, D201 D266, D195, D301, D303, D330	
7	D345, D253, ~~D268~~ ①, D192, D233 D362, D344, D237, D369, D212	D223, D213, D244, D355, D240 D261, D295, D194, D200, D234	
8	D217, D238, D360, D348, D210 D274, D284, D290, D251, D314	D208, D356, D363, D236, D206 D305, D331, D280, D361, D341	
9	D224, D258, D239, D262, D191 D368, D230, D219, D359, D246	D275, D285, D260, D352, D324 D243, D317, D312, D187, D202	28 MAY 13 KW

① D268. Number was difficult to read. 19JUL2013 KW

Item Number: 7

File Folder: 14 **Page** 1 **of** 1

~~AEH-13-PSEUDO-03~~ ② AEH-13-PSEUDO-06 Lab book/pgs: e-log p 6

② Wrong study # printed on datasheet originally. JKW 29JAN14

Species: Three Ridge

Tag Color: Green

Mark on Randomization: ✓

Reviewed By
Initials: KW Date: 27JAN2014
Verified By
Initials: SAL Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	C170, C010, C136, C096, C022 C073, C033, C062, C002, C108	C047, C158, C046, C058, C093 C024, C059, C037, C102, C014	28MAY13 KW
2	C031, C163, C056, C023, C103 C079, C032, C005, C005, C113	C105, C180, C141, C007, C003 C131, C042, C134, C114, C125	
3	C138, C155, C159, C104, C008 C045, C087, C118, C101, C020	C009, C143, C004, C174, C149 C038, C127, C154, C041, C060	
4	C175, C086, C140, C067, C156 C082, C133, C071, C110, C128	C169, C091, C016, C184, C135 C148, C053, C121, C063, C112	
5	C043, C178, C161, C034, C015 C111, C183, C026, C162, C094	C001, C147, C021, C081, C116 C069, C011, C018, C100, C140	
6	C167, C052, C071, C122, ~~C055~~ ① C089, C076, C088, C150, C182	C095, C173, C145, C171, C077 C028, C177, C181, C126, C084	
7	C057, C092, C036, C109, C144 C179, C139, C078, C005, C085	C120, C040, C146, C137, C117 C027, C164, C006, C044, C019	
8	C129, C029, C083, C049, C068 C124, C039, C019, C090, C165	C153, C157, C132, C172, C070 C152, C185, C072, C157, C091	
9	C176, C168, C080, C130, C106 C050, C057, C013, C099, C048	C115, C066, C100, C084, C055 C080, C107, C119, C098, C075	28MAY13 KW

① NL. C035. KW 28JUL2013

Item Number: 8

File Folder: 14 Page 1 of 1

~~AEH-13-PSEUDO-03-~~⑤ AEH-13-PSEUDO-06

Lab book/pgs: e-log p.6

⑤ Wrong study # printed on datasheets originally. SKW 29JAN14

Species: Wabash Pigtoe

Reviewed By
Initials: KW Date: 27 JAN 2014
Reviewed By
Initials: JW Date: 4/23/14

Tag Color: Yellow

Mark on Randomization: D

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1①	B179, B301*, B158, D251 D165, B260, B272, B264	B242, B246, B303, B295 B201, B214, B256, B273	28MAY13 KW
2①	B283, D233, B210, B248 B187, B238, B179, B206	B250, B185, B247, B265 B181, B192, B237, B184	
3	B208, B289, B229, B197 B203, B162, B270, B222	B191, B186, B163, B261 B218, B166, B228, B280	
4	B271, B294, B299, B170 B231, B252, B236, B168	B183, B178, B164, B276 B215, B257, B278, B277④	
5	B244, B297, B175, B254 B285, B259, B239, B164	B200, B281, B284, B249 B225, B266, B174, B182	
6	B213, B262, B235, B243 B290, B198, B267, B241	B286, B230, B298*, B195② B292, B173, B302, B212	
7	B211, B205, B189, B269 B227, B282, B274, B217	B194, B291, B255, B268 B232, B161, B224, B190	
8	B279, B275, B296, B258 B219, B240, B245, B287	B277, B221, B288, B223 B202, B263, B293, B169	
9	B196, B170③, B247, B193 B226, B253, B201, B304	B220, B234, B216, B160 B176, B180, B300, B172	28MAY13 KW

* Number hard to read. KW 28MAY13

File Folder: 14 Item Number: 9

Page 1 of 1

① Number IDs should be "B" not "D" KW 20JUN2013

② Number was not written down, but was in e-log. KW 20JUN2013

③ Incorrect tag number. Correct tag ID is 171 based on mussel tags IDed during assessment. KW 19JUL2013

④ Upon further review it was determined that this tag ID should be B174 KW 31DEC13

Lab book/pgs: e-log p.6

~~AEH-13-PSEUDO-03~~ ⊛ AEH-13-PSEUDO-06
⊛ Wrong study # printed on datasheet originally. JKW 29JAN14
Species: Plain pocketbook

Tag Color: White

Mark on Randomization: ④

Reviewed By
Initials: KW Date: 27JAN2014
Verified By
Initials: JKW Date: 4/23/14

Distribution Tag Numbers

Tank	8 hour	24 hour	Date/Initials
1	wrong ID. KW 28MAY13 ~~A152~~ A312, A300, A204, A270, A248 A308, A247, A237, A289	A302, A316, A231, A314, A284 A317, A343, A313, A189	28MAY13 KW
2	A310, A246, A262, A278, A202 A338, A307, A311, A269	① A296, A304, A268, A256, A193 A335, A331, A274, A244	
3	A185, A271, A259, A225, A277 A214, A340, A294, A183	A184, A323, A341, A239, A232 A290, A230, A255, A191	
4	A264, A215, A345, A318, A187 A329, A200, A334, A306	A213, A265, A208, A272, A181 A262, A261, A190, A192	
5	A279, A298, A209, A242, A285 A211, A210, A257, A325	A212, A275, A197, A186, A339 ~~A251~~ NL, A336, A273, A301 A251 KW 28MAY13	
6	A219, A236, A233, A346, A221 A320, A240, A332, A347	A203, A229, A314, ~~A216~~ ②, ~~A267~~ ③ A182, A201, A287, A199	
7	A258, A188, A337, A241, A321 A283, A198, A227, A297	A195, A327, A194, A209, A291 A274, A252, A305, A292	
8	A293, A245, A342, A253, A226 A348, A249, A205, ~~A261~~ NL A261 KW 28MAY13	A234, A326, A246, A234, A299 A309, A288, A295, A217	
9	A218, A330, A322, A228, A263 A280, ~~A27~~ A196, A315, A303 wrong ID KW 28MAY13	A260, A243, A319, A324, A206 A333, ~~A238~~ ④, A220, A254	28MAY13 JCW

① A296 was recovered from bottom of tank upon draining it. ~1030 30MAY13 KW

② NL A216. KW 20JAN2013

③ NL A267. KW 20JAN2013

④ NL · A238. KW 20JAN2013

Wrong item # JKW 3/13/14

Item Number: ~~9~~ 10

File Folder: 14

Page 1 **of** 1

Appendix 4. Test Article Information

Item Number	Item Description	Number of Pages	Report Page Number
1	Material Safety Data Sheet: Zequanox®	2	124
2	MBI-401 SDP (lot # 401P12163C) Test Article: Certificate of Analysis	1	126
3	MBI-401 SDP (lot # 401P12164C) Test Article: Certificate of Analysis	1	127
4	MBI-401 SDP (lots # 401P12163C and 401P121164C) Test Article: Packing List USPS (shipped to James Luoma 08/06/2012)	1	128
5	Test Article Stock Preparation	1	129
6	New York State Museum Post-Exposure Product Validation Assay	2	130
7	Copy of test article log book [MBI-401 SDP]; lot number 401P12163C and 401P12164C (Received mixed in Containers) Container 5 of 6	5	132

MATERIAL SAFETY DATA SHEET

Product Name: MBI-401 SDP

Contact: Marrone Bio Innovations, 2121 Second Street, Suite B-107, Davis, CA 95618
Phone (Business hours): 530-750-2800
www.marronebioinnovations.com
For emergencies such as leaks or spills call CHEMTREC 24-hour toll-free hotline at 1.800.424.9300

Trade names/ Synonyms: MBI-401 SDP
EPA Registration Number: None, Experimental
PMRA Research Authorization #: 0030-RP-10
Primary Hazards: Inhalation

SECTION 1: MATERIAL IDENTIFICATION

INGREDIENT 1

Common Name:	CL145A strain of *Pseudomonas fluorescens*
Chemical Name:	Not applicable
Molecular Formula:	Not applicable
CAS Number:	Not applicable
Percent:	50%

OTHER INGREDIENTS: inert, non-reactive

SECTION 2: PHYSICAL DATA

Boiling Point:	Not applicable
Melting Point:	Not applicable
Bulk Density:	0.78 g/ml
Solubility in Water:	Dispersible in water
Appearance:	Powder
Color:	Tan
Odor:	Sweet, musty

SECTION 3: FIRE AND EXPLOSION DATA

Flash Point:	Not flammable
Method:	Not applicable
Extinguishing Media:	Use extinguishing media appropriate for the surrounding fire
Special Fire Fighting Procedures:	None
Unusual Fire and Explosion Hazards:	None

SECTION 4: REACTIVITY

Stability:	Material is non-reactive
Hazardous Polymerization:	Does not occur
Incompatibility:	None known
Hazardous Decomposition Products:	None known
Conditions to avoid:	None known

SECTION 5: HEALTH HAZARDS

Primary Route of Entry:	Skin contact, Eye, Inhalation
Exposure Limit:	Not established
Corrosive:	Not corrosive
Inhalation:	May be irritating to respiratory tract for some individuals. Avoid breathing dust.
Skin/ Eye Irritation:	May be irritating to skin and eyes for some individuals.
Effects of Overexposure:	If product comes in contact with eyes or skin, irritation may occur.
Toxicity:	None of the components of this product are listed as carcinogenic by NTP, IARC, OSHA

Acute studies:

Acute Oral LD_{50} (Rat):	>5,000 mg/kg (very low toxicity)
Acute Dermal LD_{50} (Rabbit)	>2,000 mg/kg (non-irritating, mild or slight irritation)
Primary Dermal Irritation	Slight Irritation, Class 4
Eye Irritation	Minimal Irritation, Class 4
Inhalation:	>2.25 g/ml, Class 4

SECTION 6: FIRST AID

Emergency First Aid Procedures:

If in eyes:	Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center of doctor for treatment advice.
If inhaled:	Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.
If on skin:	Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for further treatment advice.
If swallowed:	Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

SECTION 7: SPILL, LEAK AND DISPOSAL PROCEDURES

Steps to be taken in case material is released or spilled:

Wear suitable protective clothing such as long-sleeved shirt, pants, waterproof gloves and shoes with socks. Carefully mop or sweep up spill and place in a closed container for disposal.

Waste disposal method: Dispose of in accordance with all applicable federal, state, and local environmental regulations.

For emergencies such as leaks or spills, call CHEMTREC 24-hour toll-free hotline at 1.800.424.9300.

SECTION 8: SPECIAL HANDLING

Respiratory:	Use a NIOSH approved respirator with any N-95, P-95, R-95 or HE filter for biological products when mixing/loading the product.
Protective gloves:	Wear gloves made of Latex or other impervious material.
Eye protection:	Safety goggles or safety glasses with side shields recommended.
Other protective clothes:	Clothing to prevent prolonged skin contact as needed such as long-sleeved shirt, long pants and shoes with socks.

SECTION 9: SPECIAL PRECAUTIONS

Precautions to be taken in handling and storing:

Use a NIOSH approved respirator with any N-95, P-95, R-95 or HE filter for biological products when mixing/loading the product.

Store in a dry area inaccessible to children. Store in original containers only. Keep container closed when not in use.

Empty container completely and dispose of in accordance with all applicable federal, state, and local environmental regulations.

Wash any contamination from skin or eyes immediately. Wash hands and exposed skin before eating, drinking, smoking after work or using the toilet.

SECTION 10: SHIPPING REGULATIONS

Proper shipping name:	None
DOT Label (s) Required:	None
Freight Classification:	Insecticides, Fungicides N.O.I., Other Than Poisons. NMFC 102120 Class 60

SARA Title III Hazard Classification:

Immediate (acute) Health:	None
Delayed (chronic) Health:	None
Fire:	None
Sudden Release of Pressure:	None
Reactivity:	None

National Fire Protection Association Rating:

Health:	None
Flammability:	None
Reactivity:	None

This document set forth is based on information that Marrone Bio Innovations, Inc. (MBI) believes to be accurate. No warranty, expressed or implied, is intended. The information is provided solely for your information and consideration and MBI assumes no legal responsibility for use or reliance thereon.

Marrone™
Bio Innovations

[redacted]

Marrone™ Bio Innovations

CERTIFICATE OF ANALYSIS

Name of Product:	MBI-401 SDP
Active Ingredient:	100% *Pseudomonas fluorescens* strain CL145A cells and spent fermentation media
Percent Active Ingredient:	50% by weight
Viable Cfu/g:	0 cfu/g *Pseudomonas fluorescens* strain CL145A
Lot Number:	401PI2163C
Mussel Bioassay:	Pass
Appearance:	Tan powder
Storage Conditions:	4 °C, protected from light
Date of Manufacture:	21 June 2012
Expiration Date:	21 June 2013

I hereby certify that the above information is true and correct.

Quality Control: [redacted] Date: 01 August 2012

Tamara Nicholson, Quality Control Supervisor

2121 Second Street, Suite B-107 • Davis, CA 95618 • Phone: 530-750-2800

AEH-13-PSEUDO-06

FF # 8
Item No. 2
Pg 1 of 2

Marrone™ Bio Innovations

CERTIFICATE OF ANALYSIS

Name of Product:	MBI-401 SDP
Active Ingredient:	100% *Pseudomonas fluorescens* strain CL145A cells and spent fermentation media
Percent Active Ingredient:	50% by weight
Viable Cfu/g:	0 cfu/g *Pseudomonas fluorescens* strain CL145A
Lot Number:	401P12164C
Mussel Bioassay:	Pass
Appearance:	Tan powder
Storage Conditions:	4 °C, protected from light
Date of Manufacture:	21 June 2012
Expiration Date:	21 June 2013

I hereby certify that the above information is true and correct.

Quality Control: [redacted] Date: 01 August 2012

Tamara Nicholson, Quality Control Supervisor

2121 Second Street, Suite B-107 • Davis, CA 95618 • Phone: 530-750-2800

AEH-13-PSEUDO-06

FF # 8
Item No. 2
Pg 2 of 2

THE STATE EDUCATION DEPARTMENT / OFFICE OF CULTURAL EDUCATION

New York State Museum Field Research Laboratory
51 Fish Hatchery Road
Cambridge, NY 12816
Tel. 518-677-8245
Fax 518-677-5236
E-mail: dmayer@mail.nysed.gov

PACKING LIST
DATE OF SHIPMENT - 2012/08/06

Ship from:
Denise Mayer
New York State Museum
Field Research Laboratory
51 Fish Hatchery Road
Cambridge, NY 12816

Ship To:
Jim Luoma
USGS UMESC
2630 Fanta Reed Road
La Crosse, WI 54603

Shipping Method: UPS Next Day Air
Required by: 2012/08/07

Item Description:

MBI-401 SDP Lot # 401P12163C and 401P12164C Mix in six containers of approximately 0.5 Kg each (total weight 3 Kg):

Packaged by D. Mayer.
Shipped on ice. Store at 4°C, protected from light.

Manufactured: 06-21-2012
Expiration date 06-21-2013

AEH-13-PSEUDO-06

FF # 8
Item No. 3
Pg 1 of 1

Study Number: AEH-13-PSEUDO-06 File Folder: 8 Lab book/pgs: E-log / 5

Reviewed by: JKW Date: 2/19/2014
Verified by: JR Date: 4/23/14

Test Chemical Stock Preparation

Test Chemical: *Pseudomonas fluroescens* strain 145A

Test Chemical Lot #: 401P12163C and 401P12164C Mix Date Rec'd: 7-AUG-12 Exp. Date: ~~21-JUN-12~~ 21JUN13

Wrong date. Should be 21JUN13 KW 24MAY13

Test Location: Black River, La Crosse, WI Instruments Used: Mettler Toledo PG2002-S S/N 84710288; Sartorius LC620S S/N 40707004; Sartorius R200D S/N 20903620

Weights of Chemical Samples:

Sample ID	Sample Weight	Comments	Date	Initials
Stock #1	35.00		24MAY13	KW
Stock #2	35.02		↑	↑
Stock #3	35.00			
Stock #4	70.02			
Stock #5	70.02			
Stock #6	70.02			
Analytical #1	2.00071		↓	↓
Analytical #2	2.00033		24MAY13	KW

NOTE: Chemical samples to be stored refrigerated until used for stock preparation.

Stock Solution Preparation:

Sample ID	Dilution Volume (mL)	Dilution Time	Use	Exposure Time	Date	Initials
Analytical #1	500	0830	Standard curve	0h	29MAY13	KW
Stock #4	↓	0924	Tank 1	0h	29 May 13	DLW
Stock #5		0943	Tank 2	0h	29 May 13	DLW
Stock #6		0952	Tank 9	0h	29 May 13	DLW
Stock #2		1000	Tank 3	0h	29 May 13	DLW
Stock #1		1008	Tank 4	0h	29 May 13	DLW
Stock #3	↓	1014	Tank 6	0h	29 May 13	DLW
Analytical #2	500	~~2200~~ ①	Standard check	12h	29MAY13	KW

① wrong time. Should be 2100. KW 29MAY13

NYSM Post-Treatment Product Validation Assay

MBI-401 SDP 401P12163C and 401P12164C Mix
(USGS Study #AEH-13-PSEUDO-06 Sub-adult unionids)

Date product received from USGS: 2013/06/19
Date of start of test: 2013/06/20

BACKGROUND: As standard protocol for the USEPA project, each time a batch of Zequanox product is used in a test a UMESC, a portion of the product is bioassayed by the NYSM to validate toxicity post-treatment.

- MBI-401 SDP 401P12163C and 401P12164C Mix
  - USGS Study #AEH-13-PSEUDO-06; Sub-adult unionids

PURPOSE: Post-test product validation of MBI-401 SDP 401P12163C and 401P12164C Mix from USGS-UMESC.

MATERIALS AND METHODS:

Preparation of product for testing:

Product was shipped under cold conditions and held in the laboratory refrigerator at 4°C until use. Within 30 min of treatment application, prepare each at treatment stock of each MBI-401 formulated product:

MBI-401 SDP 401P12163C and 401P12164C Mix (SDP – 50% active ingredient): 3 g of the powder from each sample was added slowly to a beaker with dilution water with stirring on a stir plate for even suspension and then the total volume was adjusted to 30 ml with dilution water. The suspension was transferred to a 50 ml centrifuge and stored in refrigerator until ready to use. The suspension, when evenly dispersed was 100 mg product/ml or 50 mg a.i./ml. For 200 ppm a.i. treatments in testing jars, 2 ml were added to each testing jar (500 ml).

Cambridge CF (Standard for Positive Controls):

As an efficacy standard, we used *Pf*-CL145A killed CF that was maintained at -80°C (Cambridge CF). Since its production in 2005, this material has been valuable as a reference standard. The Cambridge CF was produced in 2005 (2005-0027) in 100-L batches 10, 11 and 12 and E-beamed to kill the cells. The solution, at 110 mg/ml dry weight, is stored in 1 cm thick sheets in the Cambridge ultrafreezer at -80°C. A section of the sheet was broken off and weighed to determine volume (ca. 1 g = 1 ml).

For this bioassay, a positive control suspension was produced on 06/18/2012 from the frozen blocks described above and dispensed into multiple 50-ml centrifuge tubes for single-use treatment of bioassays. The dry weight of the material was 68.15 mg/ml; therefore 1.5 ml was added to each testing jar to treat at 200 ppm.

Mussel collections:

Mussels were scraped from substrates (rocks) in the field and brought back to the lab in coolers. The same day mussels were carefully examined and placed into testing jars and allowed to attach overnight at ambient laboratory temperature (ca. 20°C).

Mussel collection and handling:

Species	Collection site	Collection date	Date in lab (20°C)	Picked for test
Zebra mussels	Hedges Lake (Washington County)	06/19/2013	06/19/2013	06/19/2013

Experimental design:

For validation of efficacy the following treatments will be set up:

Zebra mussels (25 mussels/jar):

3 – Untreated Con

trol (A, B, C)

3 - 200 ppm (a.i.) Cambridge CF Positive Control (*Pf*-CL145A killed cells) (A, B, C)

3 – 200 ppm (a.i.) 401P12163C and 401P12164C Mixed (A, B, C)

Total of 9 testing jars.

Testing jar bioassay protocol:

On the day prior to treatment (06/19/2013) mussels were carefully examined and 25 mussels placed into each testing jar containing ca. 100 ml aerated hard water and allowed to attach overnight. The next morning (06/20/2013), unattached mussels were removed and replaced with attached mussels from an extra glass Petri dish. Water was replaced with 500 ml fresh aerated hard water.

After at least one hour, the treatment was applied. The optical density of each jar was measured in duplicate ($A_{660\ nm}$ Genesys Spectrophotometer).

After 24 hr of treatment, mussel mortality was checked and mussels were transferred to square plastic dishes with fresh aerated hard water. Mortality was checked and recorded each day with water replacements, for an additional 7 days (8 days total). On the final day of mortality checks, 20 mussels were measured from the untreated controls using a caliper.

Results:

Mussel length: Zebra mussels 17.67 ± 3.15 mm.

Optical density of treatments:

Treatment	Mean (±SD) OD ($A_{660\ nm}$)
Untreated Control	0.001 ± 0.002
Cambridge CF (Positive Control)	0.202 ± 0.004
MBI-401 SDP 401P12163C and 401P12164C Mixed	0.220 ± 0.005

Zebra mussel mortality: Mussels were treated in triplicate testing jars (500 ml) at 20°C for 24 hr and mortality was recorded for a total of 10 days.

Treatment	Mean % mortality (±SD)
Untreated Control	0.0 ± 0.0%
Cambridge CF (Positive Control)	100.0 ± 0.0%
MBI-401 SDP 401P12163C and 401P12164C Mixed	98.7 ± 2.3%

MBI-401 SDP 401P12163C and 401P12164C Mixed PASSED the post-test bioassay validation (98% mortality). Untreated control mortality was 0%.

CHEMICAL LOG BOOK

MBI-401 SDP

Marrone Bio Innovations
Davis, California

LOT NUMBERS:
401P12163C
and
401P12164C
(Received Mixed in Containers)

Container 5 of 6

AEH-13-PSEUDO-06 Item Number: 1

File Folder: 18 Page 1 of 5

SIGNATURE PAGE

All personnel making an entry in this log must fill out the form below in accordance with SOP GEN 009.

PRINTED NAME	SIGNATURE	INITIALS	DATE
Kerry L. Weber	[redacted]	KLW	29 AUG 12

"This Use and Maintenance Log Book has been inspected and found to be in compliance with SOP GEN 009.

Inspected and sealed on August 7 20[illegible] (Date) by [redacted] (Quality Assurance Unit)."

Item Number: 1

AEH-13-PSEUDO-06 **File Folder:** 18 **Page** 2 **of** 5

ORIGINAL

Form GEN 012.3a
Page 1 of 1

TEST CHEMICAL DATA FORM

Test Chemical (Chemical Name) MBI-401 SDP

Circle one: (Test Article) Control Article

Trade Name of Test Chemical (Synonyms) Rf-CL 145A; Zequanox

Source of Test Chemical (Manufacturer) Marrone Bio Innovations

Storage Location Refrigerator

Date Received 07 Aug 12 KW Date Opened 20MAR2013 KW Expiration Date 21JAN 2013 (5 years unless otherwise stated)

Test Chemical Lot Number 401P12h36C 401P12h42C ① Purity of Chemical 50%

Amount of Test Chemical Available or Received (if known) ~350g

Initial Mass (with cover on) of Test Chemical and Container 509.76g

Characterization of Test Chemical: Color Tan
Physical State: liquid __ solid X
Solid Form: powder X crystal __ pellet __

Chemical Abstract Service Number N/A

Manufacturer Certificate of Analysis Yes X No __

Additional Comments about the Test Chemical:

① Received mixed from manufacturer. KW 09AUG12

Sample Placed in Archives: Yes __ No X (Entries should also be made on Form GEN 012.b)

Archive Location _____ Material Safety Data Sheet Available: Yes X No __

Signature of Study Director or designee initiating Test Chemical Use Log and date:

Signature [redacted] Date 09 AUG 12

Item Number: 1

AEH-13-PSEUDO-06 File Folder: 18

Page 3 of 5

TEST CHEMICAL USE LOG

Test Chemical: MBI-401sDP			Manufacturer: Marrone Bio Innovations		Lot or Batch #: 401P12163C 401P12164C Mixed	
A Initial mass of test chemical & container with cap/ lid on (g)	B Amount removed (g)	C Mass of test chemical & container after removal, with cap/lid on (g)	D Study Number	E Purpose and Other Comments	F Date	G Initials
*1 No test chemical placed in archive	*	*		*Archived Sample	09AUG12	KW
509.62	5.69	503.93	None	Product efficacy verification for NPM	20MAR13	KW
504.00	35.00	468.98	AEH-13-PSEUDO-05 (1)	Stock #1 for sub-adult test	24MAY13	KW
468.98	35.02	433.96	AEH-13-PSEUDO-05 (1)	Stock #2 for sub-adult test	24MAY13	KW
433.96	35.00	398.95	AEH-13-PSEUDO-05 (1)	Stock #3 for sub-adult test	24MAY13	KW
398.95	70.02	328.92	AEH-13-PSEUDO-05 (1)	Stock #4 for sub-adult test	24MAY13	KW
328.92	70.02	258.89	AEH-13-PSEUDO-06	Stock #5 for subadult test	24MAY13	KW
258.89	70.02	188.84	AEH-13-PSEUDO-06	Stock #6 for sub-adult test	24MAY13	KW
~~185.1~~ (2) 186.81	2.00071	186.81	AEH-13-PSEUDO-06	Analytical Stock #1 for sub-adult test	24MAY13	KW
186.81	2.00033	184.80	AEH-13-PSEUDO-06	Analytical Stock #2 for sub-adult test	24MAY13	KW

* = The first entry should be the test chemical sample placed in the Chemical Archives. Follow GEN 011.
1 = The initial mass is also entered on Form GEN 012.a.
A. The mass of the test chemical and its container will be determined using a balance that has been verified to be accurate (SOP GEN 013).
B. The test chemical removed from the container will be placed into a tared vessel.
C. After the test chemical has been removed from the container, determine the mass of the container and its contents (with cap/lid on).

(1) Wrong study number. Should be: AEH-13-PSEUDO-06 KW 24MAY13
(2) Wrong height. KW 24MAY13

File Folder: 18 Item Number: 1 Page 4 of 5 AEH-13-PSEUDO-06

ORIGINAL

Form GEN 012.3c
Page __ of __

TEST CHEMICAL USE LOG

Test Chemical: MBI-401 SDP			Manufacturer: Nanobio Bio Innovations		Lot or Batch #: 401P121636 401P121646 Mixed	
A Initial mass of test chemical & container with cap/ lid on (g)	B Amount removed (g)	C Mass of test chemical & container after removal, with cap/lid on (g)	D Study Number	E Purpose and Other Comments	F Date	G Initials
184.83	10.76	174.04	AEH-13-PSEUDO-06	Sample for NMR	18 JUN 13	KW

A. The mass of the test chemical and its container will be determined using a balance that has been verified to be accurate (SOP GEN 013).
B. The test chemical removed from the container will be placed into a tared vessel.
C. After the test chemical has been removed from the container, determine the mass of the container and its contents (with cap/lid on).

AEH-13-PSEUDO-06 Page 5 of 5 File Folder: 18 Item Number: 1

Appendix 5. Test Animal Information

Item Number	Item Description	Number of Pages	Report Page Number
1	Email from GNFH: Origin of Test Organisms	2	138
2	Native Mussel Lengths – Data Summary	1	140
3	Plain Pocketbook (*L. cardium*) Length Summary	1	141
4	Hickorynut (*O. olivaria*) Length Summary	1	142
5	Washboard (*M. nervosa*) Length Summary	1	143
6	Higgins Eye (*L. higginsii*) Length Summary	1	144
7	Fatmucket (*L. siliquoidea*) Length Summary	1	145
8	Threeridge (*A. plicata*) Length Summary	1	146
9	Wabash Pigtoe (*F. flava*) Length Summary	1	147
10	Histological Examination of native mussel test organisms – Summary	6	148

Weber, Kerry <klweber@usgs.gov>
kw

mussel info

Luoma, James <jluoma@usgs.gov> Thu, May 23, 2013 at 12:54 PM
To: Kerry Weber <klweber@usgs.gov>

fyi

---------- Forwarded message ----------
From: **Eckert, Nathan** <nathan_eckert@fws.gov>
Date: Thu, May 23, 2013 at 12:50 PM
Subject: Re: mussel info
To: "Luoma, James" <jluoma@usgs.gov>

OK, Here Goes.

Washboard -- Sac River, Caplinger Mills, Cedar County of Missouri, Collected fall 2010 Transformed in February of 2011, reared in buckets at Missouri State U. up to 3mm and then in floating upwellers at the KC Zoo until transfer to Genoa on 5/17/13

Threeridge/Wabash Pigtoe -- Collected from the Mississippi River @ Blackhawk Park, Vernon County WI on 5/10/13.

Hickorynut – Iowa River at Hills, Johnson County, IA. Collected Spring 2010, cultured in cages on the St. Croix River summer '10, '11, '12. Retrieved from the cages 5/13/13

Fatmucket -- St. Croix River, WI, Collected Spring 2010, cultured in cages on the St. Croix River summer '10, '11, '12. Retrieved from the cages 5/13/13

Higgins' Eye -- St. Croix River, Hudson, WI. Collected 4/29/11. Cultured in cages on the St. Croix River Summer '11 & '12. Retrieved from the cages 5/13/13

Plain pocketbook -- Mississippi River, likely PdC, Collected Spring 2010. Juveniles recovered in the lab and held in bucket system through Spring '11. Mussels cultured in MARS trailer Summer '11/'12 held over winter at GNFH in pond water.

I realize that some detail is lacking here. That said a few of these species were propagated prior to my arrival at GNFH. The hatchery records say that a "Luoma" was part of the infestations.

Nathan
[Quoted text hidden]

AEH-13-PSEUDO-06

AEH-13-PSEUDO-06

--
Nathan L Eckert
Mussel Biologist
Genoa National Fish Hatchery
S5631 State Hwy 35
Genoa, WI 54632
608-689-2605

File Folder: 7

Page 1 of 2

Item Number: 1

James A. Luoma
Research Fisheries Biologist
AEH
Upper Midwest Environmental Sciences Center
2630 Fanta Reed Rd
LaCrosse, WI 54603
Office (608)781-6391
Cell (608)799-1723

AEH-13-PSEUDO-06 Item # JKW 19FEB14
Item Number: ~~7~~ 1
File Folder: 7
Page 2 of 2

Study Number: AEH-13-PSEUDO-06 Electronic Logbook (Pages 5-6) Data Source: "Native Mussel Length" File Folder: 11a-11f	Action	Date	Initials
	Created.....	1/21/2014	JKW
	Revised.....	4/24/2014	KLW
	Reviewed...	4/24/14	
	Certified.....	12/12/14	

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]Native Mussel Length Coversheet

Native Mussel Length Data

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Filename(s)

I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]PPB Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]HIC Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]WAS Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]HGE Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]FAM Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]THR Length Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Length Data.xlsx]PIG Length Summary

Test Organisms:

Common name, scientific name, three letter abbreviation

Plain Pocketbook, *Lampsilis cardium*, PPB
Hickorynut, *Obovaria olivaria*, HIC
Washboard, *Megalonaias nervosa*, WAS
Higgins Eye, *Lampsilis higginsii*, HGE
Fatmucket, *Lampsilis siliquoidea* , FAM
Threeridge, *Amblema plicata*, THR
Wabash Pigtoe, *Fusconaia flava*, PIG

Mean *(standard deviation)* Test Animal Length (mm)

	PPB	HIC	WAS	HGE	FAM	THR	PIG
Mean	39.21	30.92	44.03	23.77	57.04	63.18	51.07
(SD)	*(4.16)*	*(2.19)*	*(3.76)*	*(2.27)*	*(4.77)*	*(8.30)*	*(8.00)*
MIN	27.35	21.33	35.21	17.81	42.27	43.80	33.82
MAX	48.05	37.15	56.97	28.97	68.73	88.56	73.65

Data Explanation:

Mussel Species: Three letter code abbreviations
N: total individuals of given species.
Lengths: length (mm) of mussel as measured parallel to hinge

Data Anomalies and Deviations:

NONE

Statistical Analysis

Mean Length: Mean length of individuals within mussel species.
Standard Deviation: Standard deviation of all lengths within mussel species population.
Minimum Length: Minimum length within population of mussel species.
Maximum Length: Maximum length within population of mussel species.

File Folder 11
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Data Source: "Native Mussel Length", PPB; File Folder 11a
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 11-11-14

Plain Pocketbook *(L. cardium)* Length Summary

Mussel Species	N	Length (mm)									
PPB	162	45.88	39.56	43.37	39.42	41.36	37.94	39.67	40.79	42.20	41.46
		32.71	37.43	41.76	39.24	40.76	48.05	39.26	37.49	38.70	32.57
		36.96	37.62	42.46	36.31	41.90	43.81	37.27	46.15	43.08	36.22
		38.36	42.41	41.96	27.35	39.89	44.83	34.45	38.84	30.72	42.85
		41.31	41.35	37.93	39.02	31.86	35.17	42.95	40.12	35.01	35.86
		44.14	41.48	36.93	36.92	29.33	40.08	41.81	40.97	44.85	42.22
		42.91	42.64	43.04	39.99	45.89	39.42	37.86	41.92	41.67	35.34
		38.58	31.29	34.25	43.38	36.74	41.81	31.33	36.07	42.73	43.27
		41.74	40.07	40.67	35.52	42.24	34.79	38.33	42.88	39.44	45.21
		44.51	44.01	40.65	43.13	34.57	33.81	44.80	35.97	40.35	41.00
		31.69	38.15	37.54	37.91	42.69	43.03	41.25	34.26	41.22	42.13
		29.63	34.91	39.76	46.27	39.65	42.03	41.75	39.07	37.74	37.88
		39.94	38.30	35.72	45.51	38.86	38.63	38.64	39.06	37.79	37.68
		41.80	38.70	41.48	41.40	31.10	42.67	41.21	35.96	41.95	30.58
		30.46	29.54	33.20	42.80	32.89	36.78	41.46	40.32	39.83	45.83
		46.16	33.30	39.64	44.26	33.60	46.05	29.00	35.52	41.92	40.70
		36.35	40.58								

Mean	39.21
(SD)	(4.16)
MIN	27.35
MAX	48.05

File Folder 11a
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Hickorynut (*Obovaria olivaria*)
Data Source: "Native Mussel Length", HIC; File Folder 11b
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

[redacted] 12-12-14

Hickorynut *(O. olivaria)* Length Summary

Mussel Species	N	Length (mm)									
HIC	180	34.01	34.36	28.50	33.91	29.77	31.29	30.94	34.73	31.54	30.58
		34.18	31.56	29.58	32.15	31.22	32.12	30.17	31.71	28.02	32.01
		28.65	30.05	31.16	29.36	29.58	32.03	31.78	33.38	26.12	27.89
		32.42	33.31	34.45	32.82	28.30	30.77	31.70	34.17	28.95	29.54
		25.94	32.66	31.08	33.38	37.15	28.92	33.74	30.60	31.03	31.72
		27.80	29.11	26.88	34.12	26.70	32.45	28.19	32.53	28.93	30.57
		26.75	31.68	33.11	31.90	27.26	30.39	30.71	31.91	30.68	31.55
		30.64	29.51	33.27	28.85	28.55	31.84	32.71	30.22	30.96	31.36
		32.98	30.50	33.29	29.78	31.38	32.16	32.65	32.86	29.48	30.90
		28.93	31.72	29.74	30.52	32.89	31.89	31.94	33.42	32.64	29.96
		32.73	28.89	33.12	29.45	24.99	29.04	30.10	29.67	31.43	27.21
		29.70	29.37	28.16	30.48	32.72	27.78	31.17	32.50	31.12	30.49
		33.88	32.97	34.41	30.49	33.03	28.00	30.97	34.14	31.02	32.93
		31.93	28.39	30.83	32.84	31.50	33.90	28.23	27.87	29.51	27.11
		29.80	35.26	31.88	30.45	30.83	29.62	34.45	29.77	31.11	29.43
		29.36	30.48	30.16	29.66	31.68	32.00	31.28	30.66	34.55	32.89
		31.67	32.84	32.70	32.63	28.49	30.98	27.98	30.15	30.18	29.78
		32.47	32.82	29.30	21.33	30.47	32.95	32.97	30.84	32.93	26.78

Mean	30.92
(SD)	(2.19)
MIN	21.33
MAX	37.15

File Folder 11b
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Washboard (*Megalonaias nervosa*)
Data Source: "Native Mussel Length", WAS; File Folder 11c
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

[redacted] 12-12-14

Washboard *(M. nervosa)* Length Summary

Mussel Species	N	Length (mm)									
WAS	180	50.15	44.11	46.72	43.72	46.51	49.57	42.94	42.84	43.53	48.81
		40.85	40.82	42.92	39.83	43.71	48.96	38.94	41.85	44.50	42.97
		51.77	45.37	41.50	40.02	48.68	49.81	46.73	42.54	41.32	40.63
		41.68	40.73	42.57	46.97	47.70	48.53	47.80	40.34	41.47	42.42
		42.52	40.05	40.64	47.62	45.71	44.11	45.99	42.58	44.55	40.27
		43.84	43.66	43.12	41.55	47.51	47.02	43.75	41.21	40.49	45.35
		49.83	40.73	44.06	39.53	50.45	44.93	38.97	56.97	46.83	44.15
		43.81	46.46	44.55	39.01	38.79	41.85	46.49	54.89	45.74	56.48
		49.37	47.10	51.81	51.25	41.01	39.60	41.39	41.09	41.40	38.10
		44.62	52.52	47.36	42.19	39.43	51.97	44.34	49.86	48.96	42.96
		49.07	41.67	42.51	47.91	44.11	47.59	44.87	47.23	42.37	42.12
		39.72	36.36	42.27	41.66	41.69	39.11	45.68	48.24	39.09	44.10
		47.12	47.54	39.37	47.02	44.26	46.53	45.02	42.32	40.18	42.71
		39.53	40.18	41.72	39.20	40.80	42.02	43.13	45.74	46.31	45.67
		40.68	42.62	40.94	43.83	44.01	42.73	48.69	43.86	42.83	45.21
		40.08	49.93	43.02	41.90	45.29	46.87	42.25	46.65	42.92	38.83
		50.36	43.67	44.95	45.31	45.51	42.00	43.66	40.60	43.14	41.76
		39.30	40.45	41.29	42.95	48.51	44.33	36.05	35.21	42.02	42.40

Mean	44.03
(SD)	(3.76)
MIN	35.21
MAX	56.97

File Folder 11c
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Higgins Eye (*Lampsilis higginsii*)
Data Source: "Native Mussel Length", HGE; File Folder 11d
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

[redacted] 12-12-14

Higgins Eye *(L. higginsii)* Length Summary

Mussel Species	N	Length (mm)									
HGE	144	26.14	22.67	24.41	26.12	22.81	26.32	25.77	24.99	28.97	25.00
		26.24	23.01	24.88	23.90	24.55	20.96	25.14	23.48	25.96	20.38
		21.89	24.03	23.20	23.38	26.57	24.95	23.54	25.39	26.02	26.43
		23.74	22.87	25.08	25.13	20.81	23.50	25.90	24.62	22.98	24.09
		23.65	20.44	26.45	20.90	24.10	24.99	27.43	24.06	25.11	26.27
		24.31	24.76	20.00	24.01	25.10	23.58	26.01	27.51	26.44	24.50
		26.17	25.32	25.19	22.84	26.41	23.01	23.86	22.57	22.28	19.54
		20.00	22.97	24.82	25.06	28.18	26.32	19.90	26.13	25.92	27.82
		23.82	28.53	19.81	22.89	17.82	21.28	22.44	24.02	24.73	24.07
		24.83	23.13	21.44	20.59	25.28	24.38	25.84	23.87	24.55	21.68
		26.62	25.90	21.90	24.24	20.80	20.30	26.08	23.92	22.61	23.76
		19.58	24.41	21.42	24.55	23.91	26.00	24.77	22.85	24.15	20.70
		17.81	23.88	27.73	21.07	23.35	21.03	24.56	18.97	21.01	21.60
		21.92	23.45	20.51	25.83	24.04	22.15	19.39	24.93	25.22	25.55
		18.19	22.10	21.55	24.29						

Mean	23.77
(SD)	(2.27)
MIN	17.81
MAX	28.97

File Folder 11d
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
Data Source: "Native Mussel Length", FAM; File Folder 11e
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

[redacted] 6-12-14

Fatmucket *(L. siliquoidea)* Length Summary

Mussel Species	N	Length (mm)									
FAM	180	62.20	60.60	55.68	61.60	59.00	66.47	59.46	58.08	68.73	58.17
		62.45	53.60	60.57	59.70	54.82	60.70	63.00	63.28	62.97	57.51
		58.66	58.97	58.00	52.13	64.89	58.72	46.55	57.14	51.02	62.19
		55.09	56.43	49.82	57.63	55.70	66.32	63.51	55.20	63.62	60.98
		58.57	55.45	58.31	56.01	45.32	53.05	46.63	55.88	59.95	60.60
		50.79	62.81	54.01	51.93	60.13	59.82	53.70	50.40	57.81	62.01
		56.24	62.05	58.98	54.87	53.83	61.44	58.50	60.29	55.01	63.22
		53.92	53.30	55.75	58.93	55.64	51.43	57.90	49.17	49.85	57.01
		56.75	64.60	47.56	51.58	61.16	54.68	48.33	65.08	55.71	57.29
		56.53	62.22	51.72	58.97	42.50	58.21	54.35	56.76	57.79	50.29
		53.85	58.24	54.09	50.16	54.61	53.26	50.12	52.35	49.99	50.88
		55.52	54.25	57.03	52.28	56.60	48.41	58.39	65.25	65.56	57.51
		63.55	64.51	54.41	54.17	60.00	50.88	58.83	55.31	58.39	54.86
		51.18	55.61	60.42	58.50	58.43	55.25	58.27	50.03	61.49	64.54
		61.71	49.40	62.69	60.39	63.96	58.79	62.64	59.64	61.86	58.36
		58.15	63.21	60.07	56.36	57.41	63.43	56.87	53.29	59.46	52.97
		56.04	58.15	62.53	61.56	56.42	54.02	60.27	54.25	56.92	52.92
		57.90	42.27	58.12	52.21	59.28	55.62	49.62	58.90	58.00	60.17

Mean	57.04
(SD)	(4.77)
MIN	42.27
MAX	68.73

File Folder 11e
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Threeridge (*Amblema plicata*)
Data Source: "Native Mussel Length", THR; File Folder 11f
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-12-14

Threeridge *(A. plicata)* Length Summary

Mussel Species	N	Length (mm)									
THR	180	73.59	62.17	70.66	44.82	48.68	65.40	69.37	62.53	66.41	54.45
		65.38	59.31	70.07	63.42	63.28	78.60	64.55	66.94	50.04	59.96
		74.82	63.47	67.63	72.92	68.32	46.93	55.91	63.56	65.38	59.75
		60.87	64.40	49.80	61.80	66.65	44.92	69.58	69.91	52.83	68.16
		76.36	70.68	67.38	66.09	68.67	53.98	64.31	74.70	62.50	73.03
		67.00	62.99	55.65	70.23	73.09	67.14	49.76	57.90	74.78	61.22
		55.02	58.85	57.00	60.89	63.00	56.58	54.61	69.86	68.28	69.61
		59.72	61.58	68.51	62.87	61.36	58.54	63.85	53.55	71.93	55.90
		58.89	68.99	50.43	56.01	54.95	60.74	56.43	63.56	56.89	62.12
		61.88	60.82	55.73	62.60	66.77	74.45	64.40	62.47	62.41	55.25
		68.74	59.84	75.09	53.09	81.61	53.17	68.31	55.54	68.46	58.46
		62.22	50.86	52.59	53.09	56.22	65.59	62.15	59.40	59.60	66.59
		49.98	62.73	54.33	62.92	68.20	69.35	60.83	54.02	62.15	57.54
		65.94	44.08	57.91	50.85	88.56	74.97	82.67	65.74	82.30	74.93
		76.40	68.23	61.24	55.62	67.66	65.83	70.38	59.04	54.79	63.80
		68.24	68.12	70.04	63.23	77.14	77.98	71.53	63.66	86.40	58.82
		75.91	58.74	60.54	50.31	58.98	58.87	51.78	43.80	76.42	61.21
		77.39	73.29	66.96	56.32	56.92	61.62	53.10	60.39	62.94	66.60

Mean	63.18
(SD)	(8.30)
MIN	43.80
MAX	88.56

File Folder 11f
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
Data Source: "Native Mussel Length", PIG; File Folder 11g
Electronic Log (Pages 5-6)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12/12/4

Wabash Pigtoe *(F. flava)* Length Summary

Mussel Species	N	Length (mm)									
PIG	144	52.32	44.16	55.20	51.45	50.69	45.26	63.08	57.18	67.05	59.24
		73.64	50.83	64.72	63.07	54.57	55.21	49.57	55.00	51.21	47.31
		52.07	50.74	53.11	59.11	47.39	56.75	40.90	55.91	62.48	58.23
		55.31	49.32	49.06	53.27	55.84	41.13	50.95	45.11	64.22	42.55
		51.06	42.87	57.60	57.66	55.96	73.50	66.71	51.56	52.23	51.93
		39.90	52.92	53.75	59.58	55.11	55.56	57.79	44.95	47.80	45.34
		61.40	58.41	45.99	46.25	49.87	43.44	48.87	60.47	52.73	53.97
		62.15	45.93	49.64	46.03	68.26	42.47	52.84	61.51	46.65	42.95
		48.60	49.68	45.76	39.97	64.19	55.61	53.96	47.80	49.83	51.00
		43.64	40.57	40.64	46.76	38.47	38.05	33.82	73.65	69.95	55.78
		58.60	52.51	56.53	50.71	47.33	48.93	43.87	38.16	51.47	50.42
		50.41	53.62	57.92	40.82	50.09	52.73	45.42	50.83	42.65	46.60
		48.36	42.99	39.55	48.83	40.36	43.68	43.10	54.41	41.40	44.19
		37.05	57.92	43.16	49.05	40.49	55.99	64.24	50.55	43.11	51.09
		43.23	48.83	41.91	36.07						

Mean	51.07
(SD)	(8.00)
MIN	33.82
MAX	73.65

File Folder 11g
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06 Electronic Log (pages 10-11) Data Source: "Mussel Histology Samples" File Folder 7	Action	Date	Initials
	Created.....	5/7/2013	KLW
	Revised.....	4/23/2014	KLW
	Reviewed...	23 APR 14	
	Certified.....	12/12/14	

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]Native Mussel Histology Cover

Histology Summary

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Filename(s)

I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]PPB Histology
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]HIC Histology
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]FAM Histology
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]THR Histology
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Mussel Histology Summary.xlsx]PIG Histology

Test Organisms:
Common name, scientific name, three letter abbreviation
Plain Pocketbook, *Lampsilis cardium,* PPB
Hickorynut, *Obovaria olivaria,* HIC
Fatmucket, *Lampsilis siliquoidea,* FAM
Threeridge, *Amblema plicata,* THR
Wabash Pigtoe, *Fusconaia flava,* PIG

Data Explanation:
Three mussels of each species, excluding WAS and HGE, originating from each test tank and exposure duration were sampled for histological examination 28 days post-exposure. A total of 54 mussels (3 per test tank × 9 test tanks × 2 exposure durations) of each species were sampled.
Species (Three Letter Abbreviation)
Test Tank #: 1-9
Treatment Group: Control (0 mg/L), 50 mg/L, and 100 mg/L
Exposure Duration: 8 Hour or 24 Hour
Tag ID: Letter Prefix and code number (i.e. A123)
Number of Cassettes: Total number of cassettes used to contain an individual mussel tissue for histological examination.
Container Number: Storage container where individual mussel histology cassette is located.

Data Anomalies and Deviations:
NONE

File Folder 7
Item Number 3
Page 1 of 6

Study Number: AEH-13-PSEUDO-06
Electronic Log (pages 10-11)
Data Source: "Mussel Histology Samples" File Folder 7

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Plain Pocketbook (*L. cardium*) Histology

Mussel Species	Test Tank	Treatment Group (mg/L)	Exposure Duration	Tag ID	Number of Cassettes	Container Number
PPB	1	100	8	A204	1	2
				A270	1	2
				A300	1	3
			24	A284	1	10
				A189	1	11
				A313	1	11
	2	100	8	A269	1	5
				A338	1	5
				A311	1	6
			24	A256	1	13
				A335	1	14
				A274	1	15
	3	50	8	A183	1	2
				A250	1	3
				A340	1	3
			24	A232	1	11
				A341	1	12
				A323	1	12
	4	50	8	A200	1	5
				A329	1	6
				A215	1	6
			24	A265	1	13
				A181	1	13
				A208	1	15
	5	CONTROL	8	A279	1	2
				A257	1	3
				A285	1	3
			24	A251	1	11
				A275	1	11
				A197	1	12
	6	50	8	A236	1	8
				A219	1	9
				A233	1	9
			24	A203	1	17
				A314	1	17
				A182	1	18
	7	CONTROL	8	A258	1	6
				A297	1	6
				A337	1	6
			24	A305	1	13
				A195	1	15
				A276	1	15
	8	CONTROL	8	A249	1	8
				A348	1	8
				A253	1	8
			24	A309	1	17
				A217	1	18
				A266	1	18
	9	100	8	A228	1	7
				A196	1	8
				A280	1	9
			24	A206	1	18
				A319	1	18
				A260	1	18

Study Number: AEH-13-PSEUDO-06
Electronic Log (pages 10-11)
Data Source: "Mussel Histology Samples" File Folder 7

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Hickorynut (*O. olivaria*) Histology Samples

Mussel Species	Test Tank	Treatment Group (mg/L)	Exposure Duration	Tag ID	Number of Cassettes	Container Number
HIC	1	100	8	D007	1	1
				D028	1	2
				D172	1	3
			24	D137	1	11
				D100	1	11
				D080	1	12
	2	100	8	D013	1	4
				D102	1	6
				D168	1	6
			24	D019	1	13
				D063	1	14
				D166	1	14
	3	50	8	D186	1	1
				D005	1	1
				D073	1	2
			24	D095	1	10
				D056	1	10
				D021	1	11
	4	50	8	D006	1	4
				D094	1	5
				D129	1	6
			24	D148	1	13
				D018	1	13
				D122	1	13
	5	CONTROL	8	D053	1	2
				D012	1	2
				D092	1	2
			24	D139	1	11
				D020	1	11
				D069	1	12
	6	50	8	D111	1	7
				D130	1	8
				D097	1	9
			24	D185	1	18
				D091	1	18
				D178	1	18
	7	CONTROL	8	D183	1	4
				D001	1	4
				D085	1	4
			24	D143	1	13
				D117	1	13
				D083	1	13
	8	CONTROL	8	D164	1	7
				D176	1	8
				D142	1	8
			24	D167	1	16
				D002	1	18
				D127	1	18
	9	100	8	D060	1	7
				D088	1	9
				D145	1	9
			24	D040	1	18
				D089	1	18
				D105	1	18

Study Number: AEH-13-PSEUDO-06
Electronic Log (pages 10-11)
Data Source: "Mussel Histology Samples" File Folder 7

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Threeridge (*A. plicata*)Histology Samples

Mussel Species	Test Tank	Treatment Group (mg/L)	Exposure Duration	Tag ID	Number of Cassettes	Container Number
THR	1	100	8	C073	1	1
				C062	1	1
				C170	1	1
			24	C093	2	10
				C024	1	10
				C059	1	10
	2	100	8	C079	1	4
				C023	1	4
				C113	1	4
			24	C125	1	13
				C134	1	14
				C003	2	15
	3	50	8	C087	1	1
				C159	1	2
				C045	1	2
			24	C174	1	10
				C009	1	11
				C133	1	4
	4	50	8	C067	1	4
				C074	1	5
				C121	2	14
			24	C148	1	14
				C053	2	15
				C183	1	1
	5	CONTROL	8	C111	1	1
				C043	1	2
				C081	1	10
			24	C018	1	10
				C011	1	10
				C021	1	11
	6	50	8	C088	1	8
				C089	1	8
				C167	2	9
			24	C077	1	16
				C171	1	17
				C181	1	17
	7	CONTROL	8	C036	1	4
				C065	1	4
				C057	2	4
			24	C146	1	14
				C044	1	14
				C027	2	15
	8	CONTROL	8	C049	2	7
				C090	2	8
				C039	1	9
			24	C097	1	16
				C151	1	16
				C070	1	17
	9	100	8	C050	1	7
				C048	1	8
				C013	1	9
			24	C119	1	16
				C115	1	16
				C075	1	17

Study Number: AEH-13-PSEUDO-06
Electronic Log (pages 10-11)
Data Source: "Mussel Histology Samples" File Folder 7

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Fatmucket (*L. siliquoidea*) Histology Samples

Mussel Species	Test Tank	Treatment Group (mg/L)	Exposure Duration	Tag ID	Number of Cassettes	Container Number
FAM	1	100	8	D270	1	1
				D269	1	2
				D310	1	3
			24	D203	1	10
				D264	1	11
				D335	1	12
	2	100	8	D326	1	5
				D265	1	6
				D256	1	6
			24	D319	1	13
				D267	1	13
				D299	1	13
	3	50	8	D300	1	1
				D332	1	2
				D211	1	3
			24	D283	1	11
				D232	1	12
				D351	1	12
	4	50	8	D215	1	5
				D309	1	5
				D349	1	6
			24	D289	1	13
				D337	1	15
				D278	1	15
	5	CONTROL	8	D327	1	1
				D288	1	1
				D214	1	3
			24	D358	1	11
				D297	1	12
				D286	1	12
	6	50	8	D322	1	7
				D249	1	7
				D320	1	9
			24	D366	1	17
				D342	1	17
				D195	1	17
	7	CONTROL	8	D268	1	4
				D344	1	5
				D192	1	6
			24	D234	1	14
				D200	1	15
				D295	1	15
	8	CONTROL	8	D238	1	9
				D360	1	9
				D314	1	9
			24	D206	1	16
				D331	1	16
				D341	1	18
	9	100	8	D252	1	8
				D246	1	8
				D219	1	9
			24	D312	1	16
				D187	1	17
				D275	1	17

Study Number: AEH-13-PSEUDO-C6
Electronic Log (pages 10-11)
Data Source: "Mussel Histology Samples" File Folder 7

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Wabash Pigtoe (*F. flava*) Histology Samples

Mussel Species	Test Tank	Treatment Group (mg/L)	Exposure Duration	Tag ID	Number of Cassettes	Container Number
PIG	1	100	8	B179	1	1
				B251	1	2
				B272	1	2
			24	B303	1	10
				B256	1	10
				B273	1	11
	2	100	8	B206	1	4
				B199	1	5
				B210	1	5
			24	B184	1	13
				B207	2	14
				B250	1	14
	3	50	8	B208	1	1
				B270	1	3
				B222	1	3
			24	B186	1	10
				B163	1	12
				B261	1	12
	4	50	8	B294	1	5
				B236	1	5
				B231	1	6
			24	B183	1	13
				B178	1	13
				B215	1	15
	5	CONTROL	8	B164	1	2
				B259	1	2
				B244	1	3
			24	B266	1	10
				B249	1	11
				B182	1	12
	6	50	8	B243	1	7
				B198	1	8
				B241	1	9
			24	B302	1	16
				B173	1	17
				B286	1	17
	7	CONTROL	8	B274	1	5
				B282	1	5
				B227	1	6
			24	B291	1	14
				B190	1	15
				B268	1	15
	8	CONTROL	8	B287	1	7
				B258	1	8
				B296	1	9
			24	B169	1	16
				B288	1	16
				B202	1	17
	9	100	8	B226	1	7
				B247	1	7
				B304	1	9
			24	B180	1	16
				B300	1	17
				B234	1	18

File Folder 7
Item Number 3
Page 6 of 6

Appendix 6. Water Quality

Item Number	Item Description	Number of Pages	Report Page Number
1	Water Chemistry – Data Summary (Preexposure and exposure)	4	155
2	Ammonia – Data Summary	3	159
3	Report of Analysis – Ammonia Report from Water Quality Laboratory at UMESC	1	162
4	Data Logger (HOBO) 30 day Temperature Summary – Data Summary	4	163

Study Number: AEH-13-PSEUDO-06	Action	Date	Initials
Electronic logbook (pages: 10)	Created.....	6/11/2014	KLW
File Folder: 10	Revised.....	4/24/2014	KLW
Forms: Alka lnity, Hardness and Conductivity, Water Quality	Reviewed...	24APR14	
	Certified...	12/12/14	

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Water Chem.xlsx]Pre-Exposure Water Chem.

Pre-Exposure Water Chemistry

Test Article: *Pseudomonas fluorescens Pf* -CL 145A (SDP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Test Organisms:
Common name, scientific name, three letter abbreviation
Plain Pocketbook, *Lampsilis cardium,* PPB
Hickorynut, *Obovaria olivaria,* HIC
Washboard, *Megalonaias nervosa,* WAS
Higgins Eye, *Lampsilis higginsii,* HGE
Fatmucket, *Lampsilis siliquoidea,* FAM
Threeridge, *Amblema plicata* , THR
Wabash Pigtoe, *Fusconaia flava,* PIG

Data Explanation:
Pre-Exposure Water Chemistry - Dissolved oxygen, pH, and temperature were measured prior to exposure initiation in all test tanks. Alkalinity, hardness, and conductivity were measured in water samples collected from the head-boxes. (Head-box 1 supplied test tanks 1-5; head-box 2 supplied test tank 6-9.)

Data anomalies and deviations
NONE

File Folder 10
Item Number 1
Page 1 of 4

Study Number: AEH-13-PSEUDO-06
Electronic logbook (pages: 8-10)
File Folder: 10
Forms: Alkalinity, Hardness and Conductivity, Water Quality

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Mixed from MBI)
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Pre-Exposure Water Chemistry

Treatment Group (mg/L)	Test Tank	pH	DO (mg/L)	Temp (°C)
0	5	7.19	6.67	16.2
	7	7.15	6.56	16.2
	8	7.16	6.54	16.2
Mean		N/A	6.59	16.2
(SD)		N/A	*(0.06)*	*(0.0)*
50	3	7.16	6.67	16.2
	4	7.18	6.65	16.2
	6	7.17	6.60	16.2
Mean		N/A	6.64	16.2
(SD)		N/A	*(0.03)*	*(0.0)*
100	1	7.06	6.77	16.3
	2	7.18	6.73	16.2
	9	7.17	6.56	16.2
Mean		N/A	6.69	16.2
(SD)		N/A	*(0.09)*	*(0.0)*
	Grand Mean	N/A	6.64	16.2
	(SD)	N/A	*(0.04)*	*(0.0)*
	MIN	7.06	6.54	16.2
	MAX	7.19	6.77	16.3

Headbox Number	Alkalinity (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (µS)
1	47	62	103.2
2	42	52	106.6

Study Number: AEH-13-PSEUDO-06	Action	Date	Initials
Electronic logbook (pages: 8-10)	Created.....	6/11/2013	KLW
File Folder: 10	Revised.....	4/24/2014	KLW
Forms: Alkalinity, Hardness and Conductivity, Water Quality	Reviewed...	24 APR 2014	
	Certified...	12/12/14	

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Water Chem.xlsx]Exposure Water Chem.

Exposure Period Water Chemistry

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Test Organisms:
Common name, scientific name, three letter abbreviation
Plain Pocketbook, *Lampsilis cardium*, PPB
Hickorynut, *Obovaria olivaria*, H C
Washboard, *Megalonaias nervosa*, WAS
Higgins Eye, *Lampsilis higginsii*, HGE
Fatmucket, *Lampsilis siliquoidea*, FAM
Threeridge, *Amblema plicata*, THR
Wabash Pigtoe, *Fusconaia flava*, PIG

Data Explanation:
Exposure Period Water Chemistry- Dissolved oxygen, pH, and temperature were measured and recorded at 1, 6, 8, 12, 18, and 24h. Water samples were collected from all test tanks to measure alkalinity, hardness, and conductivity 3 hours after treatment administration.

Data anomalies and deviations
NONE

Study Number: AEH-13-PSEUDO-06
Electronic logbook (pages: 10-11)
File Folder 10
Forms: Alkalinity, Hardness and Conductivity, Water Quality

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Mixed from MBI)
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Exposure Period Water Chemistry

Treatment Group (mg/L)	Test Tank	1 Hour			6 Hour			8 Hour			12 Hour			18 Hour			24 Hour		
		DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)
0	5	6.30	7.07	16.8	5.48	7.00	17.8	4.73	6.97	18.1	4.27	6.45	18.6	3.44	7.02	18.7	2.76	6.99	18.8
	7	6.32	7.08	16.8	5.27	6.98	17.5	5.04	6.94	18.0	4.21	6.62	18.2	3.26	6.99	18.4	2.45	6.9C	18.5
	8	6.33	7.07	16.8	5.40	6.98	17.8	4.77	6.94	18.1	4.07	6.71	18.3	3.12	7.02	18.5	2.91	6.94	18.6
Mean		6.32	N/A	16.8	5.38	N/A	17.7	4.85	N/A	18.1	4.18	N/A	18.4	3.27	N/A	18.5	2.71	N/A	18.6
(SD)		*(0.01)*	*N/A*	*(0.0)*	*(0.09)*	*N/A*	*(0.1)*	*(0.14)*	*N/A*	*(0.0)*	*(0.08)*	*N/A*	*(0.2)*	*(0.13)*	*N/A*	*(0.1)*	*(0.19)*	*N/A*	*(0.1)*
50	3	6.50	7.04	16.8	5.85	6.99	17.6	5.45	6.92	17.9	4.40	6.72	18.2	0.56	6.77	18.4	0.04	6.40	18.6
	4	6.55	7.05	16.9	5.85	6.99	18.0	5.46	6.93	18.2	4.55	6.82	18.6	0.51	6.79	18.7	0.04	6.39	18.8
	6	6.45	7.06	16.8	5.78	7.00	17.8	5.54	6.94	18.0	4.20	6.76	18.3	0.82	6.80	18.5	0.05	6.42	18.6
Mean		6.51	N/A	16.8	5.83	N/A	17.8	5.48	N/A	18.0	4.38	N/A	18.4	0.63	N/A	18.5	0.04	N/A	18.7
(SD)		*(0.04)*	*N/A*	*(0.0)*	*(0.03)*	*N/A*	*(0.2)*	*(0.04)*	*N/A*	*(0.1)*	*(0.14)*	*N/A*	*(0.2)*	*(0.14)*	*N/A*	*(0.1)*	*(0.00)*	*N/A*	*(0.1)*
100	1	6.42	6.97	16.9	5.70	6.97	18.0	5.34	6.93	18.3	4.19	6.84	18.5	0.17	6.65	18.7	0.03	6.10	18.8
	2	6.60	7.02	16.9	5.79	6.99	17.7	5.51	6.93	18.0	4.03	6.86	18.3	0.16	6.66	18.4	0.04	6.13	18.6
	9	6.61	7.05	16.9	5.79	6.99	17.9	5.40	6.93	18.3	4.24	6.83	18.4	0.15	6.63	18.6	0.03	6.05	18.8
Mean		6.54	N/A	16.9	5.76	N/A	17.9	5.42	N/A	18.2	4.15	N/A	18.4	0.16	N/A	18.6	0.03	N/A	18.7
(SD)		*(0.09)*	*N/A*	*(0.0)*	*(0.04)*	*N/A*	*(0.1)*	*(0.07)*	*N/A*	*(0.1)*	*(0.09)*	*N/A*	*(0.1)*	*(0.01)*	*N/A*	*(0.1)*	*(0.00)*	*N/A*	*(0.1)*
Grand Mean		6.46	N/A	16.8	5.66	N/A	17.8	5.25	N/A	18.1	4.24	N/A	18.4	1.35	N/A	18.5	0.93	N/A	18.7
(SD)		*(0.10)*	*N/A*	*(0.0)*	*(0.20)*	*N/A*	*(0.1)*	*(0.29)*	*N/A*	*(0.1)*	*(0.10)*	*N/A*	*(0.0)*	*(1.37)*	*N/A*	*(0.0)*	*(1.26)*	*N/A*	*(0.0)*
Minimum		6.30	6.97	16.8	5.27	6.97	17.5	4.73	6.92	17.9	4.03	6.45	18.2	0.15	6.63	18.4	0.03	6.05	18.5
Maximum		6.61	7.08	16.9	5.85	7.00	18.0	5.54	6.97	18.3	4.55	6.86	18.6	3.44	7.02	18.7	2.91	6.99	18.8

Treatment Group (mg/L)	Test Tank	3 Hour		
		Conductivity (µS)	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)
0	5	103.1	52	42
	7	100.8	50	42
	8	106.3	54	42
Mean		103.4	52.0	42
(SD)		*(2.3)*	*(1.6)*	*(0.0)*
50	3	110.9	52	43
	4	111.2	54	43
	6	111.4	52	42
Mean		111.2	52.7	43
(SD)		*(0.2)*	*(0.9)*	*(0.5)*
100	1	115.6	52	45
	2	114.2	54	45
	9	115.5	54	43
Mean		115.1	53.3	44
(SD)		*(0.5)*	*(0.9)*	*(0.9)*
Grand Mean		110	53	43
(SD)		*(5)*	*(1)*	*(1)*
Minimum		101	50	42
Maximum		116	54	45

File Folder 10
Item Number 1
Page 4 of 4

Study Number: AEH-13-PSEUDO-06	Action	Date	Initials
Electronic Log (Page 8)	Created.....	1/19/2014	JKW
TAN Data Source: LTRMP Report (File Folder 10)	Revised.....	4/25/2014	KLW
pH and Temperature Data Source: File Folder 10; 24h Water Quality	Reviewed...	25APR14	
	Certified.....	12/12/14	

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Ammonia Data.xlsx]Ammonia Coversheet

Total Nitrogen and Un-ionized Ammonia

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SOP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Data Explanation:

1) Water samples were collected at 24h immediately prior to exposure termination from each exposure tank, filtered (0.45 µm), acidified with sulfuric acid and stored at 4°C until analyzed for total ammonia nitrogen (TAN) content using the Automated Phenate Method (Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005) on a Technicon Autoanalyzer II by the UMESC water quality laboratory.
2) The un-ionized ammonia fractions were calculated using the sample pH and temperature measured at the time of sample collection according to the formula in Emerson et al. (1975).

Data Anomalies and Deviations:

NONE

File Folder 10
Item Number 2
Page 1 of 3

Study Number: AEH-13-PSEUDO-06
Electronic Log (Page 8)
TAN Data Source: LTRMP Report (File Folder 10)
pH and Temperature Data Source: File Folder 10; 24h Water Quality
File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Ammonia Data.xlsx]Ammonia Data

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Test Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Total Nitrogen and Un-ionized Ammonia

Treatment Group (mg/L)	Tank	pH	Temp (°C)	TAN as NH_3-N (mg/L)	Mean TAN as NH_3-N (mg/L)	SD	Un-ionized Fraction[1]	NH_3 (mg/L)[2]	Mean NH_3 (mg/L)	SD
Control	5	6.99	18.8	0.242	0.252	0.007	0.0035	0.000854	0.000790	0.000053
	7	6.90	18.5	0.258			0.0028	0.000724		
	8	6.94	18.6	0.255			0.0031	0.000791		
50	3	6.40	18.6	0.071	0.066	0.005	0.0009	0.000064	0.000060	0.000003
	4	6.39	18.8	0.067			0.0009	0.000060		
	6	6.42	18.6	0.059			0.0009	0.000055		
100	1	6.10	18.8	0.089	0.066	0.021	0.0005	0.000041	0.000030	0.000010
	2	6.13	18.6	0.070			0.0005	0.000034		
	9	6.05	18.8	0.039			0.0004	0.000016		

[1] Un-ionized fraction (f) is calculated based on the following formula (Emerson et al. 1975): $f = \frac{1}{(10^{pKa-pH})+1}$; $pKa = 0.09018 + \frac{2729.92}{T_k}$

$T_k = T_c + 273.15$; $pKa = 0.09018 + \frac{2729.92}{(273.15 + T_c)}$; The final calculation used is then: $f = \frac{1}{\left\{\left[10^{\left(0.09018 + \left(\frac{2729.92}{(273.15+T_c)}\right)\right)-pH}\right]+1\right\}}$

[2] Un-ionized ammonia is calculated based on the following formula: Un-ionized ammonia = f * TAN (mg/L)

Study Number: AEH-13-PSEUDO-06

Electronic Log (Page 8)

TAN Data Source: LTRMP Report (File Folder 10)

pH and Temperature Data Source: File Folder 10; 24h Water Quality

File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Ammonia Data.xlsx]Ammonia Data Formula

Test Article: *Pseudomonas fluorescens* Pf-CL 145A (SDP)

Test Article lot #: 401P12163C and 401P12164C Mix

Exposure Date: 5/29/2013

Assessment Dates: 6/26-27/2013

Total Nitrogen and Un-ionized Ammonia

Treatment Group (mg/L)	Tank	pH	Temp (°C)	TAN as NH_3-N (mg/L)	Mean TAN as NH_3-N (mg/L)	SD	Un-ionized Fraction[1]	NH_3 (mg/L)[2]	Mean NH_3 (mg/L)	SD
Control	5	6.99	18.8	0.242	x=AVERAGE(F11:F13)	x=(STDEV.P(F11:F13))	x=1/(10^(0.09018+(2729.92/(273.15+E11))-D11)+1)	x=I11*F11	x=AVERAGE(J11:J13)	x=STDEV.P(J11:J13)
	7	6.90	18.5	0.258			x=1/(10^(0.09018+(2729.92/(273.15+E12))-D12)+1)	x=I12*F12		
	8	6.94	18.6	0.255			x=1/(10^(0.09018+(2729.92/(273.15+E13))-D13)+1)	x=I13*F13		
50	3	6.40	18.6	0.071	x=AVERAGE(F14:F16)	x=(STDEV.P(F14:F16))	x=1/(10^(0.09018+(2729.92/(273.15+E14))-D14)+1)	x=I14*F14	x=AVERAGE(J14:J16)	x=STDEV.P(J14:J16)
	4	6.39	18.8	0.067			x=1/(10^(0.09018+(2729.92/(273.15+E15))-D15)+1)	x=I15*F15		
	6	6.42	18.6	0.059			x=1/(10^(0.09018+(2729.92/(273.15+E16))-D16)+1)	x=I16*F16		
100	1	6.10	18.8	0.089	x=AVERAGE(F17:F19)	x=(STDEV.P(F17:F19))	x=1/(10^(0.09018+(2729.92/(273.15+E17))-D17)+1)	x=I17*F17	x=AVERAGE(J17:J19)	x=STDEV.P(J17:J19)
	2	6.13	18.6	0.070			x=1/(10^(0.09018+(2729.92/(273.15+E18))-D18)+1)	x=I18*F18		
	9	6.05	18.8	0.089			x=1/(10^(0.09018+(2729.92/(273.15+E19))-D19)+1)	x=I19*F19		

[1] Un-ionized fraction (f) is calculated based on the following formula (Emerson et al. 1975): $f = \frac{1}{(10^{pKa-pH})+1}$; $pKa = 0.09018 + \frac{2729.92}{T_k}$

$T_k = T_c + 273.15$; $pKa = 0.09018 + \frac{2729.92}{(273.15 + T_c)}$. The final calculation used is then: $f = \frac{1}{\left\{\left[10^{\left(0.09018+\left\{\frac{2729.92}{(273.15+T_c)}\right\}\right)-pH}\right]+1\right\}}$

[2] Un-ionized ammonia is calculated based on the following formula: Un-ionized ammonia = f * TAN (mg/L)

File Folder: 10

Item Number: 8

Page 3 of 3

Sample Description: 3 mL acidified exposure water (0.45 µm filtrated)
Study #: AEH-13-PSEUDO-06

Upper Midwest Environmental Sciences Center
attn: James Luoma
2630 Fanta Reed Road
La Crosse, WI54603

Water Quality Laboratory
Upper Midwest Environmental Sciences Center
USGS
2630 Fanta Reed Road
La Crosse, WI 54603

Analyzing Date:06/13/2013
Report Date: 06/19/2013

REPORT OF ANALYSIS

Sample Code	Results (Total Ammonia Nitrogen, mg NH_3-N/L)
BRT24HT1C100	0.089
BRT24HT2C100	0.07
BRT24HT3C50	0.071
BRT24HT4C50	0.067
BRT24HT5C0	0.242
BRT24HT6C50	0.059
BRT24HT7C0	0.258
BRT24HT8C0	0.255
BRT24HT9C100	0.039

USGS
Water Quality Laboratory
Laboratory Director

[redacted]
Xiaoli Yuan

Item Number: 14

File Folder: 10 Page 1 of 1

Study Number: AEH-13-PSEUDO-06	Action	Date	Initials
Electronic Log: N/A	Created.....	1/31/2014	JKW
Data Source: Temperature Logger outputs: I:\AEH-13-PSEUDO-06\Data\HOBO Data	Revised.....	4/25/2014	KLW
Forms: N/A	Reviewed...	2/5/14	
File Folder: 10	Certified...	2/12/14	
File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSUEDO-06 30 Day Temp Logger Summary.xlsx]Data Logger Coversheet			

HOBO Data Logger Post-Exposure Temperature Summary

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Received mixed from MBI)
Test Location: Black River, La Crosse, W
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Data Logger 1	Serial number: 10020139
Data Logger 2	Serial number: 10350145
Data Logger 3	Serial number: 10020134
Data Logger 4	Serial number: 10020138
Data Logger 5	Serial number: 10020141

Data Explanation:
Date: Date of temperature data collection, 5/30/2013-6/27/2013
Time: Specific time associated with individual temperature data point. Gathered daily at 0000, 0600, 1200, and 1800h.
Data Logger #: All temperature data points recorded by specific data logger over 30 day holding period.
Mean and Standard Deviation: Mean temperature and standard deviation of temperatures recorded from all five data loggers from a given day.

Data anomalies and deviations:
Temperatures recorded on 5/30/2013 and at 12:00:00 on 6/27/2013 were omitted from data analysis as some data loggers were not situated in water when data points were logged. Retaining these data points would skew mean temperature.

Post-exposure Temperature Summary		
Date	Mean	*(SD)*
5/31/2013	19.01	*(0.72)*
6/1/2013	20.42	*(0.09)*
6/2/2013	20.05	*(0.32)*
6/3/2013	19.10	*(0.25)*
6/4/2013	19.51	*(0.34)*
6/5/2013	18.15	*(0.25)*
6/6/2013	17.41	*(0.18)*
6/7/2013	16.89	*(0.23)*
6/8/2013	18.57	*(0.77)*
6/9/2013	18.26	*(0.60)*
6/10/2013	18.02	*(0.18)*
6/11/2013	19.53	*(0.36)*
6/12/2013	20.21	*(0.38)*
6/13/2013	20.76	*(0.86)*
6/14/2013	21.94	*(0.44)*
6/15/2013	22.39	*(0.39)*
6/16/2013	23.12	*(0.63)*
6/17/2013	24.43	*(0.41)*
6/18/2013	25.00	*(0.26)*
6/19/2013	23.76	*(0.64)*
6/20/2013	24.08	*(0.65)*
6/21/2013	24.12	*(0.35)*
6/22/2013	24.03	*(0.37)*
6/23/2013	23.80	*(0.30)*
6/24/2013	24.05	*(0.11)*
6/25/2013	23.63	*(0.19)*
6/26/2013	24.45	*(0.82)*
6/27/2013	24.85	*(0.12)*

File Folder 10
Item Number 15
Page 1 of 4

Study Number: AEH-13-PSEUDO-06
Electronic logbook: N/A
Data Source: File Folder 10
Forms: N/A
File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSUEDO-06 30 Day Temp Logger Summary.xlsx]Data Logger All Data

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Mixed from MBI)
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Post-Exposure Temperature Summary

Date	Time	Data Logger Number 1	2	3	4	5	Mean (STD)
		Temperature (°C)					
05/30/13	12:00:00[1]	24.448[1]	23.773[1]	18.806[1]	25.222[1]	24.448[1]	
	18:00:00[1]	18.045[1]	17.950[1]	17.950[1]	18.140[1]	17.855[1]	
05/31/13	00:00:00	18.331	18.236	18.331	18.426	18.236	19.01
	06:00:00	18.521	18.521	18.521	18.616	18.331	*(0.72)*
	12:00:00	19.092	19.092	19.092	19.187	18.996	
	18:00:00	20.138	20.138	20.138	20.234	20.043	
06/01/13	00:00:00	20.424	20.329	20.329	20.519	20.329	20.42
	06:00:00	20.424	20.424	20.424	20.424	20.234	*(0.09)*
	12:00:00	20.424	20.424	20.424	20.519	20.329	
	18:00:00	20.519	20.424	20.519	20.615	20.329	
06/02/13	00:00:00	20.519	20.519	20.519	20.615	20.424	20.05
	06:00:00	20.138	20.138	20.138	20.234	20.043	*(0.32)*
	12:00:00	19.853	19.758	19.758	19.948	19.758	
	18:00:00	19.758	19.758	19.758	19.853	19.567	
06/03/13	00:00:00	19.567	19.472	19.472	19.567	19.377	19.10
	06:00:00	19.092	19.092	19.092	19.187	18.901	*(0.25)*
	12:00:00	18.996	18.901	18.901	18.996	18.806	
	18:00:00	18.901	18.90[illegible]	18.901	18.996	18.806	
06/04/13	00:00:00	19.662	19.472	19.567	20.138	19.758	19.51
	06:00:00	19.662	19.662	19.758	20.138	19.758	*(0.34)*
	12:00:00	19.567	19.472	19.472	19.662	19.377	
	18:00:00	19.092	18.996	18.996	19.092	18.901	
06/05/13	00:00:00	18.616	18.521	18.521	18.616	18.426	18.15
	06:00:00	18.236	18.140	18.140	18.236	18.045	*(0.25)*
	12:00:00	18.045	17.950	17.950	18.045	17.855	
	18:00:00	17.950	17.950	17.950	18.045	17.855	
06/06/13	00:00:00	17.665	17.665	17.665	17.760	17.570	17.41
	06:00:00	17.475	17.379	17.379	17.475	17.284	*(0.18)*
	12:00:00	17.379	17.379	17.379	17.475	17.284	
	18:00:00	17.284	17.189	17.189	17.284	17.094	
06/07/13	00:00:00	17.094	16.999	16.999	17.094	16.903	16.89
	06:00:00	16.713	16.713	16.713	16.808	16.523	*(0.23)*
	12:00:00	16.713	16.618	16.713	16.808	16.618	
	18:00:00	17.189	17.094	17.094	17.378	17.094	
06/08/13	00:00:00	18.331	18.236	18.331	18.426	18.236	18.57
	06:00:00	18.236	18.140	18.140	18.236	18.045	*(0.77)*
	12:00:00	17.950	17.760	17.855	18.236	17.950	
	18:00:00	19.853	19.567	19.758	20.234	19.853	
06/09/13	00:00:00	18.711	18.806	18.996	19.472	18.996	18.25
	06:00:00	18.521	18.616	18.616	18.711	18.521	*(0.60)*
	12:00:00	17.570	17.475	17.475	17.570	17.379	
	18:00:00	17.950	17.855	17.950	18.140	17.855	

[1] Temperatures from these time points not used in mean and standard deviation calculation as mussel holding cages may not have been submerged when data was recorded.

Study Number: AEH-13-PSEUDO-06
Electronic logbook: N/A
Data Source: File Folder 10
Forms: N/A
File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSUEDO-06 30 Day Temp Logger Summary.xlsx]Data Logger All Data

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Mixed from VBI)
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Date	Time	Data Logger Number 1	2	3	4	5	Mean (STD)
		Temperature (°C)					
06/10/13	00:00:00	18.045	18.045	18.045	18.140	17.950	18.02 (0.18)
	06:00:00	17.855	17.760	17.855	17.950	17.665	
	12:00:00	17.950	17.950	17.950	18.045	17.855	
	18:00:00	18.236	18.236	18.238	18.426	18.140	
06/11/13	00:00:00	19.472	19.377	19.472	19.758	19.377	19.53 (0.36)
	06:00:00	19.662	19.567	19.758	19.948	19.662	
	12:00:00	18.996	18.996	18.996	19.282	18.806	
	18:00:00	19.853	19.853	19.853	20.138	19.853	
06/12/13	00:00:00	20.043	19.948	19.948	20.138	19.853	20.21 (0.38)
	06:00:00	20.234	20.234	20.234	20.329	20.138	
	12:00:00	19.948	19.853	19.853	20.043	19.758	
	18:00:00	20.615	20.329	20.519	21.378	20.805	
06/13/13	00:00:00	20.519	20.424	20.519	20.710	20.424	20.76 (0.86)
	06:00:00	20.234	20.043	20.138	20.329	20.043	
	12:00:00	20.138	20.043	20.043	20.615	20.138	
	18:00:00	22.142	21.760	21.855	22.812	22.333	
06/14/13	00:00:00	21.951	21.760	21.855	22.238	21.951	21.94 (0.44)
	06:00:00	21.664	21.569	21.569	21.664	21.473	
	12:00:00	21.664	21.569	21.569	21.760	21.473	
	18:00:00	22.429	22.429	22.525	23.100	22.525	
06/15/13	00:00:00	22.621	22.621	22.621	23.004	22.525	22.39 (0.39)
	06:00:00	22.238	22.238	22.238	22.333	22.046	
	12:00:00	21.855	21.855	21.855	21.951	21.760	
	18:00:00	22.812	22.717	22.717	23.004	22.717	
06/16/13	00:00:00	23.004	22.908	22.908	23.004	22.812	23.12 (0.63)
	06:00:00	22.621	22.525	22.525	22.621	22.429	
	12:00:00	22.908	22.812	22.812	23.004	22.717	
	18:00:00	24.158	24.158	24.158	24.448	23.966	
06/17/13	00:00:00	24.931	24.931	24.931	25.028	24.835	24.43 (0.41)
	06:00:00	24.158	24.158	24.158	24.255	24.062	
	12:00:00	23.966	23.869	23.966	24.062	23.869	
	18:00:00	24.545	24.545	24.641	25.125	24.545	
06/18/13	00:00:00	25.319	25.222	25.222	25.319	25.125	25.00 (0.28)
	06:00:00	24.641	24.545	24.641	24.641	24.448	
	12:00:00	25.028	24.931	25.028	25.319	24.931	
	18:00:00	25.125	25.028	25.125	25.416	24.931	
06/19/13	00:00:00	24.158	24.158	24.158	24.255	24.062	23.76 (0.64)
	06:00:00	23.100	23.004	23.004	23.004	22.908	
	12:00:00	23.388	23.292	23.292	23.388	23.196	
	18:00:00	24.545	24.545	24.545	24.835	24.448	
06/20/13	00:00:00	24.062	24.158	24.255	24.448	24.062	24.08 (0.65)
	06:00:00	23.388	23.388	23.388	23.388	23.196	
	12:00:00	23.773	23.677	23.677	23.773	23.581	
	18:00:00	25.125	25.028	25.028	25.222	24.931	
06/21/13	00:00:00	24.545	24.545	24.545	24.641	24.448	24.12 (0.35)
	06:00:00	24.255	24.255	24.255	24.351	24.158	
	12:00:00	23.677	23.581	23.581	23.677	23.484	
	18:00:00	24.062	24.062	24.062	24.158	23.966	

[1] Temperatures from these time points not used in mean and standard deviation calculation as mussel holding cages may not have been submerged when data was recorded.

Electronic logbook: N/A
Data Source: File Folder 10
Forms: N/A
File Name: I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSUEDO-06 30 Day Temp Logger Summary.xlsx]Data Logger All Data

Lot #: 401P12163C and 401P12164C (Mixed from MBI)
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Date	Time	Data Logger Number 1	2	3	4	5	Mean (STD)
		Temperature (°C)					
06/22/13	00:00:00	24.351	24.351	24.351	24.448	24.255	24.03
	06:00:00	23.773	23.773	23.773	23.773	23.677	(0.37)
	12:00:00	23.677	23.581	23.581	23.677	23.484	
	18:00:00	24.448	24.351	24.448	24.545	24.351	
06/23/13	00:00:00	24.255	24.255	24.255	24.351	24.158	23.80
	06:00:00	23.484	23.484	23.484	23.484	23.292	(0.30)
	12:00:00	23.773	23.677	23.773	23.773	23.581	
	18:00:00	23.773	23.773	23.773	23.869	23.677	
06/24/13	00:00:00	24.158	24.158	24.158	24.158	23.966	24.05
	06:00:00	23.966	23.869	23.966	23.966	23.773	(0.11)
	12:00:00	24.158	24.062	24.062	24.158	23.966	
	18:00:00	24.158	24.062	24.062	24.158	23.966	
06/25/13	00:00:00	23.966	23.869	23.869	23.966	23.773	23.63
	06:00:00	23.677	23.581	23.677	23.677	23.484	(0.19)
	12:00:00	23.484	23.484	23.484	23.484	23.292	
	18:00:00	23.581	23.484	23.484	23.869	23.388	
06/26/13	00:00:00	23.773	23.773	23.773	23.966	23.677	24.45
	06:00:00	23.773	23.677	23.677	23.869	23.581	(0.82)
	12:00:00	24.545	24.931	24.158	25.902	24.255	
	18:00:00	25.610	25.513	25.513	25.610	25.513	
06/27/13	00:00:00	25.028	24.931	24.931	25.028	24.835	24.85
	06:00:00	24.835	24.738	24.738	24.835	24.641	(0.12)
	12:00:00[1]	26.488[1]	25.222[1]	26.781[1]	26.977[1]	25.028[1]	

[1] Temperatures from these time points not used in mean and standard deviation calculation as mussel holding cages may not have been submerged when data was recorced.

File Folder 10
Item Number 15
Page 4 of 4

Appendix 7. Spectrophotometric Summary, SAS Program, Output and Log

Item Number	Item Description	Number of Pages	Report Page Number
1	Spectrophotometric Data – Data Summary with SAS output	18	168
2	SAS program; Exposure Concentration Analysis	2	186
3	SAS log; Exposure Concentration Analysis	5	188

Study Number: AEH-13-PSEUDO-06 Electronic Log (Pages 7-9) File Folder: 12 Data Source: DU800 spectrophotometer output (dated: May 29, 2013 to May 30, 2013)	Action	Date	Initials
	Created.....	6/11/2013	KLW
	Revised.....	4/25/2014	KLW
	Reviewed...	5/8/14	
	Certified.....	5/12/14	

Spectrophotometric Data

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP); lot #: 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Data Explanation:

1) Absorbance (660 nm) of water samples was measured on a DU800 spectrophotometer (S/N 8003098).
2) Triplicate standard dilutions of 25, 50, 100 and 200 mg/L were created from a 2,000 mg/L (A.I.) reference stock solution (Analytical Stock 1) for developing a linear regression. A second set of 25, 50, 100 and 200 mg/L standard check dilutions were created from a second 2,000 mg/L (A.I.) reference stock solution (Analytical Stock 2) for linear curve verification.
3) Data codes used within SAS
   - tank= Tank ID (1 through 9)
   - thero= theoretica concentration
   - time= sample time (0, 6, 12, 18, and 24 hours)
   - blank= indicates blank with filtered river water (r), or water from an untreated control tank (c)
   - abs= measured absorbance of sample
   - conc= known concentrations (linear regression standards used)
4) Information that is not relevant to a sample (i.e., enclosure ID for standards) or that will be calculated by SAS (i.e., predicted concentration for standard checks and samples) is denoted by a "." for input into SAS.

Data Analysis:

1) A linear regression was completed in SAS using the absorbance values of 3 replicate dilutions of 25, 50, 100 and 200 mg/L test article
2) Standard checks and exposure concentrations were predicted in SAS using the linear regression
3) The following mean exposure concentrations were determined in SAS:
   - 3a) Mean concentrations for each individual tank at each sampling time.
   - 3b) Mean concentrations of each treatment level, control 0 mg/L, 50 mg/L and 100 mg/L, at all sampling times.
   - 3c) Mean concentration of each treatment level and duration (8 hour treatment and 24 hour treatment).
   - 3d) Std Dev = Standard deviation (population) of each treatment for all time points.

File names:

Spectrophotometric Data for SAS Input
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Spectrophotometric Data.xlsx]SAS import

SAS Program/Code
I:\AEH-13-PSEUDO-06\Statistical analysis\Exposure Concentration\Treatment Concentration Program File

SAS Log
I:\AEH-13-PSEUDO-06\Statistical analysis\Exposure Concentration\Treatment Concentration Log File

SAS Output
I:\AEH-13-PSEUDO-06\Statistical analysis\Exposure Concentration\Treatment Concentration Results File

Data Anomalies and Deviations:

1) The linear curve and associated calculated concentrations created with the DU800 Spectrophotometer were not used in data analysis. All reported exposure concentrations were determined in SAS by comparison to a linear regression curve created from the absorbance values (650 nm)of known concentrations (50, 100, 200 and 300 mg/L) of test article gathered by the DU800 spectrophotometer. Linear regression equations (Appendix I, Item 1) were fit using the SAS Proc Reg procedure. Standard check and exposure sample concentrations were predicted from the regression analysis (Appendix G, Item 1). The Proc Means procedure was used to determine the mean exposure concentration of individual test tanks and treatment groups (Appendix G, Item 1). All concentrations are reported as active ingredient.
2) Tanks 3, 4 and 5 were measured twice for absorbance at 8 h. Initial absorbances appeared to be high. To verify the absorbances, the samples were re-run. The second set of absorbances were still high, which may be due to sediment disturbance/turbidity caused by 8 h mussel removal. Both sets of absorbances were averaged for the analysis.

File Folder 13
Item Number 1
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Study Number: AEH-13-PSEUDO-06
Electronic Log (Pages 7-9)
File Folder: 12
Data Source: DU800 spectrophotometer output (dated: May 29, 2013 to May 30, 2013)

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Lot #: 401P12163C and 401P12164C (Mixed from MBI)
Exposure Date: 5/29/2013 Assessment Dates: 6/26-27/2013

Spectrophotometric Data

Linear Regression Triplicate Standard

STD Conc (mg/L)	Sample Absorbance (660 nm)		
	Rep 1	Rep 2	Rep 3
0	-0.0002	0.0004	-0.0006
25	0.0331	0.0324	0.0344
50	0.0689	0.0671	0.0666
100	0.1274	0.1264	0.1449
200	0.2558	0.2562	0.2543

Exposure Standard Checks

STD Conc (mg/L)	Standard Set #1 (Abs 660 nm)			Standard Set #2 (Abs 660 nm)		
	0h	6h	12h Std 1	12h Std 2	18h	24h
0	n/a	0.0082	0.0013	n/a	-0.0031	-0.0056
25	0.0301	0.0358	0.0315	0.0479	0.0389	0.0475
50	0.0656	0.0696	0.0619	0.0772	0.0652	0.0626
100	0.1238	0.1365	0.0875	0.1415	0.1219	0.1192
200	0.2481	0.2453	0.1566	0.2731	0.2370	0.2172

Exposure Concentrations

Tank Number	Exposure Target (mg/L)	Sample Absorbance (660 nm)				
		1h	6h	12h	18h	24h
1	100	0.1508	0.1287	0.1303	0.1271	0.1289
2	100	0.1630	0.1251	0.1303	0.1237	0.1177
3	50	0.0937	0.0587	0.0878[a]	0.0649	0.0619
4	50	0.0999	0.0558	0.1130[b]	0.0723	0.0694
5	0	0.0016	0.0004	0.0140[c]	-0.0024	0.0031
6	50	0.0906	0.0690	0.0829	0.0675	0.0708
7	0	0.0003	-0.0005	0.0012	-0.0069	-0.0001
8	0	0.0008	0.0002	0.0097	-0.0037	-0.0055
9	100	0.1804	0.1329	0.1477	0.1193	0.1262

[a] Initial tank absorbance (0.0946) and second absorbance (0.0809) measurements were averaged for the analysis.
[b] Initial tank absorbance (0.1187) and second absorbance (0.1072) measurements were averaged for the analysis.
[c] Initial tank absorbance (0.0161) and second absorbance (0.0119) measurements were averaged for the analysis.

tank	thero	time	blank	abs	conc
.	0	0	r	-0.0002	0.0000
.	25	0	r	0.0331	25.0000
.	50	0	r	0.0689	50.0000
.	100	0	r	0.1274	100.0000
.	200	0	r	0.2558	200.0000
.	0	0	r	0.0004	0.0000
.	25	0	r	0.0324	25.0000
.	50	0	r	0.0671	50.0000
.	100	0	r	0.1264	100.0000
.	200	0	r	0.2562	200.0000
.	0	0	r	-0.0006	0.0000
.	25	0	r	0.0344	25.0000
.	50	0	r	0.0666	50.0000
.	100	0	r	0.1449	100.0000
.	200	0	r	0.2543	200.0000
.	25	0	r	0.0301	.
.	50	0	r	0.0656	.
.	100	0	r	0.1238	.
.	200	0	r	0.2481	.
.	0	6	c	0.0082	.
.	25	6	c	0.0358	.
.	50	6	c	0.0696	.
.	100	6	c	0.1365	.
.	200	6	c	0.2453	.
.	0	12	r	0.0013	.
.	25	12	r	0.0315	.
.	50	12	r	0.0619	.
.	100	12	r	0.0875	.
.	200	12	r	0.1566	.
.	25	12	r	0.0479	.
.	50	12	r	0.0772	.
.	100	12	r	0.1415	.
.	200	12	r	0.2731	.
.	0	18	c	-0.0031	.
.	25	18	c	0.0389	.
.	50	18	c	0.0652	.
.	100	18	c	0.1219	.
.	200	18	c	0.2370	.
.	0	24	c	-0.0056	.
.	25	24	c	0.0475	.
.	50	24	c	0.0626	.
.	100	24	c	0.1192	.
.	200	24	c	0.2172	.
1	100	1	r	0.1508	.
2	100	1	r	0.1630	.
3	50	1	r	0.0937	.

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4	50	1	r	0.0999	.
5	0	1	r	0.0016	.
6	50	1	r	0.0906	.
7	0	1	r	0.0003	.
8	0	1	r	0.0008	.
9	100	1	r	0.1804	.
1	100	6	c	0.1287	.
2	100	6	c	0.1251	.
3	50	6	c	0.0587	.
4	50	6	c	0.0658	.
5	0	6	c	0.0004	.
6	50	6	c	0.0690	.
7	0	6	c	-0.0005	.
8	0	6	c	0.0002	.
9	100	6	c	0.1329	.
1	100	12	r	0.1303	.
2	100	12	r	0.1303	.
3	50	12	r	0.0878	.
4	50	12	r	0.1130	.
5	0	12	r	0.0140	.
6	50	12	r	0.0829	.
7	0	12	r	0.0012	.
8	0	12	r	0.0097	.
9	100	12	r	0.1477	.
1	100	18	c	0.1271	.
2	100	18	c	0.1237	.
3	50	18	c	0.0649	.
4	50	18	c	0.0723	.
5	0	18	c	-0.0024	.
6	50	18	c	0.0675	.
7	0	18	c	-0.0069	.
8	0	18	c	-0.0037	.
9	100	18	c	0.1193	.
1	100	24	c	0.1289	.
2	100	24	c	0.1177	.
3	50	24	c	0.0619	.
4	50	24	c	0.0694	.
5	0	24	c	0.0031	.
6	50	24	c	0.0708	.
7	0	24	c	-0.0001	.
8	0	24	c	-0.0055	.
9	100	24	c	0.1262	.

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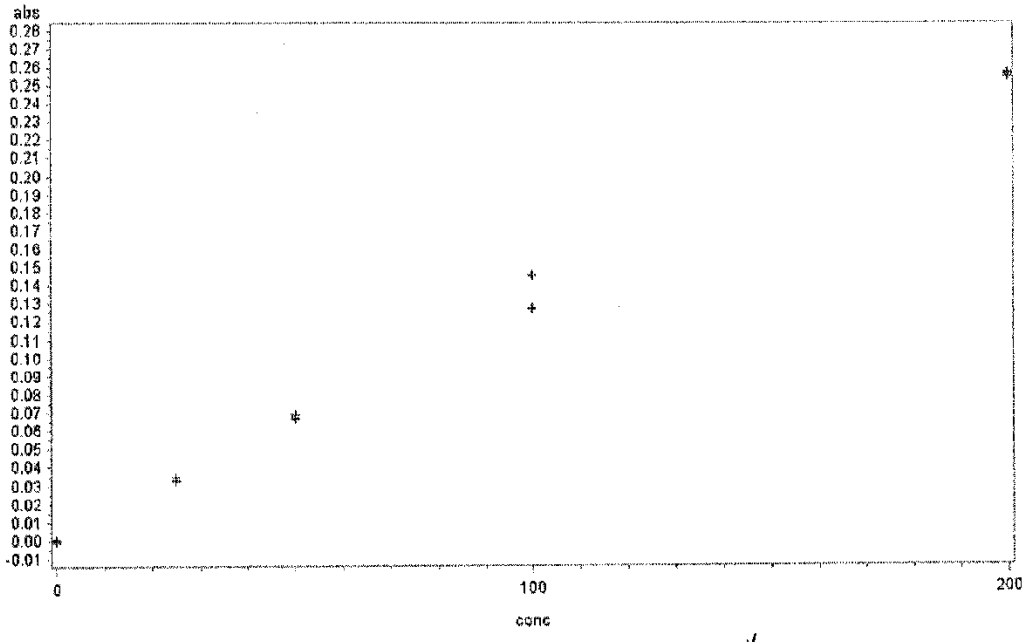
Standard Curve Linear Regression

Subadult Mussels-Spectrophotometer Data Analysis

Study # AEH-13-pseudo-06

SAS v. 9.4 Analysis completion date: 10 December 2014 Analysis prepared by: KLW



Performed by K.Weber SAS version 9.4 9.4 16:05 10DEC14 KW

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Standard Curve Linear Regression
Subadult Mussels-Spectrophotometer Data Analysis
Study # AEH-13-pseudo-06
SAS v. 9.4 Analysis completion date: 10 December 2014 Analysis prepared by: KLW

The REG Procedure
Model: MODEL1
Dependent Variable: conc conc

Number of Observations Read	88
Number of Observations Used	15
Number of Observations with Missing Values	73

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	74823	74823	5484.45	<.0001
Error	13	177.35508	13.64270		
Corrected Total	14	75000			

Root MSE	3.69360	R-Square	0.9976
Dependent Mean	75.00000	Adj R-Sq	0.9975
Coeff Var	4.92480		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-1.44976	1.40541	-1.03	0.3211
abs	abs	1	781.64163	10.55459	74.06	<.0001

Performed by K.Weber SAS version 9.4 9.4 16:05 10DEC14 KW

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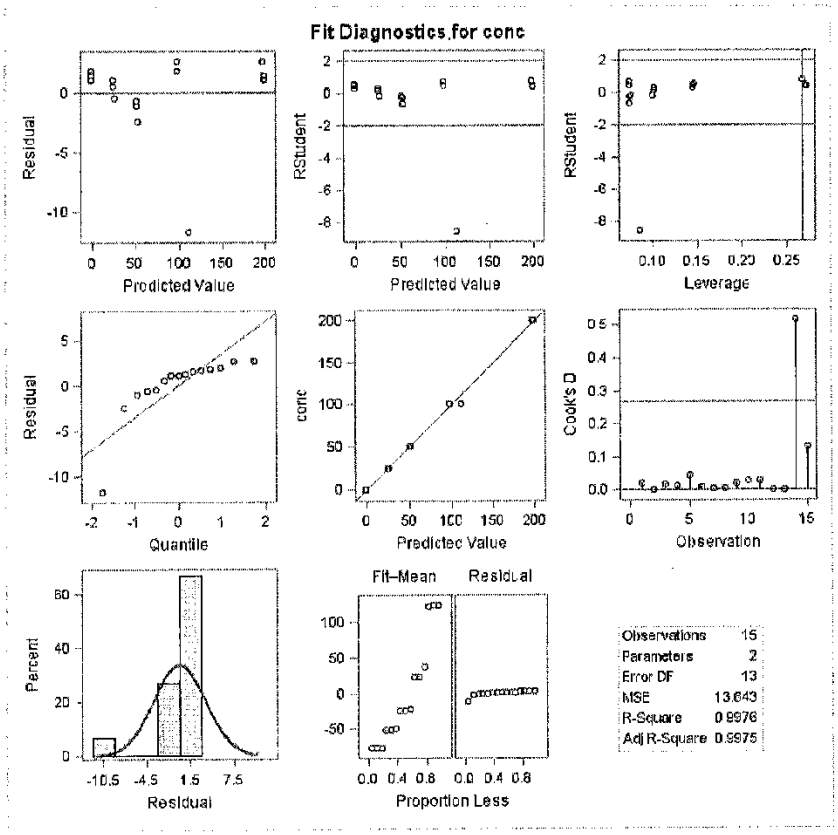
Standard Curve Linear Regression
Subadult Mussels-Spectrophotometer Data Analysis
Study # AEH-13-pseudo-06
SAS v. 9.4 Analysis completion date: 10 December 2014 Analysis prepared by: KLW

The REG Procedure
Model: MODEL1
Dependent Variable: conc conc



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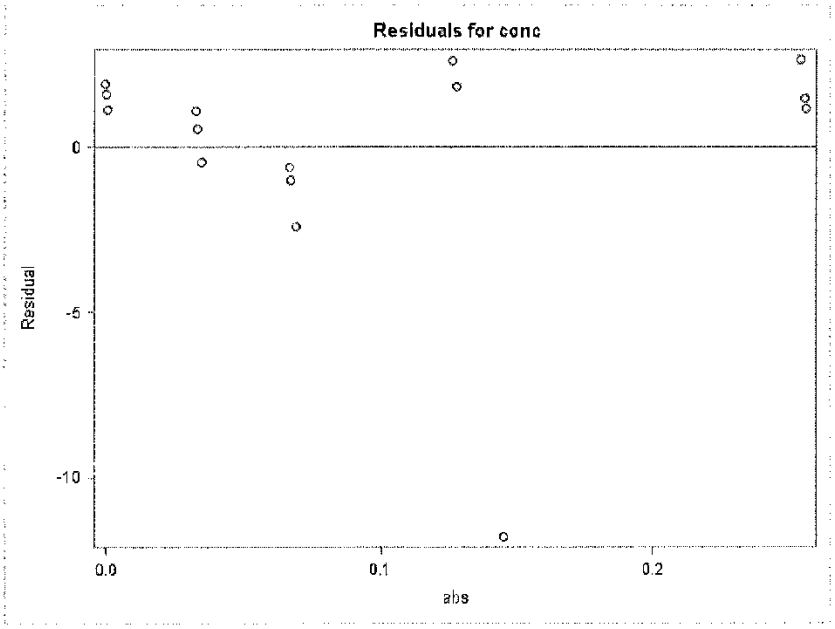

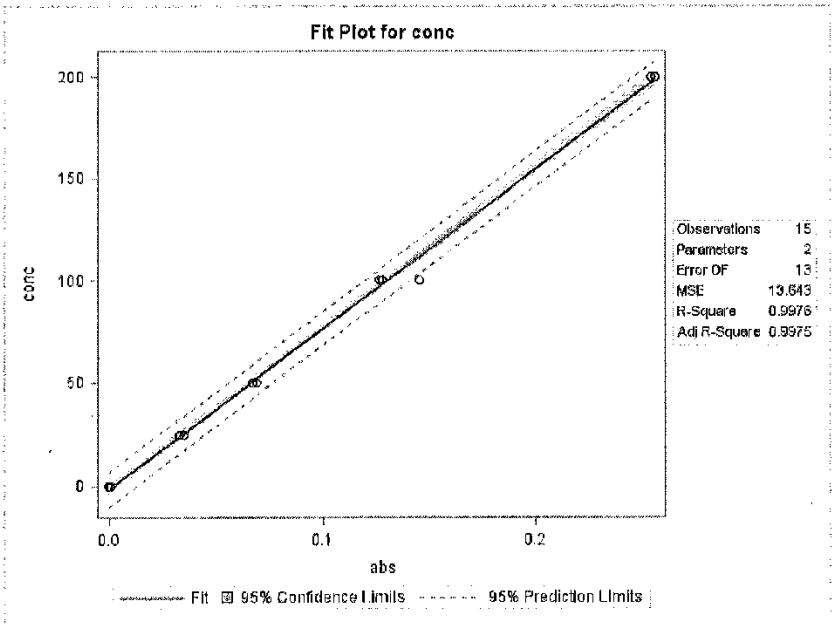

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Data file with predicted concentrations from the linear regression
Data lines with conc listed are the standards used to create the regression
Data lines without conc listed are standard checks (no tank listed) or samples (tank listed)

Obs	tank	thero	time	blank	abs	conc	predicted_ppm
1	.	0	0	r	-0.0002	0	-1.606
2	.	25	0	r	0.0331	25	24.423
3	.	50	0	r	0.0689	50	52.405
4	.	100	0	r	0.1274	100	98.131
5	.	200	0	r	0.2558	200	198.494
6	.	0	0	r	0.0004	0	-1.137
7	.	25	0	r	0.0324	25	23.875
8	.	50	0	r	0.0671	50	50.998
9	.	100	0	r	0.1264	100	97.350
10	.	200	0	r	0.2562	200	198.807
11	.	0	0	r	-0.0006	0	-1.919
12	.	25	0	r	0.0344	25	25.439
13	.	50	0	r	0.0666	50	50.608
14	.	100	0	r	0.1449	100	111.810
15	.	200	0	r	0.2543	200	197.322
16	.	25	0	r	0.0301	.	22.078
17	.	50	0	r	0.0656	.	49.826
18	.	100	0	r	0.1238	.	95.317
19	.	200	0	r	0.2481	.	192.476
20	1	100	1	r	0.1508	.	116.422
21	2	100	1	r	0.1630	.	125.958
22	3	50	1	r	0.0937	.	71.790
23	4	50	1	r	0.0999	.	76.636
24	5	0	1	r	0.0016	.	-0.199
25	6	50	1	r	0.0906	.	69.367
26	7	0	1	r	0.0003	.	-1.215
27	8	0	1	r	0.0008	.	-0.824
28	9	100	1	r	0.1804	.	139.558
29	.	0	6	c	0.0082	.	4.960
30	.	25	6	c	0.0358	.	26.533
31	.	50	6	c	0.0696	.	52.962
32	.	100	6	c	0.1365	.	105.244
33	.	200	6	c	0.2453	.	190.287
34	1	100	6	c	0.1287	.	99.148
35	2	100	6	c	0.1251	.	96.334
36	3	50	6	c	0.0587	.	44.433
37	4	50	6	c	0.0658	.	49.982
38	5	0	6	c	0.0004	.	-1.137

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39	6	50	6	c	0.0690	.	52.484
40	7	0	6	c	-0.0005	.	-1.841
41	8	0	6	c	0.0002	.	-1.293
42	9	100	6	c	0.1329	.	102.430
43	.	0	12	r	0.0013	.	-0.434
44	.	25	12	r	0.0315	.	23.172
45	.	50	12	r	0.0619	.	46.934
46	.	100	12	r	0.0875	.	66.944
47	.	200	12	r	0.1566	.	120.955
48	.	25	12	r	0.0479	.	35.991
49	.	50	12	r	0.0772	.	58.893
50	.	100	12	r	0.1415	.	109.153
51	.	200	12	r	0.2731	.	212.017
52	1	100	12	r	0.1303	.	100.398
53	2	100	12	r	0.1303	.	100.398
54	3	50	12	r	0.0878	.	67.178
55	4	50	12	r	0.0140	.	9.493
56	5	0	12	r	0.0161	.	11.135
57	6	50	12	r	0.0829	.	63.348
58	7	0	12	r	0.0012	.	-0.512
59	8	0	12	r	0.0097	.	6.132
60	9	100	12	r	0.1477	.	113.999
61	.	0	18	c	-0.0031	.	-3.873
62	.	25	18	c	0.0389	.	28.956
63	.	50	18	c	0.0652	.	49.513
64	.	100	18	c	0.1219	.	93.832
65	.	200	18	c	0.2370	.	183.799
66	1	100	18	c	0.127[illegible]	.	97.897
67	2	100	18	c	0.1237	.	95.239
68	3	50	18	c	0.0649	.	49.279
69	4	50	18	c	0.0723	.	55.063
70	5	0	18	c	-0.0024	.	-3.326
71	6	50	18	c	0.0675	.	51.31[illegible]
72	7	0	18	c	-0.0069	.	-6.843
73	8	0	18	c	-0.0037	.	-4.342
74	9	100	18	c	0.1193	.	91.800
75	.	0	24	c	-0.0056	.	-5.827
76	.	25	24	c	0.0475	.	35.678
77	.	50	24	c	0.0626	.	47.481
78	.	100	24	c	0.1192	.	91.722
79	.	200	24	c	0.2172	.	168.323
80	1	100	24	c	0.1289	.	99.304
81							

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	2	100	24	c	0.1177	.	90.549
82	3	50	24	c	0.0619	.	46.934
83	4	50	24	c	0.0694	.	52.796
84	5	0	24	c	0.0031	.	0.973
85	6	50	24	c	0.0708	.	53.890
86	7	0	24	c	-0.0001	.	-1.528
87	8	0	24	c	-0.0055	.	-5.749
88	9	100	24	c	0.1262	.	97.193

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Mean treatment concentration by tank for the entire exposure period
Individual tank means

The MEANS Procedure

tank=1

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
102.6	7.7587	93.0000	112.3

tank=2

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
101.7	14.0090	84.3012	119.1

tank=3

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
55.9227	12.6038	40.2730	71.5725

tank=4

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
48.7942	24.3745	18.5292	79.0591

tank=5

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
1.4892	5.6177	-5.4860	8.4645

tank=6

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
58.0801	7.9032	48.2669	67.8932

tank=7

Analysis Variable : predicted_ppm Predicted

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Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-2.3877	2.5388	-5.5401	0.7646

tank=8

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-1.2153	4.5954	-6.9212	4.4907

tank=9

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
109.0	18.9552	85.4602	132.5

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Mean treatment concentration by treatment group at each sampling time (replicate tanks combined for each sample time)

The MEANS Procedure

thero=0 time=1

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-0.7463	0.5126	-2.0195	0.5270

thero=0 time=6

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-1.4237	0.3694	-2.3413	-0.5061

thero=0 time=12

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
5.5850	5.8425	-8.9285	20.0985

thero=0 time=18

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-4.8369	1.8102	-9.3336	-0.3401

thero=0 time=24

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-2.1011	3.3975	-10.5410	6.3388

thero=50 time=1

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
72.5978	3.7013	63.4031	81.7924

thero=50 time=6

Analysis Variable : predicted_ppm Predicted

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Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
48.9661	4.1205	38.7302	59.2021

thero=50 time=12

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
46.6733	32.2558	-33.4545	126.8

thero=50 time=18

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
51.8843	2.9344	44.5949	59.1736

thero=50 time=24

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
51.2068	3.7407	41.9143	60.4993

thero=100 time=1

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
127.3	11.6276	98.4280	156.2

thero=100 time=6

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
99.3038	3.0514	91.7237	106.9

thero=100 time=12

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
104.9	7.8523	85.4255	124.4

thero=100 time=18

Analysis Variable : predicted_ppm Predicted

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Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
94.9788	3.0567	87.3854	102.6

thero=100 time=24

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
95.6822	4.5686	84.3331	107.0

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Mean treatment concentration by treatment group (replicate tanks combined)

The MEANS Procedure

thero=0

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-0.7046	4.4402	-3.1635	1.7543

thero=50

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
54.2657	15.8067	45.5122	63.0191

thero=100

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
104.4	13.6820	96.8650	112.0

Performed by K.Weber SAS version 9.4 9.4 16:05 10DEC14

Mean concentration for standard checks for all exposure sampling times

The MEANS Procedure

thero=0

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
-1.4051	3.3534	-4.5065	1.6963

thero=25

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
28.7346	6.0170	22.4202	35.0491

thero=50

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
50.9333	4.4405	46.2732	55.5933

thero=100

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
93.7021	14.7952	78.1755	109.2

thero=200

Analysis Variable : predicted_ppm Predicted Value of conc			
Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
178.0	31.3018	145.1	210.8

Performed by K.Weber SAS version 9.4 9.4 16:05 10DEC14

File Folder: 13

Item Number: 1

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ods html; /* open new */;
ods graphics on;
DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;

FOOTNOTE1 'Performed by K.Weber SAS version 9.4' &SYSVER &SYSTIME &SYSDATE;

options ls=97 ps=54 formdlim='-' pageno = 1 nocenter nodate nosource2;

title1 'Standard Curve Linear Regression';
title2 'Subadult Mussels-Spectrophotometer Data Analysis';
title3 h=1 'Study # AEH-13-pseudo-06';
title4 h=1 'SAS v. 9.4  Analysis completion date:  10 December 2014  Analysis prepared by: KLW';

/***********************************************
* SAS ver 9.4       Analysis prepared by:  KLW  KLW 10DEC2014
* Analysis completion date:  10 December 2014   *
***********************************************/

data Zeq; set Pseudo06.subspec;
run;
proc sort;
by tank time ; run;

run;
proc gplot data= zeq;
plot abs * conc;
run;

/*****************************************************************************************************
* This procedure creates a linear regression equation using the triplicate 25, 50, 100 and 200 mg/L st
* readings as measured on the DU-800 spectrophotometer
* This linear regression equation will be used to predict the sample concentrations for all the sample
* by using the absorbance measured with the linear regression equation created
*****************************************************************************************************/

proc reg data = zeq;
model conc = abs /edf;
output out=output_out p=predicted_ppm;
run;
proc sort;
by time tank;

/*****This prints the output data file that was imported in for analysis + the predicted values from t
Title1 "Data file with predicted concentrations from the linear regression";
Title2 "Data lines with conc listed are the standards used to create the regression";
Title3 "Data lines without conc listed are standard checks (no tank listed) or samples (tank listed)";

proc print data=output_out;
run;
data zeq2; set output_out;

/*************This deletes the standards from the data set so the means are calculated on the tank sam

if tank = "." then delete;
run;
```

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```
proc sort data = zeq2;
by tank;
run;
```



```
/*************************************************************************************************
* This procedure produces the mean concentrations for each treatment replicate (tank)over all exposure
* i.e. It gives the mean concentration of each treatment tank over the entire exposure period
*
*************************************************************************************************
title1 "Mean treatment concentration by tank for the entire exposure period";
title2 "Individual tank means";
proc means data = zeq2 mean std lclm uclm fw=8;
by tank;
var predicted_ppm;
run;
proc sort;
by thero time;

/*************************************************************************************************
* This procedure produces the mean concentrations for each treatment group by sampling time
* i.e. It gives the mean concentration of the three control, 50 ppm, and 100 ppm treatments
* at each sample time over the entire exposure
*************************************************************************************************

title1 "Mean treatment concentration by treatment group at each sampling time";
title2 "(replicate tanks combined for each sample time)";
proc means data = zeq2 mean std lclm uclm fw=8;
by thero time;
var predicted_ppm;
run;

title1 "Mean treatment concentration by treatment group";
title2 "(replicate tanks combined)";

proc means data = zeq2 mean std lclm uclm fw=8;
by thero;
var predicted_ppm;
run;

data zeq3; set output_out;
if conc > 1 then delete;
if tank > 0.5 then delete;
run;
proc sort;
by thero;
/*************************************************************************************************
* This procedure produces the mean concentrations for the standard checks for all time periods
* i.e. It gives the mean conc. of the 50ppm, 100ppm, and 200ppm standard checks at 1, 6,  12, 18 and
*************************************************************************************************
title "Mean concentration for standard checks for all exposure sampling times";
proc means data = zeq3 mean std lclm uclm fw=8;
by thero;
var predicted_ppm;
run;
quit;
run;
```

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```
4    DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;
5
6    FOOTNOTE1 'Performed by K.Weber SAS version 9.4' &SYSVER &SYSTIME &SYSDATE;
WARNING: The FOOTNOTE statement is ambiguous due to invalid options or unquoted text.
7
8    options ls=97 ps=54 formdlim='-' pageno = 1 nocenter nodate nosource2;
9
10   title1 'Standard Curve Linear Regression';                    AEH-13-PSEUDO-06
11   title2 'Subadult Mussels-Spectrophotometer Data Analysis';
12   title3 h=1  Study # AEH-13-pseudo-06';
13   title4 h=1  SAS v. 9.4  Analysis completion date:  10 December 2014  Analysis prepared by:
13 ! KLW';
14
15   /***********************************************
16   * SAS ver 9.4       Analysis prepared by:  KLW  *
17   * Analysis completion date:  10 December 2014   *
18   ***********************************************/
19
20   data Zeq; set Pseudo06.subspec;
21   run;

NOTE: There were 88 observations read from the data set PSEUDO06.SUBSPEC.
NOTE: The data set WORK.ZEQ has 88 observations and 6 variables.
NOTE: DATA statement used (Total process time):
      real time           0.03 seconds
      cpu time            0.01 seconds


22   proc sort;
23   by tank time ; run;

NOTE: There were 88 observations read from the data set WORK.ZEQ.
NOTE: The data set WORK.ZEQ has 88 observations and 6 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      cpu time            0.00 seconds

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24
25   run;
26   proc gplot data= zeq;
27   plot abs * conc;
28   run;

NOTE: 73 observation(s) contained a MISSING value for the abs * conc request.
NOTE: 32534 bytes written to I:\AEH-13-PSEUDO-06\Statistical analysis\Exposure
      Concentration\gplot.png.
29
30   /*************************************************************************************************
30 ! *********************************************
31   * This procedure creates a linear regression equation using the triplicate 25, 50, 100 and
31 ! 200 mg/L standards and the absorbance         *
32   * readings as measured on the DU-800 spectrophotometer
32 !                                              *
33   * This linear regression equation will be used to predict the sample concentrations for all
33 ! the samples and standard checks in the study *
```

```
* by using the absorbance measured with the linear regression equation created
                                                            *
*********************************************************************************************
*********************************************/

NOTE: There were 88 observations read from the data set WORK.ZEQ.
NOTE: PROCEDURE GPLOT used (Total process time):
      real time           0.37 seconds
      cpu time            0.21 seconds


proc reg data = zeq;
model conc = abs /edf;
output out=output_out p=predicted_ppm;
run;


NOTE: The data set WORK.OUTPUT_OUT has 88 observations and 7 variables.
NOTE: PROCEDURE REG used (Total process time):
      real time           2.93 seconds
      cpu time            0.59 seconds


proc sort;
by time tank;

/*****This prints the output data file that was imported in for analysis + the predicted
values from the regression**********/
Title1 "Data file with predicted concentrations from the linear regression";
Title2 "Data lines with conc listed are the standards used to create the regression";
Title3 "Data lines without conc listed are standard checks (no tank listed) or samples (tank
 listed)";


NOTE: There were 88 observations read from the data set WORK.OUTPUT_OUT.
NOTE: The data set WORK.OUTPUT_OUT has 88 observations and 7 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


proc print data=output_out;
run;

NOTE: There were 88 observations read from the data set WORK.OUTPUT_OUT.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.04 seconds
      cpu time            0.03 seconds
```



```
data zeq2; set output_out;

/*************This deletes the standards from the data set so the means are calculated on
the tank samples only************/

```

```
55   if tank = "." then delete;
56   run;

NOTE: There were 88 observations read from the data set WORK.OUTPUT_OUT.
NOTE: The data set WORK.ZEQ2 has 45 observations and 7 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


57   proc sort data = zeq2;
58   by tank;
59   run;

NOTE: There were 45 observations read from the data set WORK.ZEQ2.
NOTE: The data set WORK.ZEQ2 has 45 observations and 7 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      cpu time            0.00 seconds


60
61   /*****************************************************************************************
61 ! *****************************************
62   * This procedure produces the mean concentrations for each treatment replicate (tank)over
62 ! all exposure sampling times                    *
63   * i.e. It gives the mean concentration of each treatment tank over the entire exposure
63 ! period                                          *
64   *
64 !                                               *
65   *****************************************************************************************
65 ! *****************************************/
66   title1 "Mean treatment concentration by tank for the entire exposure period";
67   title2 "Individual tank means";
68   proc means data = zeq2 mean std lclm uclm fw=8;
69   by tank;
70   var predicted_ppm;
71   run;

NOTE: There were 45 observations read from the data set WORK.ZEQ2.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.07 seconds
      cpu time            0.04 seconds
```

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```
72   proc sort;
73   by thero time;
74
75   /*****************************************************************************************
75 ! ************************************
76   * This procedure produces the mean concentrations for each treatment group by sampling time
76 !                                    *
77   * i.e. It gives the mean concentration of the three control, 50 ppm, and 100 ppm treatments
77 !                                    *
78   * at each sample time over the entire exposure
78 !                                    *
```

```
79   ************************************************************************************************
79 ! ***********************************/
80
81   title1 "Mean treatment concentration by treatment group at each sampling time";
82   title2 "(replicate tanks combined for each sample time)";

NOTE: There were 45 observations read from the data set WORK.ZEQ2.
NOTE: The data set WORK.ZEQ2 has 45 observations and 7 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds


83   proc means data = zeq2 mean std lclm uclm fw=8;
84   by thero time;
85   var predicted_ppm;
86   run;

NOTE: There were 45 observations read from the data set WORK.ZEQ2.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.07 seconds
      cpu time            0.03 seconds


87
88   title1 "Mean treatment concentration by treatment group";
89   title2 "(replicate tanks combined)";
90
91   proc means data = zeq2 mean std lclm uclm fw=8;
92   by thero;
93   var predicted_ppm;
94   run;

NOTE: There were 45 observations read from the data set WORK.ZEQ2.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.06 seconds
      cpu time            0.03 seconds


95
96   data zeq3; set output_out;
97   if conc > 1 then delete;
98   if tank > 0.5 then delete;
99   run;

NOTE: Character values have been converted to numeric values at the places given by:
      (Line):(Column).
      98:4
NOTE: There were 88 observations read from the data set WORK.OUTPUT_OUT.
NOTE: The data set WORK.ZEQ3 has 31 observations and 7 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds

100  proc sort;
```

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```
101  by thero;
102  /*****************************************************************************************
102! *********************
103  * This procedure produces the mean concentrations for the standard checks for all time
103! periods                  *
104  * i.e. It gives the mean conc. of the 50ppm, 100ppm, and 200ppm standard checks at 1, 6,
104! 12, 18 and 24h         *
105  *****************************************************************************************
105! ********************/
106  title "Mean concentration for standard checks for all exposure sampling times";

NOTE: There were 31 observations read from the data set WORK.ZEQ3.
NOTE: The data set WORK.ZEQ3 has 31 observations and 7 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      cpu time            0.01 seconds


107  proc means data = zeq3 mean std lclm uclm fw=8;
108  by thero;
109  var predicted_ppm;
110  run;

NOTE: There were 31 observations read from the data set WORK.ZEQ3.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.07 seconds
      cpu time            0.03 seconds


111  quit;
112  run;
```

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Appendix 8. Statistical Analysis Including SAS Programs, Outputs and Logs for Survival and Treatment Concentration

Item Number	Item Description	Number of Pages	Report Page Number
1	SAS program for native mussel survival	2	194
2	SAS log for native mussel survival	3	196
3	SAS output for native mussel survival	38	199

```
DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;

FOOTNOTE1 'Performed by K. Weber SAS version ' &SYSVER &SYSTIME &SYSDATE;

options ls=97 ps=54 formdlim='-' pageno = 1 nocenter nodate nosource2;      AEH-13-PSEUDO-06

title1 h=1.5 'Statistical analysis of unionid mussel suvival after';
title2 h=1.5 'exposure to various concentrations and durations of Pf-CL145A';
title3 h=1.5 'SAS v. 9.4    Analysis completion date:  10 December 2014  Analysis prepared by: KLW';

/*************************************************KW 10DEC2014
* SAS ver 9.4       Analysis prepared by: KLW     *
* Analysis completion date:  10 December 2014     *
*************************************************/

/*****************************************************************************************************
* Variable Names:
* sps = Unionid mussel species code ID
* conc = concentration (in mg/L)
*              0 = control, no zequanox added
*             50 = 50 mg/L active ingredient
*             100 = 100 mg/L active ingredient
* time = exposure duration (either 8 or 24 h)
* tank = tank number (1 through 9 with each tank containing the same number of 8 and 24 hour animals
* tot = total number of animals in the tank for that duration (recovered at assessment)
* dead = number of animals dead at 30-d post exposure assessment
* unrec = number of animals not recovered during the assessment
* tdead = number of dead + number of unrecovered
* conca = reformated concentration C = control, A = 50 mg/l, B = 100 mg/L
*****************************************************************************************************/

data mussel; set Pseudo06.Survivaldata;
pctsurv = (tot-t_dead)/tot*100;
pctmort = t_dead/tot*100;
run;

proc sort data=mussel; by sps time conc; run;
proc print data=mussel; title4 h=1 'all data'; run;
proc means data = mussel mean std lclm uclm fw=8;
by sps;
class conc time;
var pctsurv pctmort;
run;
Title 'Pro Glimmix Analysis of survival and interactions of species, exposure duration and exposure cc
proc glimmix data = mussel;
title4 'Native Unionid Survival';
class sps time conc;
model t_dead/tot  = sps|time|conc / d = bin link = logit noint s or;
  lsmeans sps /pdiff cl ilink or;
  lsmeans time /pdiff cl ilink or;
  lsmeans conc/pdiff cl ilink or;
  lsmeans sps*time /pdiff cl ilink or;
  lsmeans sps*conc /pdiff cl ilink or;
  lsmeans time*conc /pdiff cl ilink or;
  lsmeans sps*time*conc /pdiff cl ilink or;
  random _residual_;
```

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```
run;
```

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FF # 15
Item No. 1
Pg 2 of 2

```
58   DM 'LOG; CLEAR; OUTPUT; CLEAR;';  * CLEAR LOG AND OUTPUT;
59
60   FOOTNOTE1 'Performed by K. Weber SAS version ' &SYSVER &SYSTIME &SYSDATE;
WARNING: The FOOTNOTE statement is ambiguous due to invalid options or unquoted text.
61
62   options ls=97 ps=54 formdlim='-' pageno = 1 nocenter nodate nosource2;
63
64   title1 h=1.5 'Statistical analysis of unionid mussel suvival after';
65   title2 h=1.5 'exposure to various concentrations and durations of Pf-CL145A';
66   title3 h=1.5 'SAS v. 9.4    Analysis completion date:  10 December 2014  Analysis prepared
66 ! by: KLW';
67
68   /*************************************************
69   * SAS ver 9.4       Analysis prepared by: KLW    *
70   * Analysis completion date:  10 December 2014    *
71   *************************************************/
72
73   /*****************************************************************************************
73 ! *************
74   * Variable Names:
74 !              *
75   * sps = Unionid mussel species code ID
75 !              *
76   * conc = concentration (in mg/L)
76 !              *
77   *                0 = control, no zequanox added
77 !              *
78   *              50 = 50 mg/L active ingredient
78 !              *
79   *              100 = 100 mg/L active ingredient
79 !              *
80   * time = exposure duration (either 8 or 24 h)
80 !              *
81   * tank = tank number (1 through 9 with each tank containing the same number of 8 and 24 hour
81 !  animals    *
82   * tot = total number of animals in the tank for that duration (recovered at assessment)
82 !              *
83   * dead = number of animals dead at 30-d post exposure assessment
83 !              *
84   * unrec = number of animals not recovered during the assessment
84 !              *
85   * tdead = number of dead + number of unrecovered
85 !              *
86   * conca = reformated concentration C = control, A = 50 mg/l, B = 100 mg/L
86 !              *
87   *****************************************************************************************
87 ! *************/
88
89   data mussel; set Pseudo06.Survivaldata;
90   pctsurv = (tot-t_dead)/tot*100;
91   pctmort = t_dead/tot*100;
92   run;

NOTE: There were 126 observations read from the data set PSEUDO06.SURVIVALDATA.
NOTE: The data set WORK.MUSSEL has 126 observations and 10 variables.
NOTE: DATA statement used (Total process time):
```

KW 10DEC2014

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FF # 15
Item No. 2
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```
      real time           0.01 seconds
      cpu time            0.01 seconds


93
94    proc sort data=mussel; by sps time conc; run;

NOTE: There were 126 observations read from the data set WORK.MUSSEL.
NOTE: The data set WORK.MUSSEL has 126 observations and 10 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      cpu time            0.00 seconds
```

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```
95    proc print data=mussel; title4 h=1 'all data'; run;
NOTE: Writing HTML Body file: sashtml1.htm
NOTE: There were 126 observations read from the data set WORK.MUSSEL.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           2.03 seconds
      cpu time            0.56 seconds


96    proc means data = mussel mean std lclm uclm fw=8;
97    by sps;
98    class conc time;
99    var pctsurv pctmort;
100   run;

NOTE: There were 126 observations read from the data set WORK.MUSSEL.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.10 seconds
      cpu time            0.07 seconds


101   Title 'Pro Glimmix Analysis of survival and interactions of species, exposure duration and
101! exposure concentration';
102   proc glimmix data = mussel;
103   title4 'Native Unionid Survival';
104   class sps time conc;
105   model t_dead/tot  = sps|time|conc / d = bin link = logit noint s or;
106     lsmeans sps /pdiff cl ilink or;
107     lsmeans time /pdiff cl ilink or;
108     lsmeans conc/pdiff cl ilink or;
109     lsmeans sps*time /pdiff cl ilink or;
110     lsmeans sps*conc /pdiff cl ilink or;
111     lsmeans time*conc /pdiff cl ilink or;
112     lsmeans sps*time*conc /pdiff cl ilink or;
113     random _residual_;
114     run;
```

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```
NOTE: The model does not contain an intercept. Columns of X are scaled only and not centered.
NOTE: Convergence criterion (ABSGCONV=0.00001) satisfied.
NOTE: PROCEDURE GLIMMIX used (Total process time):
```

```
real time          1.13 seconds
cpu time           0.96 seconds
```

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10DEC2014

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Statistical analysis of unionid mussel survival after
exposure to various concentrations and durations of PI-CL145A
SAS v. 9.4 Analysis completion date: 10 December 2014 Analysis prepared by: KLW
all data

Obs	sps	conc	time	tank	tot	dead	unrec	T_dead	pctsurv	pctmort
1	FAM	0	8	5	10	0	0	0	100.000	0.0000
2	FAM	0	8	7	10	0	0	0	100.000	0.0000
3	FAM	0	8	8	10	0	0	0	100.000	0.0000
4	FAM	50	8	3	10	0	0	0	100.000	0.0000
5	FAM	50	8	4	10	0	0	0	100.000	0.0000
6	FAM	50	8	6	10	0	0	0	100.000	0.0000
7	FAM	100	8	1	10	0	0	0	100.000	0.0000
8	FAM	100	8	2	10	0	0	0	100.000	0.0000
9	FAM	100	8	9	10	0	0	0	100.000	0.0000
10	FAM	0	24	5	10	0	0	0	100.000	0.0000
11	FAM	0	24	7	10	0	0	0	100.000	0.0000
12	FAM	0	24	8	10	0	0	0	100.000	0.0000
13	FAM	50	24	3	10	0	0	0	100.000	0.0000
14	FAM	50	24	4	10	0	0	0	100.000	0.0000
15	FAM	50	24	6	10	0	0	0	100.000	0.0000
16	FAM	100	24	1	10	0	0	0	100.000	0.0000
17	FAM	100	24	2	10	0	0	0	100.000	0.0000
18	FAM	100	24	9	10	0	0	0	100.000	0.0000
19	HGE	0	8	5	8	0	0	0	100.000	0.0000
20	HGE	0	8	7	8	0	0	0	100.000	0.0000
21	HGE	0	8	8	8	1	0	1	87.500	12.5000
22	HGE	50	8	3	8	0	0	0	100.000	0.0000
23	HGE	50	8	4	8	0	0	0	100.000	0.0000
24	HGE	50	8	6	8	0	0	0	100.000	0.0000
25	HGE	100	8	1	8	0	0	0	100.000	0.0000
26	HGE	100	8	2	8	0	0	0	100.000	0.0000
27	HGE	100	8	9	8	0	0	0	100.000	0.0000
28	HGE	0	24	5	8	0	1	1	87.500	12.5000
29	HGE	0	24	7	8	0	0	0	100.000	0.0000
30	HGE	0	24	8	8	0	0	0	100.000	0.0000
31	HGE	50	24	3	8	0	0	0	100.000	0.0000
32	HGE	50	24	4	8	0	0	0	100.000	0.0000
33	HGE	50	24	6	8	0	1	1	87.500	12.5000
34	HGE	100	24	1	8	0	0	0	100.000	0.0000
35	HGE	100	24	2	8	0	0	0	100.000	0.0000
36	HGE	100	24	9	8	1	0	1	87.500	12.5000
37	HIC	0	8	5	10	0	0	0	100.000	0.0000
38	HIC	0	8	7	10	0	0	0	100.000	0.0000
39	HIC	0	8	8	10	0	0	0	100.000	0.0000
40	HIC	50	8	3	10	0	0	0	100.000	0.0000
41	HIC	50	8	4	10	0	0	0	100.000	0.0000
42	HIC	50	8	6	10	0	0	0	100.000	0.0000
43	HIC	100	8	1	10	0	0	0	100.000	0.0000
44	HIC	100	8	2	10	0	0	0	100.000	0.0000
45	HIC	100	8	9	10	0	0	0	100.000	0.0000

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46	HIC	0	24	5	10	0	0	0	100.000	0.0000
47	HIC	0	24	7	10	0	0	0	100.000	0.0000
48	HIC	0	24	8	10	0	0	0	100.000	0.0000
49	HIC	50	24	3	10	0	0	0	100.000	0.0000
50	HIC	50	24	4	10	0	0	0	100.000	0.0000
51	HIC	50	24	6	10	0	0	0	100.000	0.0000
52	HIC	100	24	1	10	0	0	0	100.000	0.0000
53	HIC	100	24	2	10	0	1	1	90.000	10.0000
54	HIC	100	24	9	10	0	0	0	100.000	0.0000
55	PIG	0	8	5	8	0	0	0	100.000	0.0000
56	PIG	0	8	7	8	0	0	0	100.000	0.0000
57	PIG	0	8	8	8	0	0	0	100.000	0.0000
58	PIG	50	8	3	8	0	0	0	100.000	0.0000
59	PIG	50	8	4	8	0	0	0	100.000	0.0000
60	PIG	50	8	6	8	0	0	0	100.000	0.0000
61	PIG	100	8	1	8	0	0	0	100.000	0.0000
62	PIG	100	8	2	8	0	0	0	100.000	0.0000
63	PIG	100	8	9	8	0	0	0	100.000	0.0000
64	PIG	0	24	5	8	0	0	0	100.000	0.0000
65	PIG	0	24	7	8	0	0	0	100.000	0.0000
66	PIG	0	24	8	8	0	0	0	100.000	0.0000
67	PIG	50	24	3	8	0	0	0	100.000	0.0000
68	PIG	50	24	4	8	0	0	0	100.000	0.0000
69	PIG	50	24	6	8	0	0	0	100.000	0.0000
70	PIG	100	24	1	8	0	0	0	100.000	0.0000
71	PIG	100	24	2	8	0	0	0	100.000	0.0000
72	PIG	100	24	9	8	0	0	0	100.000	0.0000
73	PPB	0	8	5	9	0	0	0	100.000	0.0000
74	PPB	0	8	7	9	0	0	0	100.000	0.0000
75	PPB	0	8	8	9	0	0	0	100.000	0.0000
76	PPB	50	8	3	9	0	0	0	100.000	0.0000
77	PPB	50	8	4	9	0	0	0	100.000	0.0000
78	PPB	50	8	6	9	0	0	0	100.000	0.0000
79	PPB	100	8	1	9	0	0	0	100.000	0.0000
80	PPB	100	8	2	9	0	0	0	100.000	0.0000
81	PPB	100	8	9	9	0	0	0	100.000	0.0000
82	PPB	0	24	5	9	0	0	0	100.000	0.0000
83	PPB	0	24	7	9	0	0	0	100.000	0.0000
84	PPB	0	24	8	9	0	0	0	100.000	0.0000
85	PPB	50	24	3	9	0	1	1	88.889	11.1111
86	PPB	50	24	4	9	0	0	0	100.000	0.0000
87	PPB	50	24	6	9	0	0	0	100.000	0.0000
88	PPB	100	24	1	9	0	0	0	100.000	0.0000
89	PPB	100	24	2	9	0	1	1	88.889	11.1111
90	PPB	100	24	9	9	0	0	0	100.000	0.0000
91	THR	0	8	5	10	0	0	0	100.000	0.0000
92	THR	0	8	7	10	0	0	0	100.000	0.0000
93	THR	0	8	8	10	0	0	0	100.000	0.0000
94	THR	50	8	3	10	0	0	0	100.000	0.0000
95										

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	THR	50	8	4	10	0	0	0	100.000	0.0000
96	THR	50	8	5	10	0	0	0	100.000	0.0000
97	THR	100	8	1	10	0	0	0	100.000	0.0000
98	THR	100	8	2	10	0	0	0	100.000	0.0000
99	THR	100	8	9	10	0	0	0	100.000	0.0000
100	THR	0	24	5	10	0	0	0	100.000	0.0000
101	THR	0	24	7	10	0	0	0	100.000	0.0000
102	THR	0	24	8	10	0	0	0	100.000	0.0000
103	THR	50	24	3	10	0	0	0	100.000	0.0000
104	THR	50	24	4	10	0	0	0	100.000	0.0000
105	THR	50	24	6	10	0	0	0	100.000	0.0000
106	THR	100	24	1	10	0	0	0	100.000	0.0000
107	THR	100	24	2	10	0	0	0	100.000	0.0000
108	THR	100	24	9	10	0	0	0	100.000	0.0000
109	WAS	0	8	5	10	0	0	0	100.000	0.0000
110	WAS	0	8	7	10	0	0	0	100.000	0.0000
111	WAS	0	8	8	10	0	0	0	100.000	0.0000
112	WAS	50	8	3	10	0	0	0	100.000	0.0000
113	WAS	50	8	4	10	1	0	1	90.000	10.0000
114	WAS	50	8	6	10	0	0	0	100.000	0.0000
115	WAS	100	8	1	10	0	0	0	100.000	0.0000
116	WAS	100	8	2	10	0	0	0	100.000	0.0000
117	WAS	100	8	9	10	0	0	0	100.000	0.0000
118	WAS	0	24	5	10	0	0	0	100.000	0.0000
119	WAS	0	24	7	10	0	0	0	100.000	0.0000
120	WAS	0	24	8	10	0	0	0	100.000	0.0000
121	WAS	50	24	3	10	0	0	0	100.000	0.0000
122	WAS	50	24	4	10	0	0	0	100.000	0.0000
123	WAS	50	24	6	10	0	0	0	100.000	0.0000
124	WAS	100	24	1	10	0	0	0	100.000	0.0000
125	WAS	100	24	2	10	0	0	0	100.000	0.0000
126	WAS	100	24	9	10	0	0	0	100.000	0.0000

Performed by K. Weber SAS version 9.4 16:18 10DEC14

AEH-13-PSEUDO-06

Statistical analysis of unionid mussel survival after
exposure to various concentrations and durations of PI-GL145A
SAS v. 9.4 Analysis completion date: 10 December 2014 Analysis prepared by: KLW
all data

The MEANS Procedure

sps=FAM

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.

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sps=HGE

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	95.8333	7.2169	77.9056	113.8
			pctmort	4.1667	7.2169	-13.7611	22.0944
	24	3	pctsurv	95.8333	7.2169	77.9056	113.8
			pctmort	4.1667	7.2169	-13.7611	22.0944
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	95.8333	7.2169	77.9056	113.8
			pctmort	4.1667	7.2169	-13.7611	22.0944
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	95.8333	7.2169	77.9056	113.8
			pctmort	4.1667	7.2169	-13.7611	22.0944

sps=HIC

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	96.6667	5.7735	82.3245	111.0
			pctmort	3.3333	5.7735	-11.0088	17.6755

sps=PIG

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.

	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.

sps=PPB

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conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	96.2963	6.4150	80.3605	112.2
			pctmort	3.7037	6.4150	-12.2320	19.6395
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	96.2963	6.4150	80.3605	112.2
			pctmort	3.7037	6.4150	-12.2320	19.6395

sps=THR

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.

sps=WAS

conc	time	N Obs	Variable	Mean	Std Dev	Lower 95% CL for Mean	Upper 95% CL for Mean
0	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
50	8	3	pctsurv	96.6667	5.7735	82.3245	111.0
			pctmort	3.3333	5.7735	-11.0088	17.6755
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
100	8	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.
	24	3	pctsurv	100.0	0	.	.
			pctmort	0	0	.	.

Performed by K. Weber SAS version 9.4 16:18 10DEC14

AEH-13-PSEUDO-06

Pro Glimmix Analysis of survival and interactions of species, exposure duration and exposure concentration

Native Unionid Survival

The GLIMMIX Procedure

AEH-13-PSEUDO-06

Model Information	
Data Set	WORK.MUSSEL
Response Variable (Events)	T_dead
Response Variable (Trials)	tot
Response Distribution	Binomial
Link Function	Logit
Variance Function	Default
Variance Matrix	Diagonal
Estimation Technique	Maximum Likelihood
Degrees of Freedom Method	Residual

Class Level Information		
Class	Levels	Values
sps	7	FAM HGE HIC PIG PPB THR WAS
time	2	8 24
conc	3	0 50 100

Number of Observations Read	126
Number of Observations Used	126
Number of Events	8
Number of Trials	170

Dimensions	
Covariance Parameters	1
Columns in X	95
Columns in Z	0
Subjects (Blocks in V)	1
Max Obs per Subject	126

Optimization Information	
Optimization Technique	Newton-Raphson
Parameters in Optimization	42
Lower Boundaries	0
Upper Boundaries	0
Fixed Effects	Not Profiled

Iteration History					
Iteration	Restarts	Evaluations	Objective Function	Change	Max Gradient
0	0	4	34.035735639	.	1.810595
1	0	3	22.74397212	11.29176352	0.625184
2	0	3	18.866503836	3.87746828	0.22236
3	0	3	17.463447727	1.41305611	0.081631
4	0	3	16.934755697	0.51869203	0.029984
5	0	3	16.744093109	0.19066259	0.011029
6	0	3	16.673973015	0.07012009	0.004057

7	0	3	16.64818008	0.02579293	0.001493
8	0	3	16.63869177	0.00948831	0.000549
9	0	3	16.635201267	0.00349050	0.000202
10	0	3	16.63391719	0.00128406	0.000074
11	0	3	16.633444805	0.00047238	0.000027
12	0	3	16.633271024	0.00017378	0.00001
13	0	3	16.633207094	0.00006393	3.7E-6

Convergence criterion (ABSGCONV=0.00001) satisfied.

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Fit Statistics	
-2 Log Likelihood	33.27
AIC (smaller is better)	117.27
AICC (smaller is better)	160.78
BIC (smaller is better)	236.39
CAIC (smaller is better)	278.39
HQIC (smaller is better)	165.66
Pearson Chi-Square	16.64
Pearson Chi-Square / DF	0.20

Parameter Estimates

Effect	sps	time	conc	Estimate	Standard Error	DF	t Value	Pr > |t|
sps	FAM			-17.1184	423.72	84	-0.04	0.9679
sps	HGE			-3.1355	0.4546	84	-6.90	<.0001
sps	HIC			-3.3673	0.4527	84	-7.44	<.0001
sps	PIG			-16.9240	429.87	84	-0.04	0.9687
sps	PPB			-3.2581	0.4536	84	-7.18	<.0001
sps	THR			-17.1184	423.72	84	-0.04	0.9679
sps	WAS			-17.1184	423.72	84	-0.04	0.9679
time		8		-963E-13	599.23	84	-0.00	1.0000
time		24		0	.	.	.	.
sps*time	FAM	8		9.63E-11	847.44	84	0.00	1.0000
sps*time	FAM	24		0	.	.	.	.
sps*time	HGE	8		-13.7885	737.47	84	-0.02	0.9851
sps*time	HGE	24		0	.	.	.	.
sps*time	HIC	8		-13.7511	733.91	84	-0.02	0.9851
sps*time	HIC	24		0	.	.	.	.
sps*time	PIG	8		9.63E-11	853.61	84	0.00	1.0000
sps*time	PIG	24		0	.	.	.	.
sps*time	PPB	8		-13.7678	735.49	84	-0.02	0.9851
sps*time	PPB	24		0	.	.	.	.
sps*time	THR	8		9.63E-11	847.44	84	0.00	1.0000
sps*time	THR	24		0	.	.	.	.
sps*time	WAS	8		0	.	.	.	.
sps*time	WAS	24		0	.	.	.	.
conc			0	-138E-12	599.23	84	-0.00	1.0000
conc			50	-177E-12	599.23	84	-0.00	1.0000
conc			100	0	.	.	.	.
sps*conc	FAM		0	1.36E-10	847.44	84	0.00	1.0000
sps*conc	FAM		50	1.77E-10	847.44	84	0.00	1.0000

sps*conc	FAM		100	0	.	.	.	.
sps*conc	HGE		0	1.36E-10	599.23	84	0.00	1.0000
sps*conc	HGE		50	1.77E-10	599.23	84	0.00	1.0000
sps*conc	HGE		100	0	.	.	.	.
sps*conc	HIC		0	-13.7511	733.91	84	-0.02	0.9851
sps*conc	HIC		50	-13.7511	733.91	84	-0.02	0.9851
sps*conc	HIC		100	0	.	.	.	.
sps*conc	PIG		0	1.36E-10	853.61	84	0.00	1.0000
sps*conc	PIG		50	1.77E-10	853.61	84	0.00	1.0000
sps*conc	PIG		100	0	.	.	.	.
sps*conc	PPB		0	-13.7678	735.49	84	-0.02	0.9851
sps*conc	PPB		50	1.77E-10	599.23	84	0.00	1.0000
sps*conc	PPB		100	0	.	.	.	.
sps*conc	THR		0	1.36E-10	847.44	84	0.00	1.0000
sps*conc	THR		50	1.77E-10	847.44	84	0.00	1.0000
sps*conc	THR		100	0	.	.	.	.
sps*conc	WAS		0	0	.	.	.	.
sps*conc	WAS		50	0	.	.	.	.
sps*conc	WAS		100	0	.	.	.	.
time*conc		8	0	1.84E-10	847.44	84	0.00	1.0000
time*conc		8	50	13.7511	733.91	84	0.02	0.9851
time*conc		8	100	0	.	.	.	.
time*conc		24	0	0	.	.	.	.
time*conc		24	50	0	.	.	.	.
time*conc		24	100	0	.	.	.	.
sps*time*conc	FAM	8	0	-184E-12	1198.47	84	-0.00	1.0000
sps*time*conc	FAM	8	50	-13.7511	1121.06	84	-0.01	0.9902
sps*time*conc	FAM	8	100	0	.	.	.	.
sps*time*conc	FAM	24	0	0	.	.	.	.
sps*time*conc	FAM	24	50	0	.	.	.	.
sps*time*conc	FAM	24	100	0	.	.	.	.
sps*time*conc	HGE	8	0	13.7885	950.24	84	0.01	0.9885
sps*time*conc	HGE	8	50	-13.7511	952.99	84	-0.01	0.9885
sps*time*conc	HGE	8	100	0	.	.	.	.
sps*time*conc	HGE	24	0	0	.	.	.	.
sps*time*conc	HGE	24	50	0	.	.	.	.
sps*time*conc	HGE	24	100	0	.	.	.	.
sps*time*conc	HIC	8	0	13.7511	1121.06	84	0.01	0.9902
sps*time*conc	HIC	8	50	-192E-12	1037.90	84	-0.00	1.0000
sps*time*conc	HIC	8	100	0	.	.	.	.
sps*time*conc	HIC	24	0	0	.	.	.	.
sps*time*conc	HIC	24	50	0	.	.	.	.
sps*time*conc	HIC	24	100	0	.	.	.	.
sps*time*conc	PIG	8	0	-184E-12	1207.19	84	-0.00	1.0000
sps*time*conc	PIG	8	50	-13.7511	1130.38	84	-0.01	0.9903
sps*time*conc	PIG	8	100	0	.	.	.	.
sps*time*conc	PIG	24	0	0	.	.	.	.
sps*time*conc	PIG	24	50	0	.	.	.	.
sps*time*conc	PIG	24	100	0	.	.	.	.
sps*time*conc								

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	PPB	8	0	13.7678	1124.17	84	0.01	0.9903
sps*time*conc	PPB	8	50	-13.7511	949.93	84	-0.01	0.9885
sps*time*conc	PPB	8	100	0	.	.	.	.
sps*time*conc	PPB	24	0	0	.	.	.	.
sps*time*conc	PPB	24	50	0	.	.	.	.
sps*time*conc	PPB	24	100	0	.	.	.	.
sps*time*conc	THR	8	0	-184E-12	1198.47	84	-0.00	1.0000
sps*time*conc	THR	8	50	-13.7511	1121.06	84	-0.01	0.9902
sps*time*conc	THR	8	100	0	.	.	.	.
sps*time*conc	THR	24	0	0	.	.	.	.
sps*time*conc	THR	24	50	0	.	.	.	.
sps*time*conc	THR	24	100	0	.	.	.	.
sps*time*conc	WAS	8	0	0	.	.	.	.
sps*time*conc	WAS	8	50	0	.	.	.	.
sps*time*conc	WAS	8	100	0	.	.	.	.
sps*time*conc	WAS	24	0	0	.	.	.	.
sps*time*conc	WAS	24	50	0	.	.	.	.
sps*time*conc	WAS	24	100	0	.	.	.	.
Residual				0.1981	.	.	.	.

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Type III Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
sps	6	84	0.00	1.0000
time	1	84	0.00	0.9823
sps*time	6	84	0.00	1.0000
conc	2	84	0.00	1.0000
sps*conc	12	84	0.00	1.0000
time*conc	2	84	0.00	0.9998
sps*time*conc	12	84	0.00	1.0000

Odds Ratio Estimates

sps	time	conc	sps	time	conc	Estimate	DF	95% Confidence Limits	
FAM			WAS			0.101	84	<0.001	>999.999
HGE			WAS			>999.999	84	<0.001	>999.999
HIC			WAS			1.000	84	<0.001	>999.999
PIG			WAS			0.123	84	<0.001	>999.999
PPB			WAS			10.912	84	<0.001	>999.999
THR			WAS			0.101	84	<0.001	>999.999
	8			24		0.072	84	<0.001	>999.999
		0			100	0.375	84	<0.001	>999.999
		50			100	1.000	84	<0.001	>999.999

sps Least Squares Means

sps	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
FAM	-17.1184	172.98	84	-0.10	0.9214	0.05	-361.12	326.88	3.678E-8	6.362E-6	148E-159	1.0000
HGE	-7.7317	101.32	84	-0.08	0.9394	0.05	-209.22	193.76	0.000439	0.04441	1.37E-91	1.0000
HIC	-14.8265	157.91	84	-0.09	0.9254	0.05	-328.85	299.20	3.638E-7	0.000057	152E-145	1.0000
PIG	-16.9240	175.49	84	-0.10	0.9234	0.05	-365.91	332.06	4.467E-8	7.839E-6	122E-161	1.0000
PPB	-12.4366	142.15	84	-0.09	0.9305	0.05	-295.12	270.25	3.97E-6	0.000564	674E-131	1.0000

THR	-17.1184	172.98	84	-0.10	0.9214	0.05	-361.12	326.88	3.678E-8	6.362E-8	148E-159	1.0000
WAS	-14.8265	157.91	84	-0.09	0.9254	0.05	-328.85	299.20	3.638E-7	0.000057	152E-145	1.0000

Differences of sps Least Squares Means

sps	sps	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
FAM	HGE	-9.3867	200.47	84	-0.05	0.9628	0.05	-408.05	389.28	<0.001	<0.001	>999.999
FAM	HIC	-2.2918	234.22	84	-0.01	0.9922	0.05	-468.07	463.48	0.101	<0.001	>999.999
FAM	PIG	-0.1943	246.42	84	-0.00	0.9994	0.05	-490.22	489.83	0.823	<0.001	>999.999
FAM	PPB	-4.6817	223.90	84	-0.02	0.9834	0.05	-449.93	440.57	0.009	<0.001	>999.999
FAM	THR	-933E-17	244.64	84	-0.00	1.0000	0.05	-486.49	486.49	1.000	<0.001	>999.999
FAM	WAS	-2.2918	234.22	84	-0.01	0.9922	0.05	-468.07	463.48	0.101	<0.001	>999.999
HGE	HIC	7.0949	187.62	84	0.04	0.9699	0.05	-366.01	380.20	>999.999	<0.001	>999.999
HGE	PIG	9.1924	202.64	84	0.05	0.9639	0.05	-393.78	412.17	>999.999	<0.001	>999.999
HGE	PPB	4.7050	174.57	84	0.03	0.9786	0.05	-342.44	351.85	110.494	<0.001	>999.999
HGE	THR	9.3867	200.47	84	0.05	0.9628	0.05	-389.28	408.05	>999.999	<0.001	>999.999
HGE	WAS	7.0949	187.62	84	0.04	0.9699	0.05	-366.01	380.20	>999.999	<0.001	>999.999
HIC	PIG	2.0975	236.08	84	0.01	0.9929	0.05	-467.37	471.57	8.146	<0.001	>999.999
HIC	PPB	-2.3899	212.47	84	-0.01	0.9911	0.05	-424.91	420.13	0.092	<0.001	>999.999
HIC	THR	2.2918	234.22	84	0.01	0.9922	0.05	-463.48	468.07	9.893	<0.001	>999.999
HIC	WAS	9.03E-12	223.32	84	0.00	1.0000	0.05	-444.10	444.10	1.000	<0.001	>999.999
PIG	PPB	-4.4874	225.84	84	-0.02	0.9842	0.05	-453.60	444.63	0.011	<0.001	>999.999
PIG	THR	0.1943	246.42	84	0.00	0.9994	0.05	-489.83	490.22	1.215	<0.001	>999.999
PIG	WAS	-2.0975	236.08	84	-0.01	0.9929	0.05	-471.57	467.37	0.123	<0.001	>999.999
PPB	THR	4.6817	223.90	84	0.02	0.9834	0.05	-440.57	449.93	107.958	<0.001	>999.999
PPB	WAS	2.3899	212.47	84	0.01	0.9911	0.05	-420.13	424.91	10.912	<0.001	>999.999
THR	WAS	-2.2918	234.22	84	-0.01	0.9922	0.05	-468.07	463.48	0.101	<0.001	>999.999

time Least Squares Means

time	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
8	-15.7382	86.3777	84	-0.18	0.8591	0.05	-191.49	160.01	1.462E-7	0.000013	6.89E-84	1.0000
24	-13.1138	78.4078	84	-0.17	0.8676	0.05	-169.04	142.81	2.017E-6	0.000158	3.88E-74	1.0000

Differences of time Least Squares Means

time	time	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
8	24	-2.6244	118.15	84	-0.02	0.9823	0.05	-237.57	232.32	0.072	<0.001	>999.999

conc Least Squares Means

conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
0	-15.0799	105.21	84	-0.14	0.8864	0.05	-224.31	194.15	2.824E-7	0.000030	3.85E-98	1.0000
50	-14.0991	100.84	84	-0.14	0.8891	0.05	-214.63	186.43	7.531E-7	0.000076	6.14E-94	1.0000
100	-14.0991	100.84	84	-0.14	0.8891	0.05	-214.63	186.43	7.531E-7	0.000076	6.14E-94	1.0000

Differences of conc Least Squares Means

conc	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
0	50	-0.9807	145.73	84	-0.01	0.9946	0.05	-290.79	288.82	0.375	<0.001	>999.999

0	100	-0.9807	145.73	84	-0.01	0.9946	0.05	-290.79	288.82	0.375	<0.001	>999.999
50	100	-943E-14	142.61	84	-0.00	1.0000	0.05	-283.59	283.59	1.000	<0.001	>999.999

sps*time Least Squares Means

sps	time	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
FAM	8	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000
FAM	24	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000
HGE	8	-12.3279	202.64	84	-0.06	0.9516	0.05	-415.30	390.65	4.427E-6	0.000897	433E-183	1.0000
HGE	24	-3.1355	0.2625	84	-11.95	<.0001	0.05	-3.6575	-2.6135	0.04167	0.01048	0.02515	0.06827
HIC	8	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000
HIC	24	-12.5347	199.74	84	-0.06	0.9501	0.05	-409.75	384.68	3.6E-8	0.000719	112E-180	1.0000
PIG	8	-16.9240	248.18	84	-0.07	0.9458	0.05	-510.47	476.62	4.467E-8	0.000011	203E-224	1.0000
PIG	24	-16.9240	248.18	84	-0.07	0.9458	0.05	-510.47	476.62	4.467E-8	0.000011	203E-224	1.0000
PPB	8	-17.0259	246.22	84	-0.07	0.9450	0.05	-506.66	472.60	4.034E-8	8.933E-6	917E-223	1.0000
PPB	24	-7.8474	142.15	84	-0.06	0.9561	0.05	-290.54	274.84	0.000391	0.05551	664E-129	1.0000
THR	8	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000
THR	24	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000
WAS	8	-12.5347	199.74	84	-0.06	0.9501	0.05	-409.75	384.68	3.6E-8	0.000719	112E-180	1.0000
WAS	24	-17.1184	244.64	84	-0.07	0.9444	0.05	-503.60	469.37	3.678E-8	8.997E-6	194E-221	1.0000

Differences of sps*time Least Squares Means

sps	time	sps	time	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
FAM	8	FAM	24	-533E-17	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	8	HGE	8	-4.7905	317.66	84	-0.02	0.9880	0.05	-636.50	626.92	0.008	<0.001	>999.999
FAM	8	HGE	24	-13.9829	244.64	84	-0.06	0.9548	0.05	-500.47	472.50	<0.001	<0.001	>999.999
FAM	8	HIC	8	1.78E-15	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	8	HIC	24	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
FAM	8	PIG	8	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
FAM	8	PIG	24	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
FAM	8	PPB	8	-0.09247	347.09	84	-0.00	0.9998	0.05	-690.31	690.13	0.912	<0.001	>999.999
FAM	8	PPB	24	-9.2710	282.94	84	-0.03	0.9739	0.05	-571.93	553.38	<0.001	<0.001	>999.999
FAM	8	THR	8	-798E-17	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	8	THR	24	-107E-16	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	8	WAS	8	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
FAM	8	WAS	24	2.35E-11	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	24	HGE	8	-4.7905	317.66	84	-0.02	0.9880	0.05	-636.50	626.92	0.008	<0.001	>999.999
FAM	24	HGE	24	-13.9829	244.64	84	-0.06	0.9548	0.05	-500.47	472.50	<0.001	<0.001	>999.999
FAM	24	HIC	8	1.07E-14	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	24	HIC	24	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
FAM	24	PIG	8	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
FAM	24	PIG	24	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
FAM	24	PPB	8	-0.09247	347.09	84	-0.00	0.9998	0.05	-690.31	690.13	0.912	<0.001	>999.999
FAM	24	PPB	24	-9.2710	282.94	84	-0.03	0.9739	0.05	-571.93	553.38	<0.001	<0.001	>999.999
FAM	24	THR	8	-888E-18	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	24	THR	24	0	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
FAM	24	WAS	8	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
FAM	24	WAS	24	2.35E-11	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999

HGE	8	HGE	24	-9.1924	202.64	84	-0.05	0.9639	0.05	-412.17	393.78	<0.001	<0.001	>999.999
HGE	8	HIC	8	4.7905	317.66	84	0.02	0.9880	0.05	-626.92	636.50	120.364	<0.001	>999.999
HGE	8	HIC	24	0.2068	284.54	84	0.00	0.9994	0.05	-565.63	566.04	1.230	<0.001	>999.999
HGE	8	PIG	8	4.5962	320.40	84	0.01	0.9886	0.05	-632.56	641.76	99.105	<0.001	>999.999
HGE	8	PIG	24	4.5962	320.40	84	0.01	0.9886	0.05	-632.56	641.76	99.105	<0.001	>999.999
HGE	8	PPB	8	4.6980	318.88	84	0.01	0.9883	0.05	-629.44	638.83	109.733	<0.001	>999.999
HGE	8	PPB	24	-4.4805	247.53	84	-0.02	0.9856	0.05	-496.72	487.76	0.011	<0.001	>999.999
HGE	8	THR	8	4.7905	317.66	84	0.02	0.9880	0.05	-626.92	636.50	120.364	<0.001	>999.999
HGE	8	THR	24	4.7905	317.66	84	0.02	0.9880	0.05	-626.92	636.50	120.364	<0.001	>999.999
HGE	8	WAS	8	0.2068	284.54	84	0.00	0.9994	0.05	-565.63	566.04	1.230	<0.001	>999.999
HGE	8	WAS	24	4.7905	317.66	84	0.02	0.9880	0.05	-626.92	636.50	120.364	<0.001	>999.999
HGE	24	HIC	8	13.9829	244.64	84	0.06	0.9546	0.05	-472.50	500.47	>999.999	<0.001	>999.999
HGE	24	HIC	24	9.3992	199.74	84	0.05	0.9626	0.05	-387.81	406.61	>999.999	<0.001	>999.999
HGE	24	PIG	8	13.7885	248.18	84	0.06	0.9558	0.05	-479.75	507.33	>999.999	<0.001	>999.999
HGE	24	PIG	24	13.7885	248.18	84	0.06	0.9558	0.05	-479.75	507.33	>999.999	<0.001	>999.999
HGE	24	PPB	8	13.8904	246.22	84	0.06	0.9551	0.05	-475.74	503.52	>999.999	<0.001	>999.999
HGE	24	PPB	24	4.7119	142.15	84	0.03	0.9736	0.05	-277.98	287.40	111.260	<0.001	>999.999
HGE	24	THR	8	13.9829	244.64	84	0.06	0.9546	0.05	-472.50	500.47	>999.999	<0.001	>999.999
HGE	24	THR	24	13.9829	244.64	84	0.06	0.9546	0.05	-472.50	500.47	>999.999	<0.001	>999.999
HGE	24	WAS	8	9.3992	199.74	84	0.05	0.9626	0.05	-387.81	406.61	>999.999	<0.001	>999.999
HGE	24	WAS	24	13.9829	244.64	84	0.06	0.9546	0.05	-472.50	500.47	>999.999	<0.001	>999.999
HIC	8	HIC	24	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
HIC	8	PIG	8	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
HIC	8	PIG	24	-0.1943	348.49	84	-0.00	0.9996	0.05	-693.20	692.81	0.823	<0.001	>999.999
HIC	8	PPB	8	-0.09247	347.39	84	-0.00	0.9998	0.05	-690.31	690.13	0.912	<0.001	>999.999
HIC	8	PPB	24	-9.2710	282.94	84	-0.03	0.9739	0.05	-571.93	553.38	<0.001	<0.001	>999.999
HIC	8	THR	8	-115E-16	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
HIC	8	THR	24	-129E-16	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
HIC	8	WAS	8	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
HIC	8	WAS	24	2.35E-11	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
HIC	24	PIG	8	4.3894	318.58	84	0.01	0.9890	0.05	-629.14	637.92	80.588	<0.001	>999.999
HIC	24	PIG	24	4.3894	318.58	84	0.01	0.9890	0.05	-629.14	637.92	80.588	<0.001	>999.999
HIC	24	PPB	8	4.4912	317.05	84	0.01	0.9887	0.05	-626.09	634.98	89.230	<0.001	>999.999
HIC	24	PPB	24	-4.6873	245.16	84	-0.02	0.9846	0.05	-492.22	482.85	0.009	<0.001	>999.999
HIC	24	THR	8	4.5837	315.82	84	0.01	0.9885	0.05	-623.47	632.63	97.875	<0.001	>999.999
HIC	24	THR	24	4.5837	315.82	84	0.01	0.9885	0.05	-623.47	632.63	97.875	<0.001	>999.999
HIC	24	WAS	8	-544E-14	282.48	84	-0.00	1.0000	0.05	-561.74	561.74	1.000	<0.001	>999.999
HIC	24	WAS	24	4.5837	315.82	84	0.01	0.9885	0.05	-623.47	632.63	97.875	<0.001	>999.999
PIG	8	PIG	24	1.79E-15	350.99	84	0.00	1.0000	0.05	-697.97	697.97	1.000	<0.001	>999.999
PIG	8	PPB	8	0.1019	349.60	84	0.00	0.9998	0.05	-695.11	695.31	1.107	<0.001	>999.999
PIG	8	PPB	24	-9.0767	286.01	84	-0.03	0.9748	0.05	-577.84	559.69	<0.001	<0.001	>999.999
PIG	8	THR	8	0.1943	348.49	84	0.00	0.9996	0.05	-692.81	693.20	1.215	<0.001	>999.999
PIG	8	THR	24	0.1943	348.49	84	0.00	0.9996	0.05	-692.81	693.20	1.215	<0.001	>999.999
PIG	8	WAS	8	-4.3894	318.58	84	-0.01	0.9890	0.05	-637.92	629.14	0.012	<0.001	>999.999
PIG	8	WAS	24	0.1943	348.49	84	0.00	0.9996	0.05	-692.81	693.20	1.215	<0.001	>999.999
PIG	24	PPB	8	0.1019	349.60	84	0.00	0.9998	0.05	-695.11	695.31	1.107	<0.001	>999.999
PIG	24	PPB	24	-9.0767	286.01	84	-0.03	0.9748	0.05	-577.84	559.69	<0.001	<0.001	>999.999
PIG	24	THR	8	0.1943	348.49	84	0.00	0.9996	0.05	-692.81	693.20	1.215	<0.001	>999.999
PIG	24	THR	24	0.1943	348.49	84	0.00	0.9996	0.05	-692.81	693.20	1.215	<0.001	>999.999
PIG														

	24	WAS	8	-4.3894	316.58	84	-0.01	0.9890	0.05	-637.92	629.14	0.012	<0.001	>999.999
PIG	24	WAS	24	0.1943	348.49	84	0.00	0.9996	0.05	-692.61	693.20	1.215	<0.001	>999.999
PPB	8	PPB	24	-9.1785	284.31	84	-0.03	0.9743	0.05	-574.55	556.20	<0.001	<0.001	>999.999
PPB	8	THR	8	0.09247	347.09	84	0.00	0.9998	0.05	-690.13	690.31	1.097	<0.001	>999.999
PPB	8	THR	24	0.09247	347.09	84	0.00	0.9998	0.05	-690.13	690.31	1.097	<0.001	>999.999
PPB	8	WAS	8	-4.4912	317.05	84	-0.01	0.9887	0.05	-634.98	626.00	0.011	<0.001	>999.999
PPB	8	WAS	24	0.09247	347.09	84	0.00	0.9998	0.05	-690.13	690.31	1.097	<0.001	>999.999
PPB	24	THR	8	9.2710	282.94	84	0.03	0.9739	0.05	-553.38	571.93	>999.999	<0.001	>999.999
PPB	24	THR	24	9.2710	282.94	84	0.03	0.9739	0.05	-553.38	571.93	>999.999	<0.001	>999.999
PPB	24	WAS	8	4.6873	245.16	84	0.02	0.9848	0.05	-482.85	492.22	108.562	<0.001	>999.999
PPB	24	WAS	24	9.2710	282.94	84	0.03	0.9739	0.05	-553.38	571.93	>999.999	<0.001	>999.999
THR	8	THR	24	-178E-17	345.97	84	-0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
THR	8	WAS	8	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
THR	8	WAS	24	2.35E-11	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
THR	24	WAS	8	-4.5837	315.82	84	-0.01	0.9885	0.05	-632.63	623.47	0.010	<0.001	>999.999
THR	24	WAS	24	2.35E-11	345.97	84	0.00	1.0000	0.05	-687.99	687.99	1.000	<0.001	>999.999
WAS	8	WAS	24	4.5837	315.82	84	0.01	0.9885	0.05	-623.47	632.63	97.875	<0.001	>999.999

sps*conc Least Squares Means

sps	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
FAM	0	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
FAM	50	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
FAM	100	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
HGE	0	-3.1355	0.3215	84	-9.75	<.0001	0.05	-3.7748	-2.4962	0.04167	0.01284	0.02243	0.07813
HGE	50	-10.0298	214.93	84	-0.05	0.9629	0.05	-437.45	417.39	0.000044	0.009471	104E-192	1.0000
HGE	100	-10.0298	214.93	84	-0.05	0.9629	0.05	-437.45	417.39	0.000044	0.009471	104E-192	1.0000
HIC	0	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
HIC	50	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
HIC	100	-10.2428	211.86	84	-0.05	0.9616	0.05	-431.55	411.07	0.000036	0.007544	38E-189	1.0000
PIG	0	-16.9240	303.96	84	-0.06	0.9557	0.05	-621.39	587.54	4.467E-8	0.000014	136E-272	1.0000
PIG	50	-16.9240	303.96	84	-0.06	0.9557	0.05	-621.39	587.54	4.467E-8	0.000014	136E-272	1.0000
PIG	100	-16.9240	303.96	84	-0.06	0.9557	0.05	-621.39	587.54	4.467E-8	0.000014	136E-272	1.0000
PPB	0	-17.0259	301.55	84	-0.06	0.9551	0.05	-616.70	582.65	4.034E-8	0.000012	148E-270	1.0000
PPB	50	-10.1420	213.23	84	-0.05	0.9622	0.05	-434.17	413.89	0.000039	0.008398	276E-191	1.0000
PPB	100	-10.1420	213.23	84	-0.05	0.9622	0.05	-434.17	413.89	0.000039	0.008398	276E-191	1.0000
THR	0	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
THR	50	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
THR	100	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
WAS	0	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000
WAS	50	-10.2428	211.86	84	-0.05	0.9616	0.05	-431.55	411.07	0.000036	0.007544	38E-189	1.0000
WAS	100	-17.1184	299.62	84	-0.06	0.9546	0.05	-612.94	578.70	3.678E-8	0.000011	637E-269	1.0000

Differences of sps*conc Least Squares Means

sps	conc	sps	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
FAM	0	FAM	50	9.1E-16	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	FAM	100	-538E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	HGE	0	-13.9829	299.62	84	-0.05	0.9629	0.05	-609.60	581.64	<0.001	<0.001	>999.999

FAM	0	HGE	50	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	0	HGE	100	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	0	HIC	0	3.55E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	HIC	50	3.55E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	HIC	100	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
FAM	0	PIG	0	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	0	PIG	50	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	0	PIG	100	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	0	PPB	0	-0.09247	425.09	84	-0.00	0.9998	0.05	-845.44	845.25	0.912	<0.001	>999.999
FAM	0	PPB	50	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	0	PPB	100	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	0	THR	0	-72E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	THR	50	-711E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	THR	100	-711E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	0	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
FAM	0	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	FAM	100	-592E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	HGE	0	-13.9829	299.62	84	-0.05	0.9629	0.05	-609.80	581.84	<0.001	<0.001	>999.999
FAM	50	HGE	50	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	50	HGE	100	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	50	HIC	0	3.75E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	HIC	50	0	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	HIC	100	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
FAM	50	PIG	0	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	50	PIG	50	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	50	PIG	100	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	50	PPB	0	-0.09247	425.09	84	-0.00	0.9998	0.05	-845.44	845.25	0.912	<0.001	>999.999
FAM	50	PPB	50	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	50	PPB	100	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	50	THR	0	-72E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	THR	50	-107E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	THR	100	-355E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	50	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
FAM	50	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	HGE	0	-13.9829	299.62	84	-0.05	0.9629	0.05	-609.80	581.84	<0.001	<0.001	>999.999
FAM	100	HGE	50	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	100	HGE	100	-7.0886	368.74	84	-0.02	0.9847	0.05	-740.36	726.18	<0.001	<0.001	>999.999
FAM	100	HIC	0	9.23E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	HIC	50	7.11E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	HIC	100	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
FAM	100	PIG	0	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	100	PIG	50	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	100	PIG	100	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
FAM	100	PPB	0	-0.09247	425.09	84	-0.00	0.9998	0.05	-845.44	845.25	0.912	<0.001	>999.999
FAM	100	PPB	50	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	100	PPB	100	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
FAM	100	THR	0	-902E-19	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM														

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	100	THR	50	-355E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	THR	100	0	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
FAM	100	WAS	50	-8.8755	366.95	84	-0.02	0.9851	0.05	-736.80	722.85	0.001	<0.001	>999.999
FAM	100	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HGE	0	HGE	50	6.8943	214.93	84	0.03	0.9745	0.05	-420.53	434.31	986.608	<0.001	>999.999
HGE	0	HGE	100	6.8943	214.93	84	0.03	0.9745	0.05	-420.53	434.31	986.608	<0.001	>999.999
HGE	0	HIC	0	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	HIC	50	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	HIC	100	7.1073	211.86	84	0.03	0.9733	0.05	-414.20	428.42	>999.999	<0.001	>999.999
HGE	0	PIG	0	13.7885	303.96	84	0.05	0.9639	0.05	-590.67	618.25	>999.999	<0.001	>999.999
HGE	0	PIG	50	13.7885	303.96	84	0.05	0.9639	0.05	-590.67	618.25	>999.999	<0.001	>999.999
HGE	0	PIG	100	13.7885	303.96	84	0.05	0.9639	0.05	-590.67	618.25	>999.999	<0.001	>999.999
HGE	0	PPB	0	13.8904	301.55	84	0.05	0.9634	0.05	-585.78	613.56	>999.999	<0.001	>999.999
HGE	0	PPB	50	7.0085	213.23	84	0.03	0.9739	0.05	-417.03	431.04	>999.999	<0.001	>999.999
HGE	0	PPB	100	7.0085	213.23	84	0.03	0.9739	0.05	-417.03	431.04	>999.999	<0.001	>999.999
HGE	0	THR	0	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	THR	50	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	THR	100	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	WAS	0	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	0	WAS	50	7.1073	211.86	84	0.03	0.9733	0.05	-414.20	428.42	>999.999	<0.001	>999.999
HGE	0	WAS	100	13.9829	299.62	84	0.05	0.9629	0.05	-581.84	609.80	>999.999	<0.001	>999.999
HGE	50	HGE	100	1.46E-11	303.96	84	0.00	1.0000	0.05	-604.46	604.46	1.000	<0.001	>999.999
HGE	50	HIC	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	HIC	50	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	HIC	100	0.2131	301.80	84	0.00	0.9994	0.05	-599.94	600.37	1.237	<0.001	>999.999
HGE	50	PIG	0	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	50	PIG	50	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	50	PIG	100	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	50	PPB	0	6.9961	370.31	84	0.02	0.9850	0.05	-729.41	743.40	>999.999	<0.001	>999.999
HGE	50	PPB	50	0.1122	302.76	84	0.00	0.9997	0.05	-601.96	602.18	1.119	<0.001	>999.999
HGE	50	PPB	100	0.1122	302.76	84	0.00	0.9997	0.05	-601.96	602.18	1.119	<0.001	>999.999
HGE	50	THR	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	THR	50	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	THR	100	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	WAS	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	50	WAS	50	0.2131	301.80	84	0.00	0.9994	0.05	-599.94	600.37	1.237	<0.001	>999.999
HGE	50	WAS	100	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	HIC	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	HIC	50	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	HIC	100	0.2131	301.80	84	0.00	0.9994	0.05	-599.94	600.37	1.237	<0.001	>999.999
HGE	100	PIG	0	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	100	PIG	50	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	100	PIG	100	6.8943	372.28	84	0.02	0.9853	0.05	-733.42	747.21	986.608	<0.001	>999.999
HGE	100	PPB	0	6.9961	370.31	84	0.02	0.9850	0.05	-729.41	743.40	>999.999	<0.001	>999.999
HGE	100	PPB	50	0.1122	302.76	84	0.00	0.9997	0.05	-601.96	602.18	1.119	<0.001	>999.999
HGE	100	PPB	100	0.1122	302.76	84	0.00	0.9997	0.05	-601.96	602.18	1.119	<0.001	>999.999
HGE	100	THR	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	THR	50	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE														

	100	THR	100	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	WAS	0	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HGE	100	WAS	50	0.2131	301.60	84	0.00	0.9994	0.05	-599.94	600.37	1.237	<0.001	>999.999
HGE	100	WAS	100	7.0886	368.74	84	0.02	0.9847	0.05	-726.18	740.36	>999.999	<0.001	>999.999
HIC	0	HIC	50	0	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	0	HIC	100	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
HIC	0	PIG	0	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	0	PIG	50	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	0	PIG	100	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	0	PPB	0	-0.09247	425.09	84	-0.00	0.9998	0.05	-845.44	845.25	0.912	<0.001	>999.999
HIC	0	PPB	50	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.25	724.33	<0.001	<0.001	>999.999
HIC	0	PPB	100	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
HIC	0	THR	0	-107E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	0	THR	50	-107E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	0	THR	100	-711E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	0	WAS	0	1.18E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	0	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
HIC	0	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	50	HIC	100	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
HIC	50	PIG	0	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	50	PIG	50	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	50	PIG	100	-0.1943	426.81	84	-0.00	0.9996	0.05	-848.94	848.56	0.823	<0.001	>999.999
HIC	50	PPB	0	-0.09247	425.09	84	-0.00	0.9998	0.05	-845.44	845.25	0.912	<0.001	>999.999
HIC	50	PPB	50	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
HIC	50	PPB	100	-6.9764	367.75	84	-0.02	0.9849	0.05	-738.28	724.33	<0.001	<0.001	>999.999
HIC	50	THR	0	-116E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	50	THR	50	-124E-16	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	50	THR	100	-755E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	50	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	50	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
HIC	50	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
HIC	100	PIG	0	6.6812	370.51	84	0.02	0.9857	0.05	-730.12	743.48	797.276	<0.001	>999.999
HIC	100	PIG	50	6.6812	370.51	84	0.02	0.9857	0.05	-730.12	743.48	797.276	<0.001	>999.999
HIC	100	PIG	100	6.6812	370.51	84	0.02	0.9857	0.05	-730.12	743.48	797.276	<0.001	>999.999
HIC	100	PPB	0	6.7831	368.54	84	0.02	0.9854	0.05	-726.09	739.66	882.773	<0.001	>999.999
HIC	100	PPB	50	-0.1008	300.59	84	-0.00	0.9997	0.05	-597.85	597.65	0.904	<0.001	>999.999
HIC	100	PPB	100	-0.1008	300.59	84	-0.00	0.9997	0.05	-597.85	597.65	0.904	<0.001	>999.999
HIC	100	THR	0	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999
HIC	100	THR	50	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999
HIC	100	THR	100	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999
HIC	100	WAS	0	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999
HIC	100	WAS	50	4.79E-11	299.62	84	0.00	1.0000	0.05	-595.82	595.82	1.000	<0.001	>999.999
HIC	100	WAS	100	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999
PIG	0	PIG	50	1.97E-15	429.87	84	0.00	1.0000	0.05	-854.84	854.84	1.000	<0.001	>999.999
PIG	0	PIG	100	1.08E-15	429.87	84	0.00	1.0000	0.05	-854.84	854.84	1.000	<0.001	>999.999
PIG	0	PPB	0	0.1019	428.17	84	0.00	0.9998	0.05	-851.36	851.56	1.107	<0.001	>999.999
PIG	0	PPB	50	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	0	PPB	100	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	0	THR	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG														

	0	THR	50	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	0	THR	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	0	WAS	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	0	WAS	50	-6.6812	370.51	84	-0.02	0.9857	0.05	-743.48	730.12	0.001	<0.001	>999.999
PIG	0	WAS	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	50	PIG	100	-888E-15	429.67	84	-0.00	1.0000	0.05	-854.84	854.84	1.000	<0.001	>999.999
PIG	50	PPB	0	0.1019	428.17	84	0.00	0.9998	0.05	-851.36	851.56	1.107	<0.001	>999.999
PIG	50	PPB	50	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	50	PPB	100	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	50	THR	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	50	THR	50	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	50	THR	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	50	WAS	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	50	WAS	50	-6.6812	370.51	84	-0.02	0.9857	0.05	-743.48	730.12	0.001	<0.001	>999.999
PIG	50	WAS	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	100	PPB	0	0.1019	428.17	84	0.00	0.9998	0.05	-851.36	851.56	1.107	<0.001	>999.999
PIG	100	PPB	50	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	100	PPB	100	-6.7820	371.30	84	-0.02	0.9855	0.05	-745.14	731.58	0.001	<0.001	>999.999
PIG	100	THR	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	100	THR	50	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	100	THR	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	100	WAS	0	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PIG	100	WAS	50	-6.6812	370.51	84	-0.02	0.9857	0.05	-743.48	730.12	0.001	<0.001	>999.999
PIG	100	WAS	100	0.1943	426.81	84	0.00	0.9996	0.05	-848.56	848.94	1.215	<0.001	>999.999
PPB	0	PPB	50	-6.6839	369.33	84	-0.02	0.9852	0.05	-741.33	727.56	0.001	<0.001	>999.999
PPB	0	PPB	100	-6.6839	369.33	84	-0.02	0.9852	0.05	-741.33	727.56	0.001	<0.001	>999.999
PPB	0	THR	0	0.09247	425.09	84	0.00	0.9998	0.05	-845.25	845.44	1.097	<0.001	>999.999
PPB	0	THR	50	0.09247	425.09	84	0.00	0.9998	0.05	-845.25	845.44	1.097	<0.001	>999.999
PPB	0	THR	100	0.09247	425.09	84	0.00	0.9998	0.05	-845.25	845.44	1.097	<0.001	>999.999
PPB	0	WAS	0	0.09247	425.09	84	0.00	0.9998	0.05	-845.25	845.44	1.097	<0.001	>999.999
PPB	0	WAS	50	-6.7831	368.54	84	-0.02	0.9854	0.05	-739.66	726.09	0.001	<0.001	>999.999
PPB	0	WAS	100	0.09247	425.09	84	0.00	0.9998	0.05	-845.25	845.44	1.097	<0.001	>999.999
PPB	50	PPB	100	1.08E-15	301.55	84	0.00	1.0000	0.05	-599.67	599.67	1.000	<0.001	>999.999
PPB	50	THR	0	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	50	THR	50	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	50	THR	100	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	50	WAS	0	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	50	WAS	50	0.1008	300.59	84	0.00	0.9997	0.05	-597.65	597.85	1.106	<0.001	>999.999
PPB	50	WAS	100	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	100	THR	0	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	100	THR	50	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	100	THR	100	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	100	WAS	0	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
PPB	100	WAS	50	0.1008	300.59	84	0.00	0.9997	0.05	-597.65	597.85	1.106	<0.001	>999.999
PPB	100	WAS	100	6.9764	367.75	84	0.02	0.9849	0.05	-724.33	738.28	>999.999	<0.001	>999.999
THR	0	THR	50	-178E-17	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	0	THR	100	3.96E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	0	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	0	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
THR														

	0	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	50	THR	100	5.33E-15	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	50	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	50	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
THR	50	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	100	WAS	0	1.19E-11	423.72	84	0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
THR	100	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
THR	100	WAS	100	-327E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
WAS	0	WAS	50	-6.8755	366.95	84	-0.02	0.9851	0.05	-736.60	722.85	0.001	<0.001	>999.999
WAS	0	WAS	100	-445E-13	423.72	84	-0.00	1.0000	0.05	-842.62	842.62	1.000	<0.001	>999.999
WAS	50	WAS	100	6.8755	366.95	84	0.02	0.9851	0.05	-722.85	736.60	968.300	<0.001	>999.999

time*conc Least Squares Means

time	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
8	0	-15.0799	148.79	84	-0.10	0.9195	0.05	-310.97	280.81	2.824E-7	0.000042	887E-138	1.0000
8	50	-15.0852	149.15	84	-0.10	0.9197	0.05	-311.69	281.52	2.809E-7	0.000042	432E-138	1.0000
8	100	-17.0496	160.97	84	-0.11	0.9159	0.05	-337.15	303.05	3.939E-8	6.341E-6	378E-149	1.0000
24	0	-15.0799	148.79	84	-0.10	0.9195	0.05	-310.97	280.81	2.824E-7	0.000042	887E-138	1.0000
24	50	-13.1130	135.75	84	-0.10	0.9233	0.05	-283.06	256.84	2.019E-6	0.000274	117E-125	1.0000
24	100	-11.1488	121.50	84	-0.09	0.9271	0.05	-252.77	230.48	0.000014	0.001749	167E-112	1.0000

Differences of time*conc Least Squares Means

time	conc	time	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
8	0	8	50	0.005351	210.68	84	0.00	1.0000	0.05	-418.95	418.96	1.005	<0.001	>999.999
8	0	8	100	1.9698	219.20	84	0.01	0.9929	0.05	-433.94	437.88	7.169	<0.001	>999.999
8	0	24	0	1.25E-1	210.42	84	0.00	1.0000	0.05	-418.45	418.45	1.000	<0.001	>999.999
8	0	24	50	-1.9668	201.41	84	-0.01	0.9922	0.05	-402.50	398.56	0.140	<0.001	>999.999
8	0	24	100	-3.9313	192.10	84	-0.02	0.9837	0.05	-385.94	378.08	0.020	<0.001	>999.999
8	50	8	100	1.9644	219.45	84	0.01	0.9929	0.05	-434.43	438.36	7.131	<0.001	>999.999
8	50	24	0	-0.00535	210.68	84	-0.00	1.0000	0.05	-418.96	418.95	0.995	<0.001	>999.999
8	50	24	50	-1.9722	201.66	84	-0.01	0.9922	0.05	-403.03	399.08	0.139	<0.001	>999.999
8	50	24	100	-3.9366	192.38	84	-0.02	0.9837	0.05	-386.50	378.63	0.020	<0.001	>999.999
8	100	24	0	-1.9698	219.20	84	-0.01	0.9929	0.05	-437.88	433.94	0.139	<0.001	>999.999
8	100	24	50	-3.9366	210.57	84	-0.02	0.9851	0.05	-422.37	414.80	0.020	<0.001	>999.999
8	100	24	100	-5.9011	201.68	84	-0.03	0.9767	0.05	-406.96	395.16	0.003	<0.001	>999.999
24	0	24	50	-1.9668	201.41	84	-0.01	0.9922	0.05	-402.50	398.56	0.140	<0.001	>999.999
24	0	24	100	-3.9313	192.10	84	-0.02	0.9837	0.05	-385.94	378.08	0.020	<0.001	>999.999
24	50	24	100	-1.9644	182.18	84	-0.01	0.9914	0.05	-364.26	360.33	0.140	<0.001	>999.999

sps*time*conc Least Squares Means

sps	time	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Mean	Standard Error Mean	Lower Mean	Upper Mean
FAM	8	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
FAM	8	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
FAM	8	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
FAM	24	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
FAM	24	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000

FAM	24	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HGE	8	0	-3.1355	0.4546	84	-6.90	<.0001	0.05	-4.0396	-2.2314	0.04167	0.01815	0.01730	0.09697
HGE	8	50	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
HGE	8	100	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
HGE	24	0	-3.1355	0.4546	84	-6.90	<.0001	0.05	-4.0396	-2.2314	0.04167	0.01815	0.01730	0.09697
HGE	24	50	-3.1355	0.4546	84	-6.90	<.0001	0.05	-4.0396	-2.2314	0.04167	0.01815	0.01730	0.09697
HGE	24	100	-3.1355	0.4546	84	-6.90	<.0001	0.05	-4.0396	-2.2314	0.04167	0.01815	0.01730	0.09697
HIC	8	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HIC	8	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HIC	8	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HIC	24	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HIC	24	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
HIC	24	100	-3.3673	0.4527	84	-7.44	<.0001	0.05	-4.2675	-2.4671	0.03333	0.01459	0.01382	0.07820
PIG	8	0	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PIG	8	50	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PIG	8	100	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PIG	24	0	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PIG	24	50	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PIG	24	100	-16.9240	429.87	84	-0.04	0.9687	0.05	-871.76	837.92	4.467E-8	0.000019	0	1.0000
PPB	8	0	-17.0259	426.46	84	-0.04	0.9682	0.05	-865.09	831.04	4.034E-8	0.000017	0	1.0000
PPB	8	50	-17.0259	426.46	84	-0.04	0.9682	0.05	-865.09	831.04	4.034E-8	0.000017	0	1.0000
PPB	8	100	-17.0259	426.46	84	-0.04	0.9682	0.05	-865.09	831.04	4.034E-8	0.000017	0	1.0000
PPB	24	0	-17.0259	426.46	84	-0.04	0.9682	0.05	-865.09	831.04	4.034E-8	0.000017	0	1.0000
PPB	24	50	-3.2581	0.4536	84	-7.18	<.0001	0.05	-4.1600	-2.3562	0.03704	0.01618	0.01537	0.08658
PPB	24	100	-3.2581	0.4536	84	-7.18	<.0001	0.05	-4.1600	-2.3562	0.03704	0.01618	0.01537	0.08658
THR	8	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
THR	8	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
THR	8	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
THR	24	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
THR	24	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
THR	24	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
WAS	8	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
WAS	8	50	-3.3673	0.4527	84	-7.44	<.0001	0.05	-4.2675	-2.4671	0.03333	0.01459	0.01382	0.07820
WAS	8	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
WAS	24	0	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
WAS	24	50	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000
WAS	24	100	-17.1184	423.72	84	-0.04	0.9679	0.05	-859.74	825.50	3.678E-8	0.000016	0	1.0000

Differences of sps*time*conc Least Squares Means

sps	time	conc	sps	time	conc	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Odds Ratio	Lower Confidence Limit for Odds Ratio	Upper Confidence Limit for Odds Ratio
FAM	8	0	FAM	8	50	-1.64E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	FAM	8	100	5.42E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	FAM	24	0	1.04E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	FAM	24	50	1.98E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	FAM	24	100	-1.51E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	0	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999

FAM	8	0	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	0	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	0	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	0	HIC	8	0	1.78E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HIC	8	50	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HIC	8	100	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HIC	24	0	8.37E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HIC	24	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	0	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	0	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	0	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	0	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	0	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	0	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	0	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	0	THR	8	0	-729E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	THR	8	50	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	THR	8	100	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	THR	24	0	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	THR	24	50	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	THR	24	100	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	0	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	FAM	8	100	6.51E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	FAM	24	0	2.68E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	FAM	24	50	2.58E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	FAM	24	100	-14E-15	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	50	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	50	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	50	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	50	HIC	8	0	3.85E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	HIC	8	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	HIC	8	100	1.07E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	HIC	24	0	8.01E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	HIC	24	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM																

	8	50	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	50	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	50	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	50	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	50	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	50	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	50	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	50	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	50	THR	8	0	-729E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	THR	8	50	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	THR	8	100	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	THR	24	0	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	THR	24	50	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	THR	24	100	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	50	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	FAM	24	0	-438E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	FAM	24	50	-343E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	FAM	24	100	-205E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	100	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	100	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	100	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	8	100	HIC	8	0	-311E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HIC	8	50	-365E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HIC	8	100	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HIC	24	0	1.05E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HIC	24	50	-178E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	100	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	8	100	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	100	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	100	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM																

	8	100	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	8	100	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	100	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	8	100	THR	8	0	-144E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	THR	8	50	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	THR	8	100	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	THR	24	0	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	THR	24	50	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	8	100	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	8	100	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	FAM	24	50	9.44E-16	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	FAM	24	100	-161E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	0	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	0	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	0	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	0	HIC	8	0	1.9E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HIC	8	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HIC	8	100	8.88E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HIC	24	0	5.33E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HIC	24	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	24	0	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	0	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	0	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	0	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	0	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	0	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	24	0	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	24	0	THR	8	0	-108E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	THR	8	50	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	THR	8	100	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	THR	24	0	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	THR	24	50	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM																

	24	0	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	FAM	24	100	-171E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	50	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	50	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	50	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	50	HIC	8	0	1.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HIC	8	50	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HIC	8	100	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HIC	24	0	4.54E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HIC	24	50	1.78E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	24	50	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	50	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	50	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	50	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	50	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	50	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.75	<0.001	<0.001	>999.999
FAM	24	50	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.75	<0.001	<0.001	>999.999
FAM	24	50	THR	8	0	-108E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	THR	8	50	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	THR	8	100	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	THR	24	0	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	THR	24	50	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	24	50	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	HGE	8	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	100	HGE	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	HGE	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	HGE	24	0	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	100	HGE	24	50	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	100	HGE	24	100	-13.9829	423.72	84	-0.03	0.9738	0.05	-856.60	828.63	<0.001	<0.001	>999.999
FAM	24	100	HIC	8	0	1.81E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	HIC	8	50	1.78E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM																

	24	100	HIC	8	100	2.49E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	HIC	24	0	2.18E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	HIC	24	50	1.95E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	24	100	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
FAM	24	100	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	100	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	100	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	100	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
FAM	24	100	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	24	100	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
FAM	24	100	THR	8	0	8.92E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	THR	8	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	THR	8	100	1.42E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	THR	24	0	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	THR	24	50	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	THR	24	100	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	WAS	8	0	-317E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
FAM	24	100	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
FAM	24	100	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HGE	8	0	HGE	8	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	HGE	8	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	HGE	24	0	1.65E-15	0.6430	84	0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	8	0	HGE	24	50	2.13E-15	0.6430	84	0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	8	0	HGE	24	100	2.09E-15	0.6430	84	0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	8	0	HIC	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	HIC	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	HIC	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	HIC	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	HIC	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	HIC	24	100	0.2318	0.6416	84	0.36	0.7188	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	8	0	PIG	8	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PIG	8	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PIG	8	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PIG	24	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PIG	24	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PIG	24	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	8	0	PPB	8	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	8	0	PPB	8	50	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	8	0	PPB	8	100	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	8	0	PPB	24	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE																

	8	0	PPB	24	50	0.1226	0.8422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	8	0	PPB	24	100	0.1226	0.8422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	8	0	THR	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	THR	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	THR	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	THR	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	THR	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	THR	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	WAS	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	WAS	8	50	0.2318	0.8416	84	0.36	0.7188	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	8	0	WAS	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	WAS	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	WAS	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	0	WAS	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	8	50	HGE	8	100	2.92E-11	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	HGE	24	0	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE	8	50	HGE	24	50	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE	8	50	HGE	24	100	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE	8	50	HIC	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	HIC	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	HIC	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	HIC	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	HIC	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	HIC	24	100	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
HGE	8	50	PIG	8	0	-31E-16	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PIG	8	50	-539E-18	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PIG	8	100	-31E-16	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PIG	24	0	-132E-17	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PIG	24	50	-132E-17	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PIG	24	100	2.23E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	50	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	50	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	50	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	50	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	50	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
HGE	8	50	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
HGE	8	50	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
HGE	8	50	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	50	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HGE	24	0	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE																

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	8	100	HGE	24	50	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE	8	100	HGE	24	100	-13.7885	429.87	84	-0.03	0.9745	0.05	-868.63	841.05	<0.001	<0.001	>999.999
HGE	8	100	HIC	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HIC	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HIC	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HIC	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HIC	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	HIC	24	100	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
HGE	8	100	PIG	8	0	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PIG	8	50	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PIG	8	100	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PIG	24	0	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PIG	24	50	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PIG	24	100	-292E-13	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
HGE	8	100	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	100	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	100	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	100	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
HGE	8	100	PPB	24	50	-13.8659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
HGE	8	100	PPB	24	100	-13.8659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
HGE	8	100	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
HGE	8	100	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	8	100	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
HGE	24	0	HGE	24	50	4.82E-16	0.6430	84	0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	24	0	HGE	24	100	4.38E-16	0.6430	84	0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	24	0	HIC	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	HIC	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	HIC	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	HIC	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	HIC	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	HIC	24	100	0.2318	0.6416	84	0.36	0.7188	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	0	PIG	8	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PIG	8	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PIG	8	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PIG	24	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PIG	24	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PIG	24	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	0	PPB	8	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	0	PPB	8	50	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	0	PPB	8	100	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE																

	24	0	PPB	24	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	0	PPB	24	50	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	0	PPB	24	100	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	0	THR	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	THR	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	THR	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	THR	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	THR	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	THR	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	WAS	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	WAS	8	50	0.2318	0.6416	84	0.36	0.7186	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	0	WAS	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	WAS	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	WAS	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	0	WAS	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HGE	24	100	-434E-19	0.6430	84	-0.00	1.0000	0.05	-1.2786	1.2786	1.000	0.278	3.592
HGE	24	50	HIC	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HIC	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HIC	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HIC	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HIC	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	HIC	24	100	0.2318	0.6416	84	0.36	0.7186	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	50	PIG	8	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PIG	8	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PIG	8	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PIG	24	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PIG	24	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PIG	24	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	50	PPB	8	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	50	PPB	8	50	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	50	PPB	8	100	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	50	PPB	24	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	50	PPB	24	50	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	50	PPB	24	100	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	50	THR	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	THR	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	THR	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	THR	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	THR	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	THR	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	WAS	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	WAS	8	50	0.2318	0.6416	84	0.36	0.7186	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	50	WAS	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	WAS	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	WAS	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	50	WAS	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	HIC	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	HIC	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	HIC	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE																

	24	100	HIC	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	HIC	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	HIC	24	100	0.2318	0.6416	84	0.36	0.7188	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	100	PIG	8	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PIG	8	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PIG	8	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PIG	24	0	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PIG	24	50	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PIG	24	100	13.7885	429.87	84	0.03	0.9745	0.05	-841.05	868.63	>999.999	<0.001	>999.999
HGE	24	100	PPB	8	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	100	PPB	8	50	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	100	PPB	8	100	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	100	PPB	24	0	13.8904	426.46	84	0.03	0.9741	0.05	-834.17	861.95	>999.999	<0.001	>999.999
HGE	24	100	PPB	24	50	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	100	PPB	24	100	0.1226	0.6422	84	0.19	0.8491	0.05	-1.1545	1.3997	1.130	0.315	4.054
HGE	24	100	THR	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	THR	8	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	THR	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	THR	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	THR	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	THR	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	WAS	8	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	WAS	8	50	0.2318	0.6416	84	0.36	0.7188	0.05	-1.0441	1.5077	1.261	0.352	4.516
HGE	24	100	WAS	8	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	WAS	24	0	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	WAS	24	50	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HGE	24	100	WAS	24	100	13.9829	423.72	84	0.03	0.9738	0.05	-828.63	856.60	>999.999	<0.001	>999.999
HIC	8	0	HIC	8	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	HIC	8	100	5.33E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	HIC	24	0	3.42E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	HIC	24	50	1.78E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-858.37	828.87	<0.001	<0.001	>999.999
HIC	8	0	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	0	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	0	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	0	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	0	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	0	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	8	0	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	8	0	THR	8	0	-108E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	THR	8	50	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	THR	8	100	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	THR	24	0	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	THR	24	50	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC																

	8	0	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	8	0	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	HIC	8	100	7.11E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	HIC	24	0	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	HIC	24	50	0	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	8	50	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	50	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	50	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	50	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	50	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	50	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	8	50	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	8	50	THR	8	0	-108E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	THR	8	50	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	THR	8	100	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	THR	24	0	-124E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	THR	24	50	-124E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	8	50	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	HIC	24	0	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	HIC	24	50	-654E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	8	100	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	8	100	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	100	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	100	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	100	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	8	100	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC																

	8	100	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	8	100	THR	8	0	-179E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	THR	8	50	-213E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	THR	8	100	-977E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	THR	24	0	-182E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	THR	24	50	-173E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	THR	24	100	-173E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	8	100	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	8	100	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	HIC	24	50	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	24	0	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	0	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	0	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	0	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	0	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	0	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	24	0	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.48	828.76	<0.001	<0.001	>999.999
HIC	24	0	THR	8	0	-144E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	THR	8	50	-178E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	THR	8	100	-711E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	THR	24	0	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	THR	24	50	-176E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	THR	24	100	-142E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	24	0	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	HIC	24	100	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	24	50	PIG	8	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PIG	8	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PIG	8	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PIG	24	0	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PIG	24	50	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PIG	24	100	-0.1943	603.59	84	-0.00	0.9997	0.05	-1200.51	1200.12	0.823	<0.001	>999.999
HIC	24	50	PPB	8	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	50	PPB	8	50	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	50	PPB	8	100	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC																

	24	50	PPB	24	0	-0.09247	601.17	84	-0.00	0.9999	0.05	-1195.59	1195.41	0.912	<0.001	>999.999
HIC	24	50	PPB	24	50	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.46	828.76	<0.001	<0.001	>999.999
HIC	24	50	PPB	24	100	-13.8603	423.72	84	-0.03	0.9740	0.05	-856.46	828.76	<0.001	<0.001	>999.999
HIC	24	50	THR	8	0	-104E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	THR	8	50	-124E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	THR	8	100	-311E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	THR	24	0	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	THR	24	50	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	THR	24	100	-107E-16	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
HIC	24	50	WAS	8	100	1.54E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
HIC	24	100	PIG	8	0	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PIG	8	50	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PIG	8	100	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PIG	24	0	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PIG	24	50	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PIG	24	100	13.5567	429.87	84	0.03	0.9749	0.05	-841.28	868.40	>999.999	<0.001	>999.999
HIC	24	100	PPB	8	0	13.6586	426.46	84	0.03	0.9745	0.05	-834.41	861.72	>999.999	<0.001	>999.999
HIC	24	100	PPB	8	50	13.6586	426.46	84	0.03	0.9745	0.05	-834.41	861.72	>999.999	<0.001	>999.999
HIC	24	100	PPB	8	100	13.6586	426.46	84	0.03	0.9745	0.05	-834.41	861.72	>999.999	<0.001	>999.999
HIC	24	100	PPB	24	0	13.6586	426.46	84	0.03	0.9745	0.05	-834.41	861.72	>999.999	<0.001	>999.999
HIC	24	100	PPB	24	50	-0.1092	0.6408	84	-0.17	0.8651	0.05	-1.3835	1.1651	0.897	0.251	3.206
HIC	24	100	PPB	24	100	-0.1092	0.6408	84	-0.17	0.8651	0.05	-1.3835	1.1651	0.897	0.251	3.206
HIC	24	100	THR	8	0	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	THR	8	50	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	THR	8	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	THR	24	0	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	THR	24	50	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	THR	24	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	WAS	8	0	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	WAS	8	50	-362E-17	0.6402	84	-0.00	1.0000	0.05	-1.2731	1.2731	1.000	0.280	3.572
HIC	24	100	WAS	8	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	WAS	24	0	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	WAS	24	50	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
HIC	24	100	WAS	24	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
PIG	8	0	PIG	8	50	1.92E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	0	PIG	8	100	1.45E-16	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	0	PIG	24	0	2.32E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	0	PIG	24	50	2.07E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	0	PIG	24	100	4.34E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	0	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	0	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	0	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	0	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	0	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG																

	8	0	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	8	0	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	8	0	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	0	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	PIG	8	100	-176E-17	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	50	PIG	24	0	4.02E-16	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	50	PIG	24	50	-114E-17	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	50	PIG	24	100	2.42E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	50	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	50	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	50	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	50	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	50	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	8	50	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	8	50	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	8	50	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	50	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	PIG	24	0	2.18E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	100	PIG	24	50	1.92E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	100	PIG	24	100	4.19E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	8	100	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	100	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	100	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	100	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	8	100	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	8	100	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	8	100	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG																

	8	100	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	8	100	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	8	100	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	PIG	24	50	-257E-18	607.93	84	-0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	24	0	PIG	24	100	2.01E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	24	0	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	0	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	0	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	0	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	0	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	0	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	0	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	24	0	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	0	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	PIG	24	100	2.27E-15	607.93	84	0.00	1.0000	0.05	-1208.93	1208.93	1.000	<0.001	>999.999
PIG	24	50	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	50	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	50	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	50	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	50	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	50	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	50	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	24	50	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	50	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	PPB	8	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	100	PPB	8	50	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	100	PPB	8	100	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG																

	24	100	PPB	24	0	0.1019	605.52	84	0.00	0.9999	0.05	-1204.04	1204.25	1.107	<0.001	>999.999
PIG	24	100	PPB	24	50	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	100	PPB	24	100	-13.6659	429.87	84	-0.03	0.9747	0.05	-868.51	841.17	<0.001	<0.001	>999.999
PIG	24	100	THR	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	THR	8	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	THR	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	THR	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	THR	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	THR	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	WAS	8	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	WAS	8	50	-13.5567	429.87	84	-0.03	0.9749	0.05	-868.40	841.28	<0.001	<0.001	>999.999
PIG	24	100	WAS	8	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	WAS	24	0	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	WAS	24	50	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PIG	24	100	WAS	24	100	0.1943	603.59	84	0.00	0.9997	0.05	-1200.12	1200.51	1.215	<0.001	>999.999
PPB	8	0	PPB	8	50	-178E-17	603.11	84	-0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB	8	0	PPB	8	100	1.78E-15	603.11	84	0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB	8	0	PPB	24	0	1.65E-15	603.11	84	0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB	8	0	PPB	24	50	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	0	PPB	24	100	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	0	THR	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	THR	8	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	THR	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	THR	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	THR	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	THR	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	WAS	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	WAS	8	50	-13.6586	426.46	84	-0.03	0.9745	0.05	-861.72	834.41	<0.001	<0.001	>999.999
PPB	8	0	WAS	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	WAS	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	WAS	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	0	WAS	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	PPB	8	100	3.76E-16	603.11	84	0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB	8	50	PPB	24	0	3.55E-15	603.11	84	0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB	8	50	PPB	24	50	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	50	PPB	24	100	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	50	THR	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	THR	8	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	THR	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	THR	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	THR	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	THR	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	WAS	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	WAS	8	50	-13.6586	426.46	84	-0.03	0.9745	0.05	-861.72	834.41	<0.001	<0.001	>999.999
PPB	8	50	WAS	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	WAS	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	WAS	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	50	WAS	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	PPB	24	0	-178E-17	603.11	84	-0.00	1.0000	0.05	-1199.34	1199.34	1.000	<0.001	>999.999
PPB																

	8	100	PPB	24	50	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	100	PPB	24	100	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	8	100	THR	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	THR	8	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	THR	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	THR	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	THR	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	THR	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	WAS	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	WAS	8	50	-13.6586	426.46	84	-0.03	0.9745	0.05	-861.72	834.41	<0.001	<0.001	>999.999
PPB	8	100	WAS	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	WAS	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	WAS	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	8	100	WAS	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	PPB	24	50	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	24	0	PPB	24	100	-13.7678	426.46	84	-0.03	0.9743	0.05	-861.83	834.30	<0.001	<0.001	>999.999
PPB	24	0	THR	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	THR	8	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	THR	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	THR	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	THR	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	THR	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	WAS	8	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	WAS	8	50	-13.6586	426.46	84	-0.03	0.9745	0.05	-861.72	834.41	<0.001	<0.001	>999.999
PPB	24	0	WAS	8	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	WAS	24	0	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	WAS	24	50	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	0	WAS	24	100	0.09247	601.17	84	0.00	0.9999	0.05	-1195.41	1195.59	1.097	<0.001	>999.999
PPB	24	50	PPB	24	100	-302E-18	0.6414	84	-0.00	1.0000	0.05	-1.2755	1.2755	1.000	0.279	3.581
PPB	24	50	THR	8	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	THR	8	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	THR	8	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	THR	24	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	THR	24	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	THR	24	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	WAS	8	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	WAS	8	50	0.1092	0.6408	84	0.17	0.8651	0.05	-1.1651	1.3835	1.115	0.312	3.989
PPB	24	50	WAS	8	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	WAS	24	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	WAS	24	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	50	WAS	24	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	8	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	8	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	8	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	24	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	24	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	THR	24	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	WAS	8	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	WAS	8	50	0.1092	0.6408	84	0.17	0.8651	0.05	-1.1651	1.3835	1.115	0.312	3.989
PPB																

	24	100	WAS	8	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	WAS	24	0	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	WAS	24	50	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
PPB	24	100	WAS	24	100	13.8603	423.72	84	0.03	0.9740	0.05	-828.76	856.48	>999.999	<0.001	>999.999
THR	8	0	THR	8	50	-355E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	THR	8	100	7.5E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	THR	24	0	-468E-18	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	THR	24	50	-659E-19	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	THR	24	100	-562E-19	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	8	0	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	THR	8	100	1.07E-14	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	THR	24	0	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	THR	24	50	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	THR	24	100	3.55E-15	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	8	50	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	THR	24	0	-797E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	THR	24	50	-757E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	THR	24	100	-756E-17	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	8	100	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	8	100	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	THR	24	50	4.02E-16	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	THR	24	100	4.12E-16	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	24	0	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	0	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	THR	24	100	9.72E-18	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	24	50	WAS	8	100	1.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	50	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR																

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	24	100	WAS	8	0	-318E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	100	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
THR	24	100	WAS	8	100	1.56E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	100	WAS	24	0	5.55E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	100	WAS	24	50	9.59E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
THR	24	100	WAS	24	100	-808E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	0	WAS	8	50	-13.7511	423.72	84	-0.03	0.9742	0.05	-856.37	828.87	<0.001	<0.001	>999.999
WAS	8	0	WAS	8	100	4.72E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	0	WAS	24	0	8.72E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	0	WAS	24	50	1.28E-10	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	0	WAS	24	100	-491E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	50	WAS	8	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
WAS	8	50	WAS	24	0	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
WAS	8	50	WAS	24	50	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
WAS	8	50	WAS	24	100	13.7511	423.72	84	0.03	0.9742	0.05	-828.87	856.37	>999.999	<0.001	>999.999
WAS	8	100	WAS	24	0	4E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	100	WAS	24	50	8.04E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	8	100	WAS	24	100	-963E-13	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	24	0	WAS	24	50	4.04E-11	599.23	84	0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	24	0	WAS	24	100	-136E-12	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999
WAS	24	50	WAS	24	100	-177E-12	599.23	84	-0.00	1.0000	0.05	-1191.64	1191.64	1.000	<0.001	>999.999

Performed by K. Weber SAS version 9.4 16:18 10DEC14 KW

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Appendix 9. Survival Assessment Summary

Item Number	Item Description	Number of Pages	Report Page Number
1	Mortality Data	4	238
2	Plain Pocketbook (*L. cardium*) Mortality Summary	1	242
3	Hickorynut (*O. olivaria*) Mortality Summary	1	243
4	Washboard (*M. nervosa*) Mortality Summary	1	244
5	Higgins Eye (*L. higginsii*) Mortality Summary	1	245
6	Fatmucket (*L. siliquoidea*) Mortality Summary	1	246
7	Threeridge (*A. plicata*) Mortality Summary	1	247
8	Wabash Pigtoe (*F. flava*) Mortality Summary	1	248

Study Number: AEH-13-PSEUDO-06 Electronic Log (Page 10) File Folder: 12a-12g Data Source: Native Mussel Survival Assessment	Action	Date	Initials
	Created.....	1/24/2014	JKW
	Revised.....	4/25/2014	KLW
	Reviewed...	5/8/14	
	Certified.....	5/12/14	

I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]Mussel Mortality Cover

Mortality Data

Test Article: *Pseudomonas fluorescens Pf* -CL 145A (SDS); lot # 401P12163C and 401P12164C Mix
Test Location: Black River, La Crosse, WI
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013

Filename(s)

I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]PPB Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]HIC Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]WAS Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]HGE Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]FAM Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]THR Mortality Summary
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]PIG Mortality Summary

Mortality/unrecovered Summary

Common name, scientific, three letter abbreviation	Treatment Group	Duration	Tag ID	Dead/ Unrecovered
Plain pocketbook, *L. cardium, PPB*	100	24	A193	U
	50	24	A191	U
Hickorynut, *O. olivaria, HIC*	100	24	D010	U
Washboard, *M. nervosa, WAS*	50	8	A002	D
Higgins eye, *L. higginsii, HGE*	0	24	B051	U
	50	24	B117	U
	0	8	B110	D
	100	24	B048	D
Fatmucket, *L. siliquoidea, FAM*	N/A	N/A	N/A	N/A
Threeridge, *A. plicata, THR*	N/A	N/A	N/A	N/A
Wabash pigtoe, *F. flava, PIG*	N/A	N/A	N/A	N/A

Data Explanation:

1) Data columns
- Species: three letter code abbreviation as listed above
- Treatment Group: Control 0 mg/L, 50 mg/L, 100 mg/L
- Exposure Duration: 8 hour exposure or 24 hour exposure duration
- Test Tank #: 1-9
- N: number of native mussels in tank
- Dead: number of mortalities that occurred during 30 day holding period
- Unrecovered: number of mussels not recovered after treatment or after 30 day holding period
- % Survival= Percent survival of native mussels in a given test group. ((N-dead)/N)*100

2) Data codes used within SAS
- sps= three letter code abbreviations as listed above
- conc= theoretical concentration
- time= exposure duration (8h or 24h)
- tank= Test Tank # 1-9
- tot= Total mussels of species of given exposure duration in test tank
- dead= number of mortalities
- unrec= number of unrecovered mussels
- T dead= sum of unrecovered mussels and mortalities

File names:

Spectrophotometric Data for SAS Input
I:\AEH-13-PSEUDO-06\Data\Data Summaries\[AEH-13-PSEUDO-06 Native Mussel Mortality Summary.xlsx]SAS
SAS Program/Code
I:\AEH-13-PSEUDO-06\Statistical analysis\Survival Program File
SAS Log
I:\AEH-13-PSEUDO-06\Statistical analysis\Survival Log File
SAS Output
I:\AEH-13-PSEUDO-06\Statistical analysis\Survival Results File

Data Anomalies and Deviations:

All unrecovered mussels were treated as mortalities in statistical analysis.

File Folder 12
Item Number 1
Page 1 of 4

sps	conc	time	tank	tot	dead	unrec	T dead
HIC	0	8	5	10	0	0	0
HIC	0	8	7	10	0	0	0
HIC	0	8	8	10	0	0	0
HIC	0	24	5	10	0	0	0
HIC	0	24	7	10	0	0	0
HIC	0	24	8	10	0	0	0
HIC	50	8	3	10	0	0	0
HIC	50	8	4	10	0	0	0
HIC	50	8	6	10	0	0	0
HIC	50	24	3	10	0	0	0
HIC	50	24	4	10	0	0	0
HIC	50	24	6	10	0	0	0
HIC	100	8	1	10	0	0	0
HIC	100	8	2	10	0	0	0
HIC	100	8	9	10	0	0	0
HIC	100	24	1	10	0	0	0
HIC	100	24	2	10	0	1	1
HIC	100	24	9	10	0	0	0
WAS	0	8	5	10	0	0	0
WAS	0	8	7	10	0	0	0
WAS	0	8	8	10	0	0	0
WAS	0	24	5	10	0	0	0
WAS	0	24	7	10	0	0	0
WAS	0	24	8	10	0	0	0
WAS	50	8	3	10	0	0	0
WAS	50	8	4	10	1	0	1
WAS	50	8	6	10	0	0	0
WAS	50	24	3	10	0	0	0
WAS	50	24	4	10	0	0	0
WAS	50	24	6	10	0	0	0
WAS	100	8	1	10	0	0	0
WAS	100	8	2	10	0	0	0
WAS	100	8	9	10	0	0	0
WAS	100	24	1	10	0	0	0
WAS	100	24	2	10	0	0	0
WAS	100	24	9	10	0	0	0
FAM	0	8	5	10	0	0	0
FAM	0	8	7	10	0	0	0
FAM	0	8	8	10	0	0	0
FAM	0	24	5	10	0	0	0
FAM	0	24	7	10	0	0	0
FAM	0	24	8	10	0	0	0
FAM	50	8	3	10	0	0	0
FAM	50	8	4	10	0	0	0
FAM	50	8	6	10	0	0	0
FAM	50	24	3	10	0	0	0

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FAM	50	24	4	10	0	0	0	
FAM	50	24	6	10	0	0	0	
FAM	100	8	1	10	0	0	0	AEH-13-PSEUDO-06
FAM	100	8	2	10	0	0	0	
FAM	100	8	9	10	0	0	0	
FAM	100	24	1	10	0	0	0	
FAM	100	24	2	10	0	0	0	
FAM	100	24	9	10	0	0	0	
THR	0	8	5	10	0	0	0	
THR	0	8	7	10	0	0	0	
THR	0	8	8	10	0	0	0	
THR	0	24	5	10	0	0	0	
THR	0	24	7	10	0	0	0	
THR	0	24	8	10	0	0	0	
THR	50	8	3	10	0	0	0	
THR	50	8	4	10	0	0	0	
THR	50	8	6	10	0	0	0	
THR	50	24	3	10	0	0	0	
THR	50	24	4	10	0	0	0	
THR	50	24	6	10	0	0	0	
THR	100	8	1	10	0	0	0	
THR	100	8	2	10	0	0	0	
THR	100	8	9	10	0	0	0	
THR	100	24	1	10	0	0	0	
THR	100	24	2	10	0	0	0	
THR	100	24	9	10	0	0	0	
PPB	0	8	5	9	0	0	0	
PPB	0	8	7	9	0	0	0	
PPB	0	8	8	9	0	0	0	
PPB	0	24	5	9	0	0	0	
PPB	0	24	7	9	0	0	0	
PPB	0	24	8	9	0	0	0	
PPB	50	8	3	9	0	0	0	
PPB	50	8	4	9	0	0	0	
PPB	50	8	6	9	0	0	0	
PPB	50	24	3	9	0	1	1	
PPB	50	24	4	9	0	0	0	
PPB	50	24	6	9	0	0	0	
PPB	100	8	1	9	0	0	0	
PPB	100	8	2	9	0	0	0	
PPB	100	8	9	9	0	0	0	
PPB	100	24	1	9	0	0	0	
PPB	100	24	2	9	0	1	1	
PPB	100	24	9	9	0	0	0	
HGE	0	8	5	8	0	0	0	
HGE	0	8	7	8	0	0	0	
HGE	0	8	8	8	1	0	1	Page 3 of 4

HGE	0	24	5	8	0	1	1
HGE	0	24	7	8	0	0	0
HGE	0	24	8	8	0	0	0
HGE	50	8	3	8	0	0	0
HGE	50	8	4	8	0	0	0
HGE	50	8	6	8	0	0	0
HGE	50	24	3	8	0	0	0
HGE	50	24	4	8	0	0	0
HGE	50	24	6	8	0	1	1
HGE	100	8	1	8	0	0	0
HGE	100	8	2	8	0	0	0
HGE	100	8	9	8	0	0	0
HGE	100	24	1	8	0	0	0
HGE	100	24	2	8	0	0	0
HGE	100	24	9	8	1	0	1
PIG	0	8	5	8	0	0	0
PIG	0	8	7	8	0	0	0
PIG	0	8	8	8	0	0	0
PIG	0	24	5	8	0	0	0
PIG	0	24	7	8	0	0	0
PIG	0	24	8	8	0	0	0
PIG	50	8	3	8	0	0	0
PIG	50	8	4	8	0	0	0
PIG	50	8	6	8	0	0	0
PIG	50	24	3	8	0	0	0
PIG	50	24	4	8	0	0	0
PIG	50	24	6	8	0	0	0
PIG	100	8	1	8	0	0	0
PIG	100	8	2	8	0	0	0
PIG	100	8	9	8	0	0	0
PIG	100	24	1	8	0	0	0
PIG	100	24	2	8	0	0	0
PIG	100	24	9	8	0	0	0

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Study Number: AEH-13-PSEUDO-06
Mussel species: Plain Pocketbook (*Lampsilis cardium*)
Electronic Log (Page 10)
File Folder 12a

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-12-14

Plain Pocketbook (*L. cardium*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
PPB	Control (0)	8	5	9	0	0	100.0
			7	9	0	0	100.0
			8	9	0	0	100.0
		Mean/total	N/A	27	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	5	9	0	0	100.0
			7	9	0	0	100.0
			8	9	0	0	100.0
		Mean/total	N/A	27	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	50	8	3	9	0	0	100.0
			4	9	0	0	100.0
			6	9	0	0	100.0
		Mean/total	N/A	27	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	3	9	0	1	88.9
			4	9	0	0	100.0
			6	9	0	0	100.0
		Mean/total	N/A	27	0	1	96.3
		SD	N/A	0.0	0.0	0.5	5.2
	100	8	1	9	0	0	100.0
			2	9	0	0	100.0
			9	9	0	0	100.0
		Mean/total	N/A	27	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	1	9	0	0	100.0
			2	9	0	1	88.9
			9	9	0	0	100.0
		Mean/total	N/A	27	0	1	96.3
		SD	N/A	0.0	0.0	0.5	5.2

File Folder 12a
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Hickorynut (*Obovaria olivaria*)
Electronic Log (Page 10)
File Folder 12b

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article ot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted]

Hickorynut (*O. olivaria*) Mortality Summary 12-12-14

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
HIC	Control (0)	8	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	50	8	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	100	8	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	1	10	0	0	100.0
			2	10	0	1	90.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	1	96.7
		SD	N/A	0.0	0.0	0.5	4.7

File Folder 12b
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Washboard (*Megalonaias nervosa*)
Electronic Log (Page 10)
File Folder 12c

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-14

Washboard (*M. nervosa*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
WAS	Control (0)	8	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	50	8	3	10	0	0	100.0
			4	10	1	0	90.0
			6	10	0	0	100.0
		Mean/total	N/A	30	1	0	96.7
		SD	N/A	0.0	0.5	0.0	4.7
		24	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
	100	8	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0

File Folder 12c
Item Number 1
Page 1 of 1

Study Number: AEH-13-PSEUDO-06
Mussel species: Higgins Eye (*Lampsilis higginsii*)
Electronic Log (Page 10)
File Folder 12d

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article ot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-12-14

Higgins Eye (*L. higginsii*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
HGE	Control (0)	8	5	8	0	0	100.0
			7	8	0	0	100.0
			8	8	1	0	87.5
		Mean/total	N/A	24	1	0	95.8
		SD	N/A	0.0	0.5	0.0	5.9
		24	5	8	0	1	87.5
			7	8	0	0	100.0
			8	8	0	0	100.0
		Mean/total	N/A	24	0	1	95.8
		SD	N/A	0.0	0.0	0.5	5.9
	50	8	3	8	0	0	100.0
			4	8	0	0	100.0
			6	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	3	8	0	0	100.0
			4	8	0	0	100.0
			6	8	0	1	87.5
		Mean/total	N/A	24	0	1	95.8
		SD	N/A	0.0	0.0	0.5	5.9
	100	8	1	8	0	0	100.0
			2	8	0	0	100.0
			9	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	1	8	0	0	100.0
			2	8	0	0	100.0
			9	8	1	0	87.5
		Mean/total	N/A	24	1	0	95.8
		SD	N/A	0.0	0.5	0.0	5.9

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Study Number: AEH-13-PSEUDO-06
Mussel species: Fatmucket (*Lampsilis siliquoidea*)
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Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-12-13

Fatmucket (*L. siliquoidea*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
FAM	Control (0)	8	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
		24	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
	50	8	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
		24	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
	100	8	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0
		24	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
		Mean/total	N/A	30	0	0	100.0
			N/A	0.0	0.0	0.0	0.0

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Study Number: AEH-13-PSEUDO-06
Mussel species: Threeridge (*Amblema plicata*)
Electronic Log (Page 10)
File Folder 12f

Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12-JUL-14

Threeridge (*A. plicata*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
THR	Control (0)	8	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0
		24	5	10	0	0	100.0
			7	10	0	0	100.0
			8	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0
	50	8	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0
		24	3	10	0	0	100.0
			4	10	0	0	100.0
			6	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0
	100	8	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0
		24	1	10	0	0	100.0
			2	10	0	0	100.0
			9	10	0	0	100.0
			Mean/total	N/A	30	0	0	100.0
			SD	N/A	0.0	0.0	0.0	0.0

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Study Number: AEH-13-PSEUDO-06
Mussel species: Wabash Pigtoe (*Fusconaia flava*)
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Test Article: *Pseudomonas fluorescens Pf*-CL 145A (SDP)
Article lot #: 401P12163C and 401P12164C Mix
Exposure Date: 5/29/2013
Assessment Dates: 6/26-27/2013 [redacted] 12/12/14

Wabash Pigtoe (*F. flava*) Mortality Summary

Species	Treatment Group (mg/L)	Exposure Duration	Tank #	N	Dead	Unrecovered	% Survival
PIG	Control (0)	8	5	8	0	0	100.0
			7	8	0	0	100.0
			8	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	5	8	0	0	100.0
			7	8	0	0	100.0
			8	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	50	8	3	8	0	0	100.0
			4	8	0	0	100.0
			6	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	3	8	0	0	100.0
			4	8	0	0	100.0
			6	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
	100	8	1	8	0	0	100.0
			2	8	0	0	100.0
			9	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0
		24	1	8	0	0	100.0
			2	8	0	0	100.0
			9	8	0	0	100.0
		Mean/total	N/A	24	0	0	100.0
		SD	N/A	0.0	0.0	0.0	0.0

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