Appendix F.4.3

AVESI Radiological Survey Report, December 12, 2016

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AVESI RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **Peck Iron: Portsmouth, VA**	RWP: N/A	Page 1 of 3
PURPOSE OF SURVEY: Unrestricted Release Peck Iron Equipment	DATE: 12/12/16	TIME: 0800

Instrument Type(s): (√ if used)	**Detector Area (cm^2)**	**Serial Number:**		**Cal. Due Date:**		**Background: (CPM)**		**Efficiency (%)**	
		meter	**detector**	**meter**	**detector**	**Alpha (α)**	**Beta (βγ)**	**Alpha (α)**	**Beta (βγ)**
_X__Ludlum 2929/43-10-1	N/A	158789	66367	10/26/2017	10/26/2017	0.4	45	30.6	26.7
_X__Ludlum 2360/43-93	100	327746	362780	11/29/2017	11/29/2017	0.1	201	13.2	16.2
____Ludlum 2221/44-9	15.5	X	X	X	X	X	X	X	X
_X__Ludlum Model 19	N/A	101689	N/A	11/9/17	N/A	N/A	5 µrem	NA	N/A

Contamination Limits: ($dpm/100cm^2$)	Removable α **20**	Removable βγ **1000**	Total α **100**	Total βγ **5000**

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	$dpm/100cm^2$ α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	$dpm/100cm^2$ βγ Removable	Gross CPM α Total	Net CPM α Total	$dpm/100cm^2$ α Total	Gross CPM βγ Total	Net CPM βγ Total	$dpm/100cm^2$ βγ Total	MR/hr or µR/hr
1	Trash Roll Off 1	0	0	<20	40	0	<1000	1	0.9	<100	233	32	<5000	5
2	Trash Roll Off 2	1	0.6	<20	49	4	<1000	0	0	<100	198	0	<5000	6
3	Trash Roll Off 3	2	1.6	<20	48	3	<1000	1	0.9	<100	214	13	<5000	5
4	Trash Roll Off 4	1	0.6	<20	45	0	<1000	1	0.9	<100	226	25	<5000	5
5	Trash Roll Off 5	0	0	<20	50	5	<1000	0	0	<100	189	0	<5000	5
6	Trash Roll Off 6	1	0.6	<20	45	0	<1000	0	0	<100	193	0	<5000	5
7	Trash Roll Off 7	1	0.6	<20	43	0	<1000	0	0	<100	209	8	<5000	5
8	Trash Roll Off 8	1	0.6	<20	49	4	<1000	1	0.9	<100	219	18	<5000	6
9	Trash Roll Off 9	0	0	<20	48	3	<1000	3	2.9	<100	197	0	<5000	5

REMARKS: Trash Roll off Bay Disposal & Recycling S/N: 12075
No removable or fixed radioactivity was detected.

TECHNICIAN(S) SIGNATURE/DATE:  / 12/12/2016 _____ / _____

REVIEWER SIGNATURE/DATE:  / 12/15/2016

AVESI RADIOLOGICAL SURVEY REPORT (Supplement)

SURVEY LOCATION: **Peck Iron: Portsmouth, VA** | Page 2 of 3

Contamination Limits: (dpm/100cm^2) | Removable α **20** | Removable βγ **1000** | Total α **100** | Total βγ **5000**

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm^2 α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm^2 βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm^2 α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm^2 βγ Total	MR/hr or µR/hr
10	Trash Roll Off 10	0	0	<20	44	0	<1000	0	0	<100	208	7	<5000	5
11	Porta Jon 1 Outside 1	2	1.6	<20	50	5	<1000	0	0	<100	196	0	<5000	6
12	Porta Jon 1 Outside 2	3	2.6	<20	42	0	<1000	1	0.9	<100	207	6	<5000	7
13	Porta Jon 2 Outside 1	2	1.6	<20	37	0	<1000	0	0	<100	186	0	<5000	5
14	Porta Jon 2 Outside 2	0	0	<20	49	4	<1000	2	1.9	<100	190	0	<5000	5
15	Porta Jon 1 Inside Floor	0	0	<20	53	8	<1000	1	0.9	<100	214	13	<5000	5
16	Porta Jon 2 Inside Floor	1	0.6	<20	46	1	<1000	0	0	<100	201	0	<5000	5
17	Trailer Outside 1	0	0	<20	49	4	<1000	1	0.9	<100	214	13	<5000	6
18	Trailer Outside 2	0	0	<20	48	3	<1000	0	0	<100	201	0	<5000	6
19	Trailer Outside 3	0	0	<20	50	5	<1000	1	0.9	<100	211	10	<5000	6
20	Trailer Outside 4	0	0	<20	43	0	<1000	2	1.9	<100	219	18	<5000	5
21	Trailer Outside 5	1	0.6	<20	38	0	<1000	0	0	<100	204	3	<5000	5
22	Trailer Outside 6	0	0	<20	44	0	<1000	0	0	<100	214	13	<5000	5
23	Trailer Outside 7	0	0	<20	46	1	<1000	1	0.9	<100	232	31	<5000	5
24	Trailer Outside 8	2	1.6	<20	44	0	<1000	2	1.9	<100	211	10	<5000	5
25	Trailer Wheels	1	0.6	<20	50	5	<1000	3	2.9	<100	199	0	<5000	6

REMARKS:
Porta Jon by Spivey Port: Toilets (no S/N attached)
Trailer Williams Scotsman S/N: CBS-742B
No removable or fixed radioactivity was detected.

TECHNICIAN(S) SIGNATURE/DATE:  / 12/12/2016 /

REVIEWER SIGNATURE/DATE:  / 12/15/2016

SURVEY LOCATION: **Peck Iron: Portsmouth, VA** | Page 3 of 3

Contamination Limits: (dpm/100cm^2) | Removable α **20** | Removable βγ **1000** | Total α **100** | Total βγ **5000**

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm^2 α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm^2 βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm^2 α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm^2 βγ Total	MR/hr or µR/hr
26	Trailer Wheels	0	0	<20	41	0	<1000	0	0	<100	217	16	<5000	5
27	Trailer Inside Floor 1	0	0	<20	53	8	<1000	0	0	<100	240	39	<5000	5
28	Trailer Inside Floor 2	1	0.6	<20	45	0	<1000	1	0.9	<100	234	33	<5000	5
29	Trailer Inside Floor 3	1	0.6	<20	45	0	<1000	0	0	<100	206	5	<5000	5
30	Trailer Inside Floor 4	1	0.6	<20	55	10	<1000	0	0	<100	232	31	<5000	5
31	Trailer Inside Floor 5	0	0	<20	45	0	<1000	0	0	<100	231	30	<5000	5
32	Trailer Inside Wall 1	2	1.6	<20	47	2	<1000	0	0	<100	216	15	<5000	5
33	Trailer Inside Wall 2	1	0.6	<20	48	3	<1000	0	0	<100	204	3	<5000	5
34	Trailer Inside Wall 3	1	0.6	<20	32	0	<1000	2	1.9	<100	208	7	<5000	5
35	Trailer Inside Wall 4	0	0	<20	48	3	<1000	0	0	<100	246	45	<5000	5
36	Trailer Inside Wall 5	2	1.6	<20	48	3	<1000	1	0.9	<100	214	13	<5000	5
37	Trailer Stairs 1	1	0.6	<20	43	0	<1000	2	1.9	<100	244	43	<5000	6
38	Trailer Stairs 2	0	0	<20	46	1	<1000	3	2.9	<100	236	35	<5000	6
39	Tools	0	0	<20	41	0	<1000	0	0	<100	201	0	<5000	6
40	Storage Box Outside	0	0	<20	40	0	<1000	2	1.9	<100	214	13	<5000	6
41	Storage Box Inside	1	0.6	<20	43	0	<1000	0	0	<100	211	10	<5000	5

REMARKS:
Tools: small shovel, hammer
Storage Box Small kept outside
No removable or fixed radioactivity was detected.

TECHNICIAN(S) SIGNATURE/DATE: [signature] /12/12/2016 /

REVIEWER SIGNATURE/DATE: [signature] / 12/15/2016

Appendix F.5

Wetland Delineation, Final Report
Peck Iron and Metal Superfund Site, Portsmouth VA
July 10, 2015

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PECK IRON AND METAL SUPERFUND SITE
PORTSMOUTH, VIRGINIA

WETLAND DELINEATION

FINAL REPORT

Prepared for

HydroGeoLogic Inc.
11107 Sunset Hills Rd., Suite 400
Reston, VA 20190

Prepared by

Cardno
501 Butler Farm Road, Suite H
Hampton, VA 23666

Cardno
Shaping the Future

July 10, 2015

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
U.S.	United States

1.0 INTRODUCTION

The purpose of the project is to conduct a Jurisdictional Wetland Delineation of the approximately 33 acre Peck Iron and Metal Superfund Site, located at 3850 Elm Avenue in Portsmouth Virginia. The site is a former scrap metal processing facility.

The Site is bounded to the north by Elm Avenue and ARREFF Terminals, Inc., to the east by Victory Boulevard, to the southeast by Wheelabrator Portsmouth, Inc., to the west by the Norfolk Naval Shipyard, Scott Center Annex and Sherwin Williams, and to the south by Paradise Creek. The Cradock neighborhood lies on the opposite shore of Paradise Creek to the south.

The objective of the effort is to identify all the wetlands and Waters of the United States (U.S.) subject to jurisdiction under Section 404 of the Clean Water Act. The delineation was undertaken by John Lowenthal, a Senior Biologist with Cardno with over 27 years' experience delineating wetlands. Mr. Lowenthal is also a certified Professional Wetland Delineator with the State of Virginia and a certified Professional Wetland Scientist.

2.0 METHODOLOGY

Prior to the field investigation, existing information was reviewed including U.S. Geological Survey mapping, Natural Resource Conservation Service (NRCS) soils mapping, U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) mapping, and available aerial photography (see Figures 1-4 of Appendix A).

2.1 Wetland Delineation

The study area was delineated using the methodology outlined in the U.S. Corps of Engineers Wetland Delineation Manual (1987) and the Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coast Region (2010).

In addition, on May 27, 2015, the Environmental Protection Agency and Corps of Engineers published a new Clean Water Rule in an effort to more clearly define the limits of wetlands and Waters of the US. This rule is proposed to take effect on August 28, 2015. This proposed rule would have little effect on wetland delineations in Virginia due to the existing state and federal wetlands programs.

The wetland boundary was flagged using pink and black striped tape, and the flags were located using Global Positioning System Units (Trimble Geo XT) and differentially corrected to sub-meter horizontal accuracy. The limits of flagged potential wetlands are illustrated on Figure 5 of Appendix A.

Soils, vegetation and hydrology data were collected at specific data points to represent the study area. The data points are identified on Figures 5 of Appendix A, and the data sheets are included in Appendix B. Prior to excavation of a soil samples, the area was evaluated by HGL staff for the presence of subsurface metal and radioactive materials. Soils were unable to be evaluated at numerous locations due to the potential presence of sub-surface unidentified metal.

2.2 Wetland Functions and Values

Wetland Functions were assigned to the onsite wetlands based on Tiner (2003) for the following 10 wetland functions and values: 1) surface water detention, 2) coastal storm surge detention, 3) streamflow maintenance, 4) nutrient transformation, 5) retention of sediments and other particulates, 6) shoreline stabilization, 7) provision of fish and shellfish habitat, 8) provision of waterfowl and waterbird habitat, 9) provision of other wildlife habitat, and 10) conservation of biodiversity. Definitions of the functions and values are provided below.

1. ***Surface water*** detention is important for reducing downstream flooding and lowering flood heights, both of which aid in minimizing property damage and personal injury from such events.
2. ***Coastal storm surge*** detention is included to highlight the importance of tidal wetlands at storing tidal waters brought into estuaries by storms (e.g., Nor'easters, tropical storms, and hurricanes). Estuarine and freshwater tidal wetlands and adjacent transition zones are important areas for temporary storage of this water.
3. ***Streamflow maintenance*** is important in that many wetlands are sources of groundwater discharge and some may be in a position to sustain streamflow in the watershed. Such wetlands are critically important for supporting aquatic life in streams. All wetlands classified as headwater wetlands are important for streamflow.
4. ***Nutrient transformation*** is another critical function in that all wetlands recycle nutrients, but those having a fluctuating water table are best able to recycle nitrogen and other nutrients. Vegetation slows the flow of water causing deposition of mineral and organic particles with adsorbed nutrients (nitrogen and phosphorus), whereas hydric soils are the places where chemical transformations occur. Microbial action in the soil is the driving force behind chemical transformations in wetlands. Microbes need a food source (i.e., organic matter) to survive, so wetlands with high amounts of organic matter should have an abundance of microflora to perform the nutrient cycling function.
5. ***Sediment and other particulate retention*** is another important function since many wetlands owe their existence to being located in areas of sediment deposition. This is especially true for floodplain and estuarine wetlands. This function supports water quality maintenance by capturing sediments with bonded nutrients or heavy metals (as in and downstream of urban areas). Estuarine and floodplain wetlands plus streamside and lakeshore fringe and basin wetlands including in-stream ponds are likely to trap and retain sediments and particulates at significant levels. Terrene through-flow basins should function similarly. Vegetated wetlands will likely favor sedimentation over non-vegetated wetlands and are therefore rated higher.
6. ***Shoreline stabilization*** is another important function in that vegetated wetlands along all waterbodies (e.g., estuaries, lakes, rivers, and streams) provide this function. Vegetation stabilizes the soil or substrate and diminishes wave action, thereby reducing shoreline erosion potential. Provision of fish and shellfish habitat is also important

because it is well documented that vegetated tidal and permanently flooded non tidal wetlands provide nursery, feeding and refuge habitat.

7. ***Provision of fish and shellfish habitat*** includes tidal wetlands and freshwater wetlands along stream and ponds that provide shallow water habitat utilized for nursery and juvenile fish habitat as well. These shallow area collect detritus (organic materials) utilized as food sources for aquatic invertebrates that sustain juvenile and some adult fishes. These shallow tidal areas also support crustaceans such as crabs and oysters.
8. ***Provision of waterfowl and waterbird habitat*** includes wetlands designated as important for waterfowl (e.g., ducks, geese, mergansers, and loons) and waterbirds (e.g., wading birds, shorebirds, rails, marsh wrens, and red-winged blackbirds) are generally those used for nesting, reproduction, or feeding. The emphasis is on the wetter wetlands and ones that are frequently flooded for long periods.
9. ***Provision of other wildlife habitat function*** was based on assessing "other wildlife" and conditions that would likely provide significant habitat for other vertebrate wildlife (mainly reptiles and amphibians, interior forest birds, and mammals).
10. ***The function of conservation biodiversity*** is very important and in the context of this assessment, the term "biodiversity" is used to identify wetlands that may contribute to the preservation of an assemblage of wetlands that encompass the natural diversity of wetlands in a given watershed. Four types of wetlands may be identified: 1) certain wetland types that appear to be scarce or relatively uncommon in the watershed, 2) individual wetlands that possess several different covertypes (i.e., naturally diverse wetland complexes), 3) complexes of large wetlands, and 4) regionally unique or uncommon wetland types.

3.0 RESULTS AND DISCUSSION

The delineation was conducted on June 15 and 16, 2015. The rainfall weather patterns were considered typical for this time period.

3.1 Soils and Groundwater

The soils mapped by the NRCS for the majority of the site are identified as “Urban Land” due to the highly developed nature of the property. The soil types mapped for the remainder of the site consist of the Bohicket muck on a 0 to 1 percent slope. Shallow soils pits/samples (0-18 inches) were excavated during the delineation. Fill material was identified in the majority of the soil samples collected for the delineation and included various types of debris. As stated above, soils were unable to be collected at numerous locations due to the potential presence of sub-surface unidentified metal.

Groundwater was not encountered during any of the shallow sampling for the delineation, except in the lower elevation areas of the tidal marsh, where it was recorded 6-8 inches below the soils surface.

3.2 Vegetation

The vegetation cover over the site is primarily herbaceous with a few shrub species typical of disturbed sites. Depressions have formed in the fill material, potentially due to compaction of the soils by vehicles and/or equipment and/or differential settlement of the fill material. These depressions pond water for intermittent periods and the vegetation growing in them are species typical of wetter conditions including black willow (*Salix nigra)*, soft rush (*Juncus effusis*) and Phragmites (*Phragmites australis*), a very aggressive invasive plant.

The vegetation of the tidal wetlands located along Paradise Creek is dominated by smooth cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), salt grass (*Distichlis spicata*), black needlerush (*Juncus rom*erianus) and *Phragmites*, with groundsel tree (*Baccharis hamilifolia*) prominent along the transition zone.

The forested wetland located in the north east portion of the site is primarily located on the ARREFF site (see Figure 5 in Appendix A). The vegetation of this area is comprised of red maple (*Acer rubrum*), willow oak (*Quercus phellos*), sycamore (*Platanus occidentalis*), greenbriar (*Smilax rotundifolia*), and English ivy (*Hedera helix*).

3.3 Jurisdictional Wetlands

The delineation identified two wetland areas that would be considered potential jurisdictional wetlands; 1) the tidal wetlands along Paradise Creek along with the adjacent drainage ditch/swale and 2) the forested wetland located on the northeastern portion of the site. Wetland data was collected at two locations within each wetland and the data forms are included in Appendix B.

The small depressional areas that exhibit some wetland characteristics, mainly the presence of hydrophytic vegetation are not considered jurisdictional due to the fact that they would be considered man-made and are located on top of fill material. Many of these are located in areas where the soils were not able to be sampled, confirming the presence of fill material.

In addition, two ditches were identified on the northeast corner of the site and are illustrated on Figure 5. Ditch A runs adjacent to the railroad right-of-way and drains under Victory Boulevard. Ditch B appears to be connected to the forested wetland and drains to a culvert under Victory Boulevard. Ditch A is not considered jurisdictional because it is assumed that it was created in uplands and adjacent to the railroad tracks, however Ditch B could be considered jurisdictional because it may receive drainage from a wetland located upstream (i.e., the forested wetland).

It is important to note, that all the wetlands are considered “potential jurisdictional wetlands”, until such time that the wetland limits are confirmed by the Army Corps of Engineers.

3.4 Wetland Types Identified

Two types of wetlands, subject to jurisdiction by the U.S. Army Corps of Engineers and the Virginia Department of Environmental Quality, were identified on the project site; 1) tidal and 2) non-tidal freshwater forested wetlands.

3.4.1 Tidal Wetlands

The tidal wetlands are located along the perimeter of the site adjacent to Paradise Creek and are illustrated on Figure 5 (2.82 acres). The acreage listed is just that portion of the wetland located within the Peck Iron and Metal site and does not represent the entire wetland acreage. They are comprised of low marsh, mid marsh and high marsh areas. The low and mid marsh are dominated by *Spartina* and *Distichlis* and the high marsh areas are dominated by *Phragmites* and *Baccharis*. Due to the very dense stands of *Phragmites* located at the upper wetland elevations, these wetlands are somewhat disconnected from the adjacent upland area. These dense *Phragmites* stands provide "predator cover" possibly decreasing waterfowl and waterbird use, whereas conversely, it provides a vegetative barrier separating the disturbed uplands from the lower elevation tidal wetlands.

In addition, the drainage ditch/swale located along the western perimeter of the site contained standing water and may be tidally influenced at the lower end. This swale was densely vegetated with *Phragmites*. The upper end of the swale behind Sherman Williams likely has greater freshwater influence.

The functions and values provided by the tidal marsh are listed below. The degree of function (low, moderate or high) is based on Tiner's scoring which incorporates the Cowardin classification of each wetland type. Cardno has integrated site specific information into the analysis. A typical tidal marsh with a low level of disturbance would typically score high in many of the categories below. The presence of the dense stands of *Phragmites* located at the high marsh elevations and the large amount of fill material placed at the wetland edge would reduce the value for some functions.

Surface water detention	low-moderate
Coastal storm surge detention	low-moderate
Streamflow maintenance	Not applicable
Nutrient transformation	high
Sediment retention	high
Shoreline stabilization	high
Fish and Shellfish Habitat	moderate-high
Waterfowl and waterbird habitat	moderate
Other wildlife habitat	moderate
Conservation biodiversity	low

3.4.2 Non-tidal Freshwater Wetlands

The non-tidal freshwater wetland area is located on the northeast portion of the site adjacent to the ARREFF Site (0.14 acres). The acreage listed is just that portion of the wetland located within the Peck Iron and Metal site and does not represent the entire wetland acreage. This is a forested wetland that is bordered by fill material along the entire perimeter. The canopy vegetation is dominated by *Acer*, *Quercus* and *Platanus* trees with a fairly open understory due to canopy denseness. The area ponds

water as confirmed by the presence of water stained leaves, sediment deposits on the leaves and water marks on the trees. Many trees also exhibit a high degree of "fluting" around the base, a tree adaptation for life in wet conditions for added stability. There are numerous piles of concrete and other debris located within the wetland.

This forested wetlands is somewhat isolated from the adjacent upland areas, primarily due to the large amounts of fill materials, including mounds and berms around the perimeter of the wetland.

The functions and values for a forested wetland of this type are listed below. Again, the degree of function (low, moderate or high) is based on Tiner's scoring which is based on the Cowardin classification of each wetland type. Cardno has incorporated site specific information into the analysis.

Surface water detention	low
Coastal storm surge detention	low
Streamflow maintenance	Not applicable
Nutrient transformation	moderate
Sediment retention	moderate
Shoreline stabilization	low
Fish and Shellfish Habitat	not applicable
Waterfowl and waterbird habitat	low
Other wildlife habitat	low
Conservation biodiversity	low

3.5 National Wetland Inventory Data

The national Wetland inventory mapping, using the Cowardin Classification System (1979) identifies the tidal wetland area as E2EM1P which translates to Estuarine Intertidal Emergent Persistent Irregularly Flooded. This would be considered accurate for the higher elevation areas dominated by *Phragmites*, however low and mid marsh areas dominated by *Spartina* would be considered "Regularly Flooded" by daily high and low tides.

The fresh water forested wetland located on the northeast portion of the site is identified as Palustrine Forested Broad Leaved Deciduous Saturated. This is accurate except for the water regime modifier "Saturated", as this area is subject to "Intermittent Flooding", more than saturated, likely after larger rainfall events, based on field indicators of water marks on trees, the large amount of blackened and sediment covered leaves.

4.0 OBSERVED ECOLOGICAL RECEPTORS

Any fauna species observed are listed below along with the habitat they were observed in.

Eastern rat snake (*Pantherophis alleghaniensis*)	Tidal Marsh

Great egret (*Ardea alba*)	Tidal Marsh
Fiddler crab (*Uca pugnax*)	Tidal Marsh
Periwinkle snail (*Littorina littorea*)	Tidal Marsh

Small mammal scat was observed at numerous locations throughout the site and is likely raccoon (*Procyon lotor*), however no raccoons were directly observed.

5.0 FEDERAL AND STATE REGULATIONS

The freshwater and tidal wetlands in Virginia are regulated by federal, state and local regulatory processes. In general, working in non-wetland or upland areas adjacent to wetlands does not trigger the regulatory requirement for wetland permits unless the activity impacts the adjacent wetland.

However, activities in adjacent uplands are regulated if the wetlands are considered tidal and part of Chesapeake Bay Preservation areas. The wetlands along Paradise Creek would be considered Chesapeake Bay Preservation areas (see additional explanation below).

5.1 Federal Regulations

Permits are required from the Army Corps of Engineers for work in wetlands for the following situations:

1. Structures and/or work affecting navigable waters of the U.S.
2. Any discharge of dredged or fill material into wetlands or waters of the U.S.

There are two general types of permits:

1. ***Standard Permits*** - these include Individual Permits and letters of permission for large or complex actions. A public notice and comment period are required for these permits.
2. ***General Permits*** - these include Nationwide Permits and Regional General Permits for small or routine actions that are similar in nature and typically have only minor environmental impacts.

5.2 State/Local Regulations

In Virginia, generally, activities requiring a wetland permit from the Department of Environmental quality include dredging, filling, or discharging any pollutant into or adjacent to surface waters, or otherwise altering the physical, chemical or biological properties of surface waters, excavating in wetlands, or on or after October 1, 2001, conducting the following activities in a wetland:

1. New activities to cause draining that significantly alter or degrades existing wetland acreage or functions.
2. Filling or dumping.
3. Permanent flooding or impounding.
4. New activities that cause significant alteration or degradation of existing wetland acreage or functions.

The Virginia Marine Resources Commission also regulates tidal wetlands, subaqueous of bottomlands primary sand dunes.

In additional, localities as well as the Department of Environmental Quality administer the Chesapeake Bay Preservation Act which includes tidal wetlands, perennial tributary streams and adjacent upland buffers known as Chesapeake Bay Preservation Areas or Resource Protection Areas. The upland buffer is typically 100 feet from the wetland edge.

6.0 REFERENCES

Army Corps of Engineers. 1987. Wetland Delineation Manual. Wetland Research Program Technical Report Y-87-1 January 1987.

Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plan Region. Version 2.0. ERDC/EL TR 10-20.

Cowardin, Lewis. 1979. Classification of Wetlands and Deepwater Habitats of the United States. USFWS. FWS/OBS-79/31 December 1979.

Tiner, R.W. 2003. Correlating Enhanced National Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Region 5, Hadley, MA.

APPENDIX A
FIGURES

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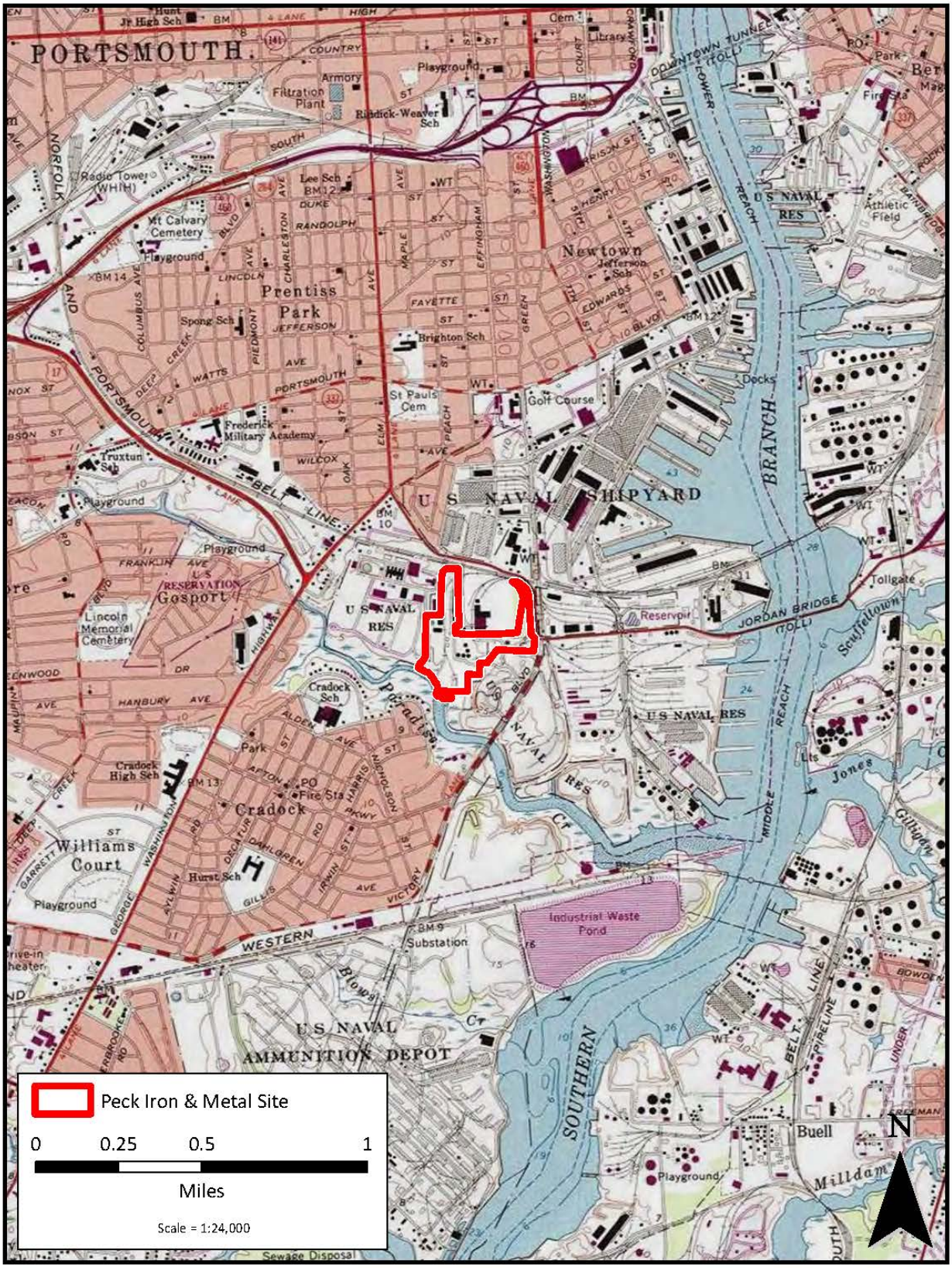

Figure 1. Peck Iron and Metal USGS Map

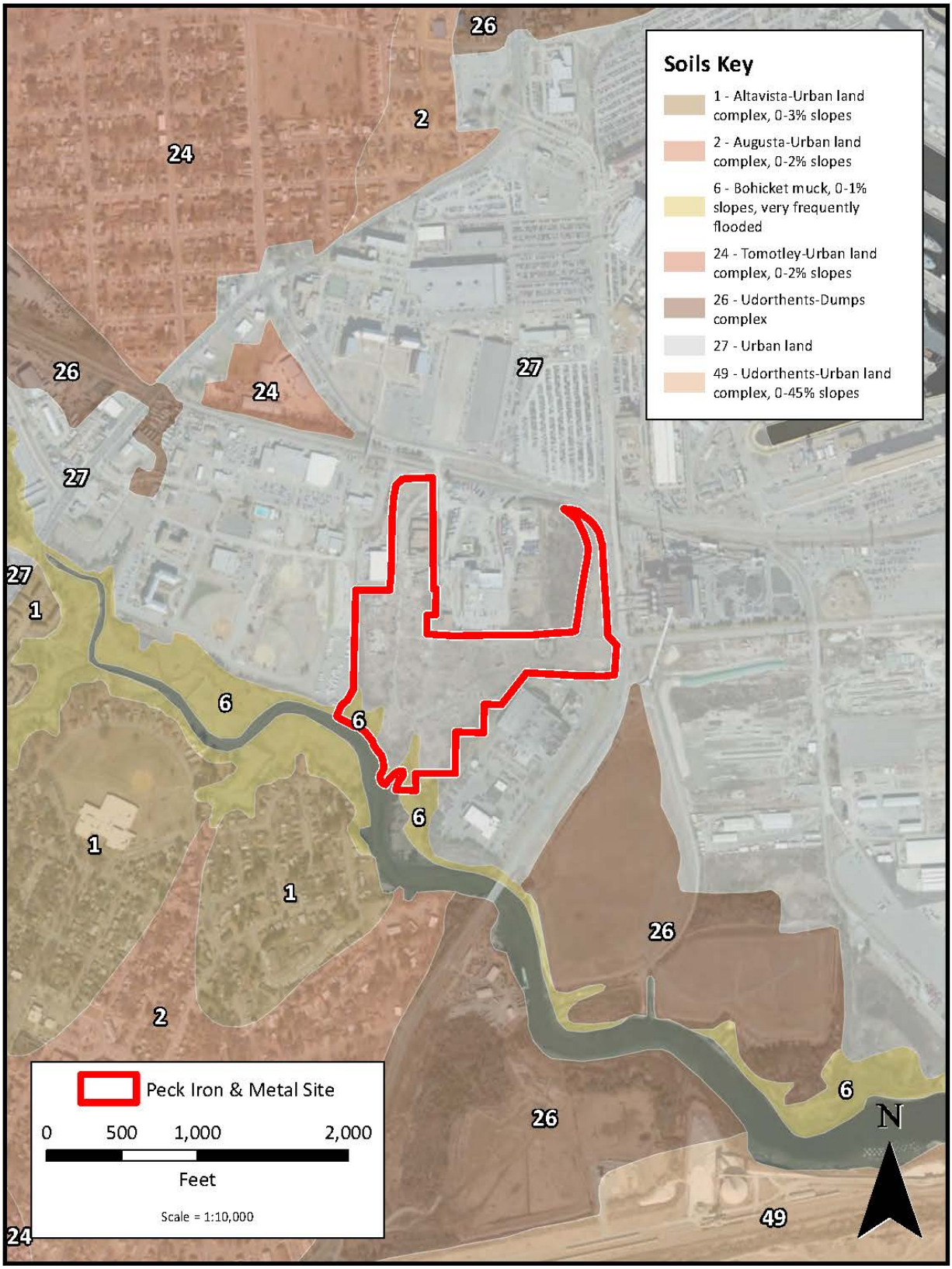

Figure 2. Peck Iron and Metal Soils Maps

Figure 3. Peck Iron and Metal Color Infrared Photograph

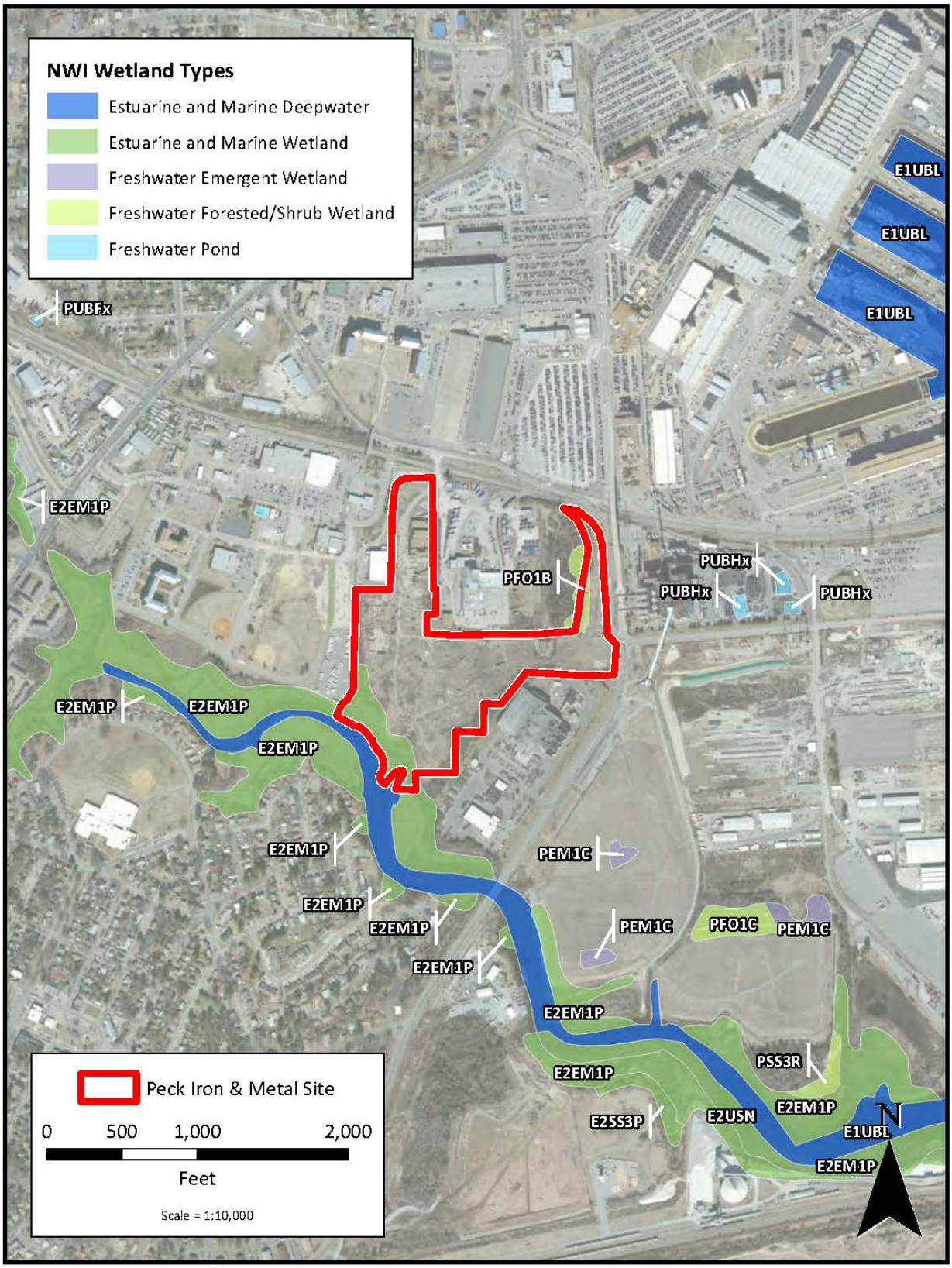

Figure 4. Peck Iron and Metal National Wetland Inventory Map

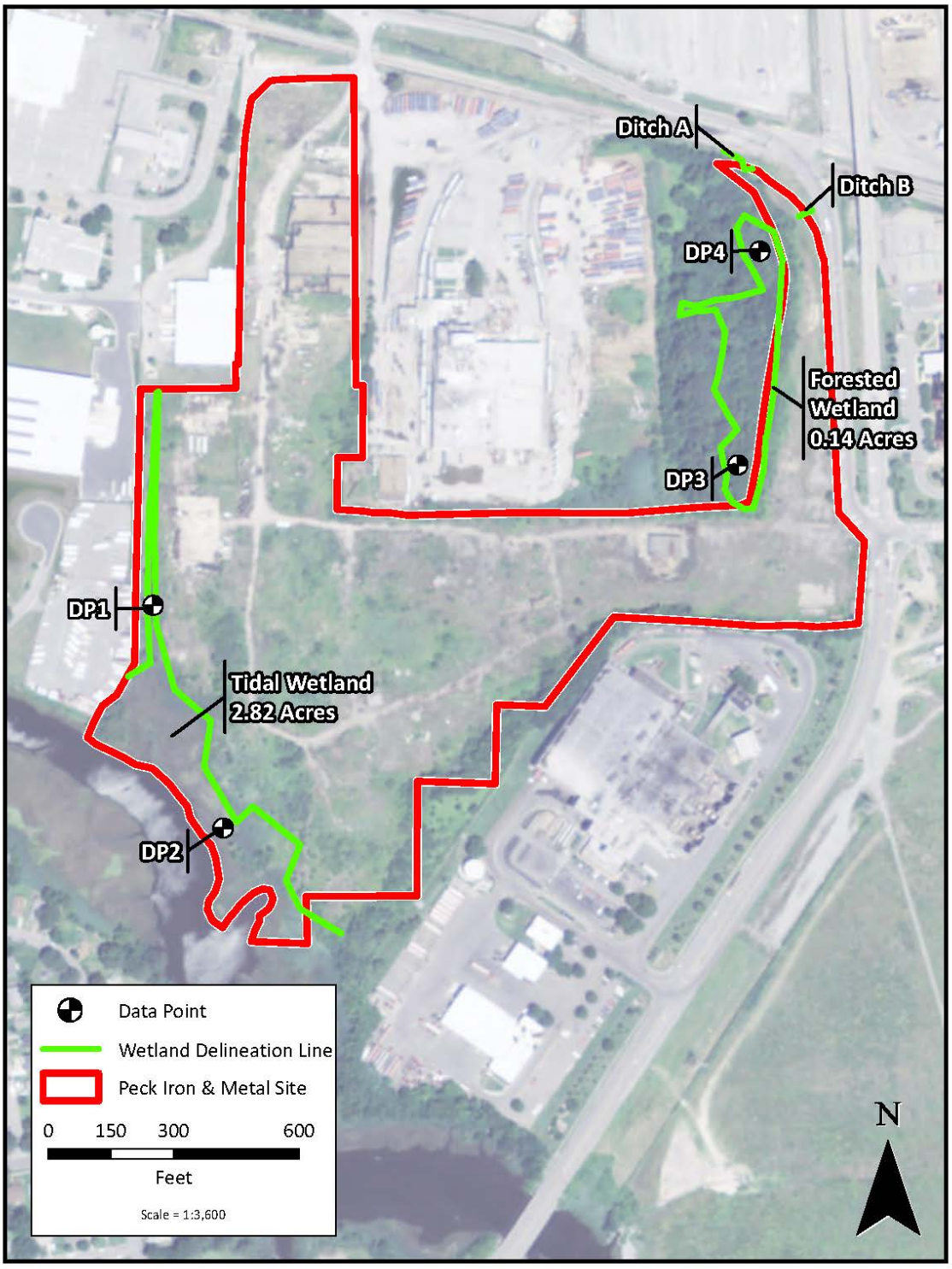

Figure 5. Peck Iron and Metal Wetland Delineation Exhibit

APPENDIX B
WETLAND DATA SHEETS

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WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal City/County: Portsmouth Sampling Date: 6/16/15
Applicant/Owner: Peck State: VA Sampling Point: DP 1
Investigator(s): John Lowenthal Section, Township, Range:
Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%):
Subregion (LRR or MLRA): LRRT Lat: 36.807709 Long: -76.310037 Datum:
Soil Map Unit Name: Urban Land NWI classification: E2EM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)
Are Vegetation Yes, Soil Yes, or Hydrology Yes significantly disturbed? Are "Normal Circumstances" present? Yes X No
Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No	**Is the Sampled Area within a Wetland?** Yes X No
Hydric Soil Present?	Yes X No	
Wetland Hydrology Present?	Yes X No	

Remarks:
Normal Circumstances is typically defined as the last five years. Site has not changed use in the last five years, however it is significantly disturbed from pre-development condition.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☑ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes No X Depth (inches):
Water Table Present? Yes No X Depth (inches):
Saturation Present? (includes capillary fringe) Yes X No Depth (inches): 4

Wetland Hydrology Present? Yes X No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Area subject to intermittent inundation after rainfall events. Hydrology criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP 1

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. NA			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size:)			
1. NA			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size:)			
1. Phragmites australis	100	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
50% of total cover:	20% of total cover:		
Woody Vine Stratum (Plot size:)			
1. NA			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- [x] 1 - Rapid Test for Hydrophytic Vegetation
- [ ] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No _____

Remarks: (If observed, list morphological adaptations below).

Mono-culture of phragmites, vegetation criteria met.

US Army Corps of Engineers — Atlantic and Gulf Coastal Plain Region – Version 2.0

SOIL Sampling Point: DP 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	organic							
2-10	2.5Y 5/2	90	7.5YR 5/5	10	C	M	sandy clay loam	
10-16	2.5 Y 5.1	85	7.5YR 5/6	15	C	M	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No _____

Remarks:

Soil criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal City/County: Portsmouth Sampling Date: 6/16/15
Applicant/Owner: Peck State: VA Sampling Point: DP 2
Investigator(s): John Lowenthal Section, Township, Range:
Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%):
Subregion (LRR or MLRA): LRRT Lat: 36.806595 Long: -76.309697 Datum:
Soil Map Unit Name: Bohick Muck NWI classification: E2EM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)
Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No
Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No	**Is the Sampled Area within a Wetland?** Yes X No
Hydric Soil Present?	Yes X No	
Wetland Hydrology Present?	Yes X No	

Remarks:
Normal Circumstances is typically defined as the last five years. Site has not changed use in the last five years, however it is significantly disturbed from pre-development condition.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes X No Depth (inches): tidal
Water Table Present? Yes X No Depth (inches): 6
Saturation Present? (includes capillary fringe) Yes X No Depth (inches): 2

Wetland Hydrology Present? Yes X No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Area subject to tidal action. Hydrology criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP 2

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. NA			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size:)			
1. Baccharis hamilifolia	10	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size:)			
1. Phragmites australis	10	Yes	FACW
2. Spartina alterniflora	40	Yes	OBL
3. Spartina patens	40	Yes	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
50% of total cover:	20% of total cover:		
Woody Vine Stratum (Plot size:)			
1. NA			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- [x] 1 - Rapid Test for Hydrophytic Vegetation
- [ ] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No _____

Remarks: (If observed, list morphological adaptations below).

Tidal marsh, vegetation criteria met.

US Army Corps of Engineers — Atlantic and Gulf Coastal Plain Region – Version 2.0

SOIL Sampling Point: DP 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	organic							
3-12	2.5Y 5/1	90	7.5YR 5/6	10	C	M	sandy clay	
12-16	5Y 5/1	90	7.5YR 5/6	10	C	M	silty clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No _____

Remarks:

Soil criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal City/County: Portsmouth Sampling Date: 6/16/15
Applicant/Owner: Peck State: VA Sampling Point: DP 3
Investigator(s): John Lowenthal Section, Township, Range:
Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%):
Subregion (LRR or MLRA): LRRT Lat: 36.808486 Long: -76.305335 Datum:
Soil Map Unit Name: Urban Land NWI classification: PFO1J
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
Normal Circumstances is typically defined as the last five years. Site has not changed use in the last five years, however it is significantly disturbed from pre-development condition.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☑ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____
Water Table Present? Yes ____ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes X No ____ Depth (inches): 4

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Area subject to intermittent inundation after rainfall events. Hydrology criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP 3

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	60	Yes	FAC
2. Quercus phellos	20	Yes	FACW
3. Platanus occidentalis	20	Yes	FACW
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size:)			
1. Acer rubrum	10	No	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10 = Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size:)			
1. Lonicera japinica	5	No	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	5 = Total Cover		
50% of total cover:	20% of total cover:		
Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	5	No	FAC
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species	x 4 =	
UPL species	x 5 =	
Column Totals: (A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [x] 1 - Rapid Test for Hydrophytic Vegetation
- [ ] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No

Remarks: (If observed, list morphological adaptations below).

Vegetation criteria met.

US Army Corps of Engineers — Atlantic and Gulf Coastal Plain Region – Version 2.0

SOIL Sampling Point: DP 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	organic							
1-8	10YR 5/1	90	7.5YR 5/4	10	C	M	clay loam loam	
8-16	2.5Y 5/1	85	7.5YR 5/6	15	C	M	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No _____

Remarks:

Soil criteria met.

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WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal City/County: Portsmouth Sampling Date: 6/16/15
Applicant/Owner: Peck State: VA Sampling Point: DP 4
Investigator(s): John Lowenthal Section, Township, Range: _____
Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): _____
Subregion (LRR or MLRA): LRRT Lat: 36.809353 Long: -76.305175 Datum: _____
Soil Map Unit Name: Urban Land NWI classification: PFO1J
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)
Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No _____
Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
Normal Circumstances is typically defined as the last five years. Site has not changed use in the last five years, however it is significantly disturbed from pre-development condition.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☑ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____
Water Table Present? Yes _____ No X Depth (inches): _____
Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 3

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Area subject to intermittent inundation after rainfall events. Hydrology criteria met.

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VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP 4

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	50	Yes	FAC
2. Quercus phellos	25	Yes	FACW
3. Platanus occidentalis	25	Yes	FACW
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Sapling/Shrub Stratum (Plot size:)			
1. Acer rubrum	5	No	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 = Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Herb Stratum (Plot size:)			
1. Hedera helix	5	No	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	5 = Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	10	Yes	FAC
2.			
3.			
4.			
5.			
	10 = Total Cover		
50% of total cover: ____ 20% of total cover: ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- [x] 1 - Rapid Test for Hydrophytic Vegetation
- [ ] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: (If observed, list morphological adaptations below).

Vegetation criteria met.

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SOIL Sampling Point: DP 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	organic							
1-8	10YR 5/1	90	7.5YR 5/4	10	C	M	clay loam loam	
8-16	2.5Y 5/1	85	7.5YR 5/6	15	C	M	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No _____

Remarks:

Soil criteria met.

US Army Corps of Engineers Atlantic and Gulf Coastal Plain Region – Version 2.0

Appendix F.6

ABMS Biota Sampling Report
Peck Iron and Metal Superfund Site Portsmouth, Virginia
(October 4, 2016)

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Aquatic Biological Monitoring Services (ABMS), LLC

10237 Slidingrock Drive
Mechanicsville, Virginia 23116
(804) 402-9005
Tom Gunter, Owner
tomgunter@comcast.net
October 28, 2016

PECK IRON AND METAL SUPERFUND SITE PORTSMOUTH, VIRGINIA
2016 ABMS, LLC BIOTA SAMPLING REPORT

Introduction

ABMS, LLC was sub-contracted in 2016 by HydroGeoLogic, Inc (HGL) to conduct biological sampling for mummichogs and to cultural oysters at seven (7) sampling site within the Elizabeth River system, as related to this superfund project. These sites and their geographic locations are as follows:

Site	North Coordinates	West Coordinates
PCSD02	36.80619	76.31256
PCSD04	36.80613	76.30985
PCSD09	36.80284	76.30702
PCSD12	36.80134	76.30610
Control 1 Scuffletown	36.80917	76.28249
Control 2 Gilligan	36.79826	76.28500
Control 3 Newtown	36.76890	76.29180

Methods

Mummichog Collections

Mummichogs were collected by using standard ¼ inch mesh minnow traps measuring 17" long with a 27" circumference at the middle. The two entrances were 1 and ½ inches each. The traps were baited with dog food. On one deployment effort, the traps were set in deep water areas near the oyster cages. These sets were unproductive and the traps were moved to the edge of the tidal marsh grass near the shoreline during incoming high tides. Those sets were highly productive.

Oyster Cultural

Oysters were cultivated in 18 X 18 inch holding pots made with ½ by ½ inch mesh vinyl coated wire. These pots were set on four (4) inch feet to keep the pots off of the creek(s) bottom. The connection points on each pot were made with plastic cable ties. Sixteen (16) oyster holding pots were used for this

study at the different sample sites. Cultural bags were not used for this study due to the fear the bags would suffocate the oysters. A total of 605 triploid oysters were deployed throughout the study sites on 6/23/2016. Harvest of these oysters (346 animals) occurred on 10/26/2016 – a total of 96 cultivation days.

Results

Mummichog Collections

A total of 613 mummichogs were collected on three sampling efforts at all seven (7) sites. Total biomass collected was 2,472 grams – exceeding the biomass needed for tissue analysis for this study. All fish collected at each site were preserved in vacuum sealed bags and frozen. A breakdown of the sampling results for each site is available in Table 1 of this report.

Oyster Cultural

The overall oyster survival rate for this study was 57.2 percent. Oyster tissue biomass (grams) was 4,036, exceeding that needed for tissue analysis for this study. Oysters were shucked using stainless steel shucking knives. The shucking table and measuring equipment (ruler and gram scale) was disinfected between tissue preparations for each site sampled. Tissue samples were placed in labeled glass jars and frozen. A breakdown of the results of oyster cultivation and harvest for each study site is available in Table2 of this report.

Discussion

Mummichog Collections

The average weights of these fish were greater than expected for this study. As a result, fewer individuals were needed to provide the biomass necessary for tissue analysis. Catch per unit effort (CPUE) for these fish was fairly consistent between sample sites. The fish were not collected effectively in deeper water. The best result occurred on sets during incoming high tides when the traps were set along the edge of the marsh grass near the creek(s) shoreline.

Recommendations

- Set minnow traps on an incoming high tide along the creek shoreline at the edge of the marsh vegetation. Traps should be checked on the hour or as sampling time will allow. This will likely reduce the sampling effort for this fish species.

Oyster Cultural

Oyster cultivation for this study went better than expected, given the shallow water conditions of the sample sites and the human population and activity in the sample area. The holding pots were very efficient for the small amount of animals needed for this study. Some of the pots were moved by wind

or current flows in Paradise and Newtown creeks, however, during a storm event the last week of the cultivation period. Lucky all the pot were located and indentified except for one at control site 3 (Newtown Creek). That pot was not found after the storm event and the day of harvest.

Recommendations

- Label each pot accordingly to the sample site of deployment.
- Pots should be weighted down to prevent movement.
- Pots should be checked in two week intervals or shortly after strong storm events throughout the study period.

Table 1. Paradise Creek Mummichog Summary

Site	# Mummichogs Collected	Total Weight (g)	Average Weight (g)	CPUE (# per trap minute)
PCSD02	29	186	6.41	.148
PCSD04	92	324	3.52	.119
PCSD09	78	447	5.73	.094
PCSD12	79	390	4.93	.099
Control 1 Scuffletown	104	339	3.25	.158
Control 2 Gilligan	142	549	3.86	.177
Control 3 Newtown	89	237	2.66	.084

Table 2. Paradise Creek Oyster Cultural Summary

Site	# Oysters Deployed	Total # Harvested	Percent Survival	Total Tissue Harvested for Analysis (grams)
PCSD02	65	21	32.3%	349
PCSD04	151	96	63.6%	1,152
PCSD09	80	55	68.7%	506
PCSD12	65	44	67.7%	438
Control 1 Scuffletown	82	44	50.0%	562
Control 2 Gilligan	83	57	68.7%	565
***Control 3 Newtown**	82	29	35.4%	464

* One holding pot missing from the Newtown (Control 3) site.

Appendix F.7

Ecotoxicological Evaluation of Sediments For Toxicity and Bioaccumulation Testing US EPA Virginia Superfund Site (December 28, 2016)

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ECOTOXICOLOGICAL EVALUATION OF SEDIMENTS FOR TOXICITY AND BIOACCUMULATION TESTING – US EPA VIRGINIA SUPERFUND SITE

Prepared for

HydroGeoLogic, Inc.
11107 Sunset Hills Rd., Suite 400
Reston, Virginia 20190

Prepared by:

EA Engineering, Science, and Technology, Inc., PBC
231 Schilling Circle
Hunt Valley, Maryland 21031
For questions concerning this report, please contact Wayne McCulloch
ph: 410-584-7000

Results relate only to the items tested or to the samples as received by the laboratory.

This report contains 22 pages plus 5 attachments.

28 December 2016

Wayne L. McCulloch
Laboratory Director

Date

EA Project Number 70005.15

ACCREDITED IN ACCORDANCE WITH nelac
ID# E87550

EA Report Number 7453

1. INTRODUCTION

At the request of the HydroGeoLogic, Inc., EA Engineering, Science, and Technology performed whole sediment toxicity testing and bioaccumulation testing on sediment samples collected from a Superfund Site located in southeastern Virginia, in support of HydroGeoLogic's Remedial Investigation. The purpose of this study was to evaluate the toxicity and bioaccumulation potential of the sediment samples.

The toxicity testing program consisted of: 1) 28-day whole sediment toxicity tests with *Leptocheirus plumulosus* (amphipod); 2) 20-day whole sediment toxicity tests with *Neanthes arenaceodentata* (polychaete); and 3) 28-day bioaccumulation tests with *Nereis virens* (polychaete). The whole sediment toxicity tests evaluated the effects of exposure to the sediment samples on survival, growth or reproduction of the test organisms. The bioaccumulation test evaluated survival of the test organisms and bioaccumulative effects as a result of exposure to the sediment samples. At the completion of the bioaccumulation testing, the organism tissues were submitted for selected chemical analyses, the results of which are not included in this report.

2. MATERIALS AND METHODS

2.1 SAMPLE RECEIPT AND PREPARATION

Five sediment samples from the Superfund Site in southeastern Virginia, were collected and composited by HydroGeoLogic personnel. The sediment samples were placed into 2-gallon pails. The samples were held at ≤4°C and were hand delivered to EA's Ecotoxicology Laboratory in Hunt Valley, Maryland. Upon receipt at EA, the sediment samples were logged in and assigned EA laboratory accession numbers, and were stored in the dark in a secured walk-in cooler at ≤4°C until used for testing. Table 1 summarizes the sample identification, accession numbers, and collection/composite and receipt information for the sediment samples. Chain-of-custody records are included in Attachment I.

2.2 LABORATORY WATER

Artificial seawater was used as the overlying water. The artificial seawater was prepared by mixing Crystal Sea synthetic sea salts with laboratory water to a final salinity of 30 ppt or 20 ppt. The source of the laboratory water was the City of Baltimore municipal tap water that was passed through a high-capacity, activated carbon filtration system. This synthetic seawater formulation has proven acceptable for aquatic toxicological studies, and has been used successfully at EA for maintaining multigeneration cultures of opossum shrimp, and for holding healthy populations of estuarine and marine species. Batches of artificial seawater were aerated and aged at least 24 hours prior to use in testing.

2.3 CONTROL AND REFERENCE SEDIMENT

A sample of sediment from Pretty Boy Reservoir, Maryland was collected for use as the control sediment for the *Leptocheirus plumulosus* and *Neanthes arenaceodentata* testing. Sediment collected from this location has historically been non-toxic and is routinely utilized as a control sediment in EA's toxicity tests. A natural sediment from the organism collection site was used as laboratory controls in the bioaccumulation testing. Control sediment used in the *N. virens* test was collected from the Damariscotta River, Booth Bay Harbor, Maine.

2.4 TOXICITY TEST METHODS

The toxicity tests performed during this study were conducted in accordance with the appropriate guidance, as indicated in the following sections. The test methodologies followed EA's standard toxicity testing protocols (EA 2013) and the results comply with current NELAC standards, except where noted in the report.

2.4.1 *Leptocheirus plumulosus* 28-Day Toxicity Testing

The 28-day *L. plumulosus* chronic toxicity testing was conducted in accordance with US EPA (2001) guidance. The *L. plumulosus* were acquired from Chesapeake Cultures (Hayes, Virginia). Lot LP-086 was received at EA on 10 November 2016 and was used to initiate the toxicity tests on the same day. During the holding period, the organisms were gradually acclimated to laboratory water at 25°C and to 20 ppt salinity.

The tests were conducted in 1-liter beakers each containing 175 ml of sediment and 800 ml of overlying water. The tests were performed with five replicates per sediment sample. The sediment and overlying water were added to the chambers 24 hours prior to introduction of the test organisms. The beakers were left undisturbed to allow any suspended sediment particles in the water column to settle and equilibrate. Twenty organisms were randomly introduced into each replicate beaker. The introduction of the test organisms to the test chambers marked the initiation of the toxicity tests. The test chambers were placed in an environmental chamber and maintained at a target temperature of 25±1°C with a 16-hour light/8-hour dark photoperiod. The overlying water was gently aerated at a rate of 100 bubbles per minute throughout the 28-day exposure period. During the first two weeks of the exposure period, the *L. plumulosus* were fed three times a week with 1 ml/replicate of a 20 mg/ml slurry of finely ground Tetramin in deionized water. This feeding schedule was maintained during weeks three and four, however the concentration of the slurry was increased to 40 mg/ml Tetramin, to provide additional food for the older (larger) test organisms.

The overlying water in the exposure chambers was renewed three times each week by siphoning 400 ml of the old overlying water from each test chamber, and then slowly siphoning fresh

replacement water into the chamber, taking care not to disturb the sediment. Temperature, pH, dissolved oxygen, and salinity measurements were recorded daily on the overlying water in one replicate of each sediment. Ammonia measurements were conducted on composite samples of pore water from each sediment sample at test initiation and termination. These water quality measurements are summarized in Tables 2 and 4.

At the end of the 28-day exposure period, the surviving adult organisms from each replicate were retrieved by screening through a 500 μm sieve. The number of surviving adult *L. plumulosus* from each replicate was recorded, and the surviving adults from each replicate were placed in a dried, pre-weighed tin and placed in a drying oven overnight at 100°C. The tins were then removed from the oven and placed in a desiccator to cool. Each pan was weighed to the nearest 0.01 mg to determine a mean dry weight per replicate, obtained by dividing the total organism dry weight per replicate by the number of surviving organisms per replicate. The growth rate per replicate was calculated by subtracting the mean initial dry weight of the test organisms from the final mean dry weight per replicate, divided by 28 days. Initial dry weights were determined prior to test initiation, using four replicates of 10 randomly selected organisms.

Material that passed through the 500 μm sieve when recovering the adult organisms was retained on a 250 μm sieve to retrieve the offspring. Amphipods and residual sediment that was retained on the 250 μm sieve was rinsed with freshwater to remove salts, and was washed into a sample jar. The offspring were stained with a 1g/L solution of rose bengal, and preserved with 70% alcohol. The offspring were counted, and the reproduction endpoint was calculated as the number of offspring per surviving adult. A summary of survival, growth rate and reproduction for the *L. plumulosus* exposed to each sediment sample is provided in Table 7. Copies of the original data sheets for the *L. plumulosus* 28-day toxicity testing are included as Attachment II.

2.4.2 *Neanthes arenaceodentata* 20-Day Toxicity Testing

The 20-day *N. arenaceodentata* chronic toxicity testing was conducted in accordance with the methods described by Puget Sound Estuary Program (1995) and modifications to the test approved by the Dredged Material Management Program agencies. The *N. arenaceodentata* were acquired from Aquatic Toxicology Support (Bremerton, Washington). Lot NA-028 was

received at EA on 17 November 2016 and was used to initiate the toxicity tests on the same day. During the holding period, the organisms were gradually acclimated to laboratory water at 20°C and to the appropriate test salinity.

The tests were conducted in 1-liter beakers each containing 175 ml of sediment and 800 ml of overlying water. The tests were performed with five replicates per sediment sample. The sediment and overlying water were added to the chambers 24 hours prior to introduction of the test organisms. The beakers were left undisturbed to allow any suspended sediment particles in the water column to settle and equilibrate. Five organisms were randomly introduced into each replicate beaker. The introduction of the test organisms to the test chambers marked the initiation of the toxicity tests. The test chambers were placed in an environmental chamber and maintained at a target temperature of 20±1°C with a 16-hour light/8-hour dark photoperiod. The overlying water was gently aerated at a rate of 100 bubbles per minute throughout the 20-day exposure period. During the exposure period, the *N. arenaceodentata* were fed every other day with 40 mg of finely ground Tetramin per test chamber.

The overlying water in the exposure chambers was renewed every three days by siphoning 400 ml of the old overlying water from each test chamber, and then slowly siphoning fresh replacement water into the chamber, taking care not to disturb the sediment. Temperature, pH, dissolved oxygen, and salinity measurements were recorded daily on the overlying water in one replicate of each sediment. Ammonia measurements were conducted on composite samples of pore water from each sediment sample at test initiation and termination. These water quality measurements are summarized in Tables 3 and 5.

At the end of the 20-day exposure period, the surviving adult organisms from each replicate were retrieved by screening through a 500 μm sieve. The number of surviving adult *N. arenaceodentata* from each replicate was recorded. For weight determinations, surviving organisms were placed in pre-weighed, ashed crucibles (one replicate per crucible). Organisms were oven dried for a minimum of six hours after which each crucible was weighed. The crucibles with dried organisms were then ashed at 550°C for 2 hours, allowed to cool, and weighed again. A mean ash-free dry weight of the organisms in each replicate was calculated by subtracting the ashed weight of crucible with organisms from the oven dry weight of crucible

with organisms, then dividing by the number of surviving organisms in the replicate. The growth rate per replicate was calculated by subtracting the mean initial weight of the test organisms from the final mean weight per replicate, divided by 20 days. Initial dry weights were determined prior to test initiation, using four replicates of 5 randomly selected organisms.

A summary of survival and growth rate for the *N. arenaceodentata* exposed to each sediment sample is provided in Table 8. Copies of the original data sheets for the *N. arenaceodentata* 20-day toxicity testing are included as Attachment III.

2.4.3 *Nereis virens* Bioaccumulation Testing

Bioaccumulation testing was conducted using the sand worm (*Nereis virens*) according to USEPA/USACE (1998) guidance. The adult worms (NV-057) were received from Aquatic Research Organisms (Hampton, New Hampshire) on 9 November 2016. The *N. virens* were loaded into the test immediately to minimize cannibalism/holding stress.

The sediment samples and overlying water were added to the test chambers at least 24 hours prior to test initiation to allow time for the suspended sediments to settle and equilibrate. The overlying water was 30 ppt artificial seawater (Crystal Sea artificial sea salts). The bioaccumulation tests were 28 days in duration and were conducted as static renewal assays. The overlying water was replaced three times a week by siphoning approximately 80 percent of the overlying water from the aquaria, and replacing with new overlying water, taking care not to disturb the sediment surface.

The bioaccumulation tests were conducted in 10-gallon aquaria with 5 L of sediment and 22 L of overlying water per aquarium. There were five replicates per test sediment and control sediment. Based on the analytical tissue biomass requirements, 25 organisms were randomly introduced into each replicate chamber for the *N. virens* testing.

During the 28-day exposure period, the test chambers were maintained at a target temperature of 20±1°C with a 16-hour light/8-hour dark photoperiod. Gentle aeration was provided to each aquarium throughout the test period. Observations of mortality and abnormal organism behavior

were recorded daily, and dead organisms were removed, as observed, from the test chambers. Measurements of temperature, pH, dissolved oxygen, and salinity of the overlying water were recorded on one replicate of each sample and control at test initiation, termination, and three times a week prior to replacement of the overlying water. The water quality measurements are summarized in Table 6. The organisms were not fed during the exposure period.

The bioaccumulation tests were initiated on 9 November and completed on 7 December 2016. After 28 days of exposure, the organisms were recovered from the samples and placed into clean artificial sea water for 24 hours to purge their digestive tracts. A summary of the percent survival can be found in Table 9. After the depuration period, the organism tissues were collected and submitted for chemical analyses. Copies of the original data sheets are included in Attachment IV.

2.4.4 Data Analysis

Statistical analyses were performed on the whole sediment test data according to using the ToxCalc statistical software package (Version 5.0, Tidepool Scientific Software). For the whole sediment toxicity test data, statistical analyses were performed to determine if exposure to any of the sediment samples resulted in significantly lower survival, growth or reproduction (p=0.05) of the test organisms as compared to the control sediment. The results of the whole sediment and bioaccumulation testing are summarized in Tables 7-9.

2.4.5 Reference Toxicant Testing

In conformance with EA's quality assurance/quality control program requirements, reference toxicant testing was performed by EA on the acquired lots of *L. plumulosus, N. arenaceodentata* and *N. virens* utilized in the testing program. The reference toxicant tests consisted of a graded concentration series of a specific toxicant in water only tests, with no sediment present in the test chambers. The results of the reference toxicant tests were compared to established control chart limits. Table 10 presents the results of the reference toxicant testing.

2.5 ARCHIVES

Original data sheets, records, memoranda, notes, and computer printouts are archived at EA's office in Hunt Valley, Maryland. These data will be retained for a period of 5 years unless a longer period of time is requested by HydroGeoLogic, Inc.

3. RESULTS AND DISCUSSION

This bioassay/bioaccumulation study with the sediments collected from a Superfund Site located in southeastern Virginia, was conducted in support of HydroGeoLogic's Remedial Investigation. The results of these toxicity tests met the current NELAC standards, where applicable.

3.1 *Leptocheirus plumulosus* 28-DAY TOXICITY TESTING

Results of the *L. plumulosus* chronic sediment toxicity test are summarized in Table 7. After 28 days of exposure, sample FE16SEDDUP03 had 73 percent survival, and was significantly less (p=0.05) than the control sample, which had 94 percent survival. It should be noted that there was a large amount of variability within the data with replicate survivals ranging from 45 to 100 percent. Therefore, the observed statistical difference may be a result of artifactual toxicity in the replicates and not an indication of actual toxicity. Survival in the remaining site sediment samples ranged from 82 to 91 percent, and were not significantly different from the control sample.

Growth rate in the site samples ranged from 0.058 to 0.064 mg/surviving organism/day, which were not significantly different than the control sample with a growth rate of 0.053 mg/surviving organism/day. Additionally, mean young production in the test sediments was not significantly different than the control, with mean young production in the site sediments ranging from 0.82 to 1.42 young per surviving adult, compared to 1.46 young per surviving adult in the control.

Overall, the results indicated that none of the samples had a toxic effect on the test organisms with respect to survival, growth or reproduction as compared to the control sediment.

3.2 *Neanthes arenaceodentata* 20-DAY TOXICITY TESTING

Results of the *N. arenaceodentata* chronic sediment toxicity test are summarized in Table 8. After 20 days of exposure, survival in the site sediment samples ranged from 92 to 100 percent, and were not significantly less (p=0.05) than the control sample, which had 96 percent survival.

Growth rate as mean dry weight (MDW) ranged from 0.70 to 0.79 mg/surviving organism/day, while the control sediment had a growth rate of 0.62 mg/surviving organism/day. Growth rate as ash free dry weight (AFDW) ranged from 0.52 to 0.58 mg/surviving organism/day, compared to the control sediment, which had a growth rate of 0.51 mg/surviving organism/day. There were no statistical differences between the control and site sediments for growth as either mean dry weight or ash free dry weight.

3.3 *Nereis virens* 28- DAY BIOACCUMULATION TESTING

Tables 9, summarizes the survival of *N. virens* following 28 days of exposure to the sediment samples. Percent survial of *N. virens* exposed to the site samples ranged from 94 to 98 percent. Percent survival in the laboratory control was 96 percent. There was no statistical difference (p=0.05) in survival between the site sediments and the control sediment.

3.4 REFERENCE TOXICANT TESTS

The results of the reference toxicant tests are summarized in Table 10. All of the reference toxicant test results fell within the established laboratory control chart limits.

4. REFERENCES CITED

EA. 2013. EA Ecotoxicology Laboratory Quality Assurance and Standard Operating Procedures Manual. EA Manual ATS-102. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Hunt Valley, Maryland.

Puget Sound Estuary Program (PSEP). 1995. Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Final Report. Prepared for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA. Washington State Department of Ecology, Olympia, WA.

US EPA. 2001. Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus*. First Edition. EPA/600/R-01/020. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.

US EPA and USACE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.-Inland Testing Manual. EPA/823/B-94/004. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. and Department of the Army, U.S. Army Corps of Engineers, Washington, D.C.

TABLE 1 SUMMARY OF COLLECTION AND RECEIPT INFORMATION FOR SEDIMENT SAMPLES – US EPA VIRGINIA SUPERFUND SITE

Sample Identification	EA Accession Number	Sample Date	Receipt Time and Date
PCSD02_TOX00	AT6-638	25 October 2016	1340, 26 October 2016
PCSD04_TOX00	AT6-639	25 October 2016	1340, 26 October 2016
PCSD09_TOX00	AT6-640	25 October 2016	1340, 26 October 2016
PCSD12_TOX00	AT6-641	25 October 2016	1340, 26 October 2016
FE16SEDDUP03	AT6-642	25 October 2016	1340, 26 October 2016

TABLE 2 AMMONIA CONCENTRATIONS MEASURED ON SEDIMENT PORE WATER FOR 28-DAY SOLID PHASE TOXICITY TESTING WITH *Leptocheirus plumulosus* – US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-396
Testing Dates: 11/10/16 – 12/8/16

Sample Identification	**EA Accession Number**	**Day 0 Pore Water (mg/L NH_3-N)**	**Day 28 Pore Water (mg/L NH_3-N)**
Control	AT6-485	8.93	14.20
PCSD02_TOX00	AT6-638	11.46	0.64
PCSD04_TOX00	AT6-639	14.52	1.76
PCSD09_TOX00	AT6-640	10.08	3.48
PCSD12_TOX00	AT6-641	10.54	3.12
FE16SEDDUP03	AT6-642	12.15	3.20

TABLE 3 AMMONIA CONCENTRATIONS MEASURED ON SEDIMENT PORE WATER FOR 20-DAY SOLID PHASE TOXICITY TESTING WITH *Neanthes arenaceodentata* – US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-399
Testing Dates: 11/17/16 – 12/7/16

Sample Identification	**EA Accession Number**	**Day 0 Pore Water (mg/L NH_3-N)**	**Day 20 Pore Water (mg/L NH_3-N)**
Control	AT6-485	27.80	11.80
PCSD02_TOX00	AT6-638	12.28	1.24
PCSD04_TOX00	AT6-639	14.96	2.52
PCSD09_TOX00	AT6-640	10.26	1.40
PCSD12_TOX00	AT6-641	9.56	0.88
FE16SEDDUP03	AT6-642	15.04	3.10

TABLE 4 SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING 28-DAY SOLID PHASE BIOASSAY TESTING WITH *Leptocheirus plumulosus* – US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-396
Testing Dates: 11/10/16 – 12/8/16

Sediment Sample Identification	**EA Accession Number**	**Range**			
		Temperature (°C)	**pH**	**Dissolved Oxygen (mg/L)**	**Salinity (ppt)**
Control	AT6-485	24.0 – 26.0	6.4 – 8.2	6.8 – 8.4	18.0 – 22.0
PCSD02_TOX00	AT6-638	24.0 – 27.7	6.5 – 8.1	5.8 – 8.0	19.0 – 22.0
PCSD04_TOX00	AT6-639	24.0 – 26.0	6.5 – 8.1	5.6 – 7.6	18.9 – 22.0
PCSD09_TOX00	AT6-640	24.0 – 26.0	6.6 – 8.1	6.4 – 7.6	19.6 – 22.0
PCSD12_TOX00	AT6-641	24.0 – 26.0	6.7 – 8.1	6.6 – 7.6	19.2 – 22.0
FE16SEDDUP03	AT6-642	24.0 – 26.0	6.7 – 8.2	6.5 – 7.7	19.1 – 22.0

TABLE 5 SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING 20-DAY SOLID PHASE BIOASSAY TESTING WITH *Neanthes arenaceodentata* – US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-399
Testing Dates: 11/17/16 – 12/7/16

Sediment Sample Identification	**EA Accession Number**	**Range**			
		Temperature (°C)	**pH**	**Dissolved Oxygen (mg/L)**	**Salinity (ppt)**
Control	AT6-485	19.0 – 21.0	6.9 – 8.1	6.9 – 8.2	28.9 – 33.0
PCSD02_TOX00	AT6-638	19.0 – 21.0	7.0 – 8.1	7.1 – 8.0	27.7 – 33.0
PCSD04_TOX00	AT6-639	19.0 – 21.0	7.0 – 8.1	7.1 – 8.3	27.6 – 32.3
PCSD09_TOX00	AT6-640	19.0 – 21.0	7.1 – 8.2	7.0 – 7.9	27.9 – 32.5
PCSD12_TOX00	AT6-641	19.1 – 21.0	7.1 – 8.2	7.0 – 7.8	27.9 – 32.3
FE16SEDDUP03	AT6-642	19.0 – 21.0	7.2 – 8.3	6.9 – 7.7	28.3 – 33.0

TABLE 6 SUMMARY OF WATER QUALITY PARAMETERS MEASURED DURING 28-DAY SOLID PHASE BIOACCUMULATION TESTING WITH *Nereis virens* – US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-395
Testing Dates: 11/9/16-12/7/16

Sediment Sample Identification	**EA Accession Number**	**Range**			
		Temperature (°C)	**pH**	**Dissolved Oxygen (mg/L)**	**Salinity (ppt)**
Control	AT6-485	19.0 – 20.6	7.4 – 8.0	5.7 – 7.7	28.3 – 32.5
PCSD02_TOX00	AT6-638	19.0 – 20.7	7.4 – 8.1	6.3 – 7.4	28.4 – 32.2
PCSD04_TOX00	AT6-639	19.0 – 20.7	7.4 – 8.2	6.6 – 7.4	28.2 – 32.5
PCSD09_TOX00	AT6-640	19.0 – 20.7	7.4 – 8.2	6.7 – 7.4	28.0 – 32.3
PCSD12_TOX00	AT6-641	19.0 – 20.7	7.4 – 8.1	6.6 – 7.4	28.0 – 32.7
FE16SEDDUP03	AT6-642	19.0 – 20.7	7.4 – 8.3	6.9 – 7.7	28.3 – 33.0

TABLE 7 RESULTS OF 28-DAY WHOLE SEDIMENT TOXICITY TESTING WITH *Leptocheirus plumulosus* - US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-396
Testing Dates: 11/10/16 – 12/8/16

Sample Identification	EA Accession Number	No. Alive/No. Exposed	28-Day Mean Percent Survival	Growth Rate as mg/Organism/Day (±S.D.)	Mean Reproduction as Young per Surviving Adult
Control	AT6-485	94 / 100	94	0.053 (±0.011)	1.46
PCSD02_TOX00	AT6-638	91 / 100	91	0.058 (±0.009)	1.38
PCSD04_TOX00	AT6-639	88 / 100	88	0.064 (±0.006)	1.42
PCSD09_TOX00	AT6-640	71 / 80	89	0.064 (±0.003)	1.32
PCSD12_TOX00	AT6-641	82 / 100	82	0.063 (±0.012)	0.82
FE16SEDDUP03	AT6-642	73 / 100	73[(a)]	0.061 (±0.018)	1.37

(a) Significantly different than the contol (p=0.05).

TABLE 8 RESULTS OF 28-DAY WHOLE SEDIMENT TOXICITY TESTING WITH *Neanthes arenaceodentata* - US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-399
Testing Dates: 11/17/16 – 12/7/16

Sample Identification	EA Accession Number	No. Alive/No. Exposed	20-Day Mean Percent Survival	MDW Growth Rate as mg/Organism/Day (±S.D.)	AFDW Growth Rate as mg/Organism/Day (±S.D.)
Control	AT6-485	24 / 25	96	0.62 (±0.09)	0.51 (±0.08)
PCSD02_TOX00	AT6-638	25 / 25	100	0.70 (±0.05)	0.52 (±0.03)
PCSD04_TOX00	AT6-639	23 / 25	92	0.79 (±0.06)	0.58 (±0.06)
PCSD09_TOX00	AT6-640	23 / 25	92	0.78 (±0.15)	0.55 (±0.04)
PCSD12_TOX00	AT6-641	23 / 25	92	0.75 (±0.12)	0.55 (±0.07)
FE16SEDDUP03	AT6-642	24 / 25	96	0.74 (±0.07)	0.53 (±0.05)

TABLE 9 RESULTS OF 28-DAY BIOACCUMULATION TESTING WITH *Nereis virens* - US EPA VIRGINIA SUPERFUND SITE

Test Number: TN-16-395
Testing Dates: 11/9/16 - 12/7/16

Sample Identification	EA Accession Number	No. Alive/No. Exposed	28-Day Mean Percent Survival
Control	AT6-687	120 / 125	96
PCSD02_TOX00	AT6-638	118 / 125	94
PCSD04_TOX00	AT6-639	117 / 125	94
PCSD09_TOX00	AT6-640	118 / 125	94
PCSD12_TOX00	AT6-641	119 / 125	95
FE16SEDDUP03	AT6-642	123 / 125	98

TABLE 10 RESULTS OF REFERENCE TOXICANT TESTING ON ACQUIRED LOTS OF TEST ORGANISMS – US EPA VIRGINIA SUPERFUND SITE

Test Species	Organism Lot Number	Reference Toxicant	Test Endpoint	Acceptable Control Chart Limits
Leptocheirus plumulosus	LP-086	Cadmium chloride ($CdCl_2$)	48-Hour LC50: 13.9 mg/L Cd	3.0 – 20.0 mg/L Cd
Neanthes arenaceodentata	NA-028	Cadmium chloride ($CdCl_2$)	48-Hour LC50: 7.5 mg/L Cd	2.7 – 11.7 mg/L Cd
Nereis virens	NV-057	Potassium chloride (KCl)	48-Hour LC50: 1,439 mg/L KCl	567 – 1,626 mg/L KCl

ATTACHMENT I

Chain-of-Custody Record
(4 pages)

USEPA
DateShipped: 10/26/2016
CarrierName: East Coast Courier
AirbillNo: N/A

CHAIN OF CUSTODY RECORD
Site #: VAN000306115
Contact Name: Mike Chanov
Contact Phone: 410 584 7000

No: 3-102616-061741-0369
Cooler #: N/A
Lab: EA Engineering, Science and Technology
Lab Phone:

Lab #	Sample #	Location	CLP Sample #	Tag	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	PCSD02_TOX00	PCSD02_TOX00	C0504	12666	Toxicity 1 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.8
	PCSD02_TOX00	PCSD02_TOX00	C0504	12667	Toxicity 2 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.5
	PCSD02_TOX00	PCSD02_TOX00	C0504	12668	Toxicity 3 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.4
	PCSD02_TOX00	PCSD02_TOX00	C0504	12669	Toxicity 4 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.7
	PCSD02_TOX00	PCSD02_TOX00	C0504	12670	Toxicity 5 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.9
	PCSD02_TOX00	PCSD02_TOX00	C0504	12671	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
	PCSD02_TOX00	PCSD02_TOX00	C0504	12672	Toxicity 7 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.2
	PCSD02_TOX00	PCSD02_TOX00	C0504	12673	Toxicity 8 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.6
	PCSD02_TOX00	PCSD02_TOX00	C0504	13132	Toxicity 9 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.0
	PCSD02_TOX00	PCSD02_TOX00	C0504	13133	Toxicity 10 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.8
	PCSD04_TOX00	PCSD04_TOX00	C0529	12923	Toxicity 1 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.8
	PCSD04_TOX00	PCSD04_TOX00	C0529	12924	Toxicity 2 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.6
	PCSD04_TOX00	PCSD04_TOX00	C0529	12925	Toxicity 3 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.7
	PCSD04_TOX00	PCSD04_TOX00	C0529	12926	Toxicity 4 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
	PCSD04_TOX00	PCSD04_TOX00	C0529	12927	Toxicity 5 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.4
	PCSD04_TOX00	PCSD04_TOX00	C0529	12928	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.2
	PCSD04_TOX00	PCSD04_TOX00	C0529	12929	Toxicity 7 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.4
	PCSD04_TOX00	PCSD04_TOX00	C0529	12930	Toxicity 8 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.6

ATC-638

AT6-639

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
Initial Release	[signature] /HGL	10/26/16 800 AM	[signature]	10.26.16 8:30 AM	Good
			[signature] (EA)	10/26/16 1340	Good

Custody seals intact 10/26/16 [signature]

USEPA
DateShipped: 10/26/2016
CarrierName: East Coast Courier
AirbillNo: N/A

CHAIN OF CUSTODY RECORD
Site #: VAN000306115
Contact Name: Mike Chanov
Contact Phone: 410 584 7000

No: 3-102616-061741-0369
Cooler #: N/A
Lab: EA Engineering, Science and Technology
Lab Phone:

Lab #	Sample #	Location	CLP Sample #	Tag	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	PCSD04_TOX00	PCSD04_TOX00	C0529	13134	Toxicity 9 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.6
	PCSD04_TOX00	PCSD04_TOX00	C0529	13135	Toxicity 10 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.3
	PCSD09_TOX00	PCSD09_TOX00	C0530	12942	Toxicity 1 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.3
	PCSD09_TOX00	PCSD09_TOX00	C0530	12943	Toxicity 2 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.8
	PCSD09_TOX00	PCSD09_TOX00	C0530	12944	Toxicity 3 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.1
	PCSD09_TOX00	PCSD09_TOX00	C0530	12945	Toxicity 4 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.8
	PCSD09_TOX00	PCSD09_TOX00	C0530	12946	Toxicity 5 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
	PCSD09_TOX00	PCSD09_TOX00	C0530	12947	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.7
	PCSD09_TOX00	PCSD09_TOX00	C0530	12948	Toxicity 7 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.9
	PCSD09_TOX00	PCSD09_TOX00	C0530	12949	Toxicity 8 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.2
	PCSD09_TOX00	PCSD09_TOX00	C0530	13136	Toxicity 9 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
	PCSD09_TOX00	PCSD09_TOX00	C0530	13137	Toxicity 10 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.3
	PCSD12_TOX00	PCSD12_TOX00	C0531	12961	Toxicity 1 of 10	Sediment	10/25/2016	1	Bucket	4 C	5.0
	PCSD12_TOX00	PCSD12_TOX00	C0531	12962	Toxicity 2 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.7
	PCSD12_TOX00	PCSD12_TOX00	C0531	12963	Toxicity 3 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.7
	PCSD12_TOX00	PCSD12_TOX00	C0531	12964	Toxicity 4 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.8
	PCSD12_TOX00	PCSD12_TOX00	C0531	12965	Toxicity 5 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
	PCSD12_TOX00	PCSD12_TOX00	C0531	12966	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.0

AT6-640

AT6-641

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
initial release	[signature] HTL	10/26/16 0820	[signature]	8:30AM 10.26.16	Good
			B. [signature] (EA)	10/26/16 1340	Good

Custody seals intact 10/26/16 [signature]

USEPA
DateShipped: 10/26/2016
CarrierName: East Coast Courier
AirbillNo: N/A

CHAIN OF CUSTODY RECORD
Site #: VAN000306115
Contact Name: Mike Chanov
Contact Phone: 410 584 7000

No: 3-102616-061741-0369
Cooler #: N/A
Lab: EA Engineering, Science and Technology
Lab Phone:

Lab #	Sample #	Location	CLP Sample #	Tag	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	PCSD12_TOX00	PCSD12_TOX00	C0531	12967	Toxicity 7 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.2
	PCSD12_TOX00	PCSD12_TOX00	C0531	12968	Toxicity 8 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.9
	PCSD12_TOX00	PCSD12_TOX00	C0531	13138	Toxicity 9 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.7
	PCSD12_TOX00	PCSD12_TOX00	C0531	13139	Toxicity 10 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.2
	FE16SEDDUP03	FE16SEDDUP03	C0532	12980	Toxicity 1 of 10	Sediment	10/25/2016	1	Bucket	4 C	2.8
	FE16SEDDUP03	FE16SEDDUP03	C0532	12981	Toxicity 2 of 10	Sediment	10/25/2016	1	Bucket	4 C	2.8
	FE16SEDDUP03	FE16SEDDUP03	C0532	12982	Toxicity 3 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.1
	FE16SEDDUP03	FE16SEDDUP03	C0532	12983	Toxicity 4 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.6
	FE16SEDDUP03	FE16SEDDUP03	C0532	12984	Toxicity 5 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.5
	FE16SEDDUP03	FE16SEDDUP03	C0532	12985	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	2.4
	FE16SEDDUP03	FE16SEDDUP03	C0532	12986	Toxicity 7 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.4
	FE16SEDDUP03	FE16SEDDUP03	C0532	12987	Toxicity 8 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.8
	FE16SEDDUP03	FE16SEDDUP03	C0532	13140	Toxicity 9 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.9
	FE16SEDDUP03	FE16SEDDUP03	C0532	13141	Toxicity 10 of 10	Sediment	10/25/2016	1	Bucket	4 C	3.9

AA6-642

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
initial release	[signature] HGL	800 10/26/2016	[signature]	8:30 AM 10.26.16	Good
			[signature] (EA)	10/26/16 1340	Good

Custody Seals intact 10/26/16 [signature]

ATTACHMENT II

Leptocheirus plumulosus 28-Day Whole Sediment Test
Data Sheets and Statistical Analyses
(33 pages)

SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

TEST ORGANISM INFORMATION

Common Name: Amphipod

Scientific Name: *Leptocheirus plumulosus*

Lot Number: LP-086

Source: Chesapeake Cultures

Adults Isolated (Time, Date): _____

Neonates Pulled (Time, Date): _____

Acclimation: <24hrs Age: >250 µm <500 µm

Culture Water (T/S): 23.6 °C 19.4 ppt

TEST INITIATION

Date	Time	Initials	Activity
11/9/16 ↓	1530 ↓	MJ/BO BO	Sediment Added to Chambers
			Overlying Water Added to Chambers
11/10/16	1409	JB/NM/MS	Organisms Transferred

TEST SET-UP

Sample Number(s): AT6-485, AT6-638 to 642

Overyling Water: 20 ppt Crystal Sea (LD6-511)

Treatment	Volume Test Sediment	Volume Overlying Water
AT6- (Lab Control)	175 ml	725 ml
AT6-638	↓	↓
AT6-639		
AT6-640		
AT6-641		
AT6-642		

TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM RECOVERY RECORD

Project Number: 70005.15 TEST ORGANISM

Client: HGL Common Name: Amphipod

QC Test Number: TN-16-396 Scientific Name: *Leptocheirus plumulosus*

Organisms Recovered (date, time, initials): 12/8/16 0930 MS/JB

Treatment	Replicate	Number of Organisms Loaded	Number of Organisms Recovered	Total Neonates
AT6-486	A	20	16	44
(Lab Control)	B	20	19	37
	C	20	20	16
	D	20	19	16
	E	20	20	19
AT6-638	A	20	18	33
	B	20	18	17
	C	20	15	21
	D	20	~~18~~ 20	31
	E	20	20	23
T6-639	A	20	18	12
	B	20	17	53
	C	20	18	22
	D	20	18	18
	E	20	17	19
AT6-640	A	20	16	28
	B	20	17	10
	C	20	20	30
	D	20	~~16~~ 17 0*	0*
	E	20	19	26
AT6-641	A	20	20	12
	B	20	12	16
	C	20	15	10
	D	20	16	12
	E	20	19	14
AT6-642	A	20	9	18
	B	20	20	13
	C	20	12	16
	D	20	17	15
	E	20	15	30

12/8 JB

WEIGHT DATA (Test Species: *L. plumulosus*)

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Tin Lot: Red 164

Oven Temp (°C): Start: 107°C End: ~~12/12/16~~ 101° 12/12 MS

	Date	Time	Initials
Loaded tins placed in oven:	11/10/16	1424	MM
Loaded tins removed from oven:	12/12/16	1300	BO
Loaded tins weighed:	12/12/16	1500	BO

Oven Number: BLM-01

Balance Number: P0115825

Test Concentration	Rep	Tin #	A Weight of Tin (mg)	B Weight of Tin and Dried Organisms (mg)	B-A Total Dry Organism Weight (mg)	C Number of Organisms Weighed	(B-A)/C Mean Dry Organism Weight (mg)	(if applicable) Mean Biomass (mg/exposed org.)
Initials	A	118	29.81	31.73	1.92	10	0.192	0.192
BO 12/12	B	129	~~27.99~~ 31.16	32.45	1.29	10	0.129	0.129
	C	128	28.24	29.15	0.91	10	0.091	0.091
BO 12/12	D	108	~~30.13~~ 28.67	30.19	1.52	10	0.152	0.152

Dry wt. calculations checked (date, initials): 12/15/16 MM

Biomass calculations checked (date, initials): 12/15/16 MM

WEIGHT DATA (Test Species: *L. plumulosus*)

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Tin Lot: Black 1600

Oven Temp (°C): Start: 104° End: ~~12/12/16 101°~~ 12/12 MS

	Date	Time	Initials
Loaded tins placed in oven:	12/8/16	1037	JB
Loaded tins removed from oven:	12/12/16	1300	BO
Loaded tins weighed:	12/12/16	1500	BO

Oven Number: BLM-01 Balance Number: P0115825

Test Concentration	Rep	Tin #	A Weight of Tin (mg)	B Weight of Tin and Dried Organisms (mg)	B-A Total Dry Organism Weight (mg)	C Number of Organisms Weighed	(B-A)/C Mean Dry Organism Weight (mg)	(if applicable) Mean Biomass (mg/exposed org.)	
AT6-~~485~~	A	40	29.05	58.96	29.91	16	1.86	1.50	
(Lab Control)	B	69	27.63	47.30	19.67	19	1.03	0.98	
	C	66	28.12	55.17	27.05	20	1.35	1.35	
	D	97	29.57	60.83	31.26	19	1.64	1.56	
	E	108	30.13	60.31	30.18	20	~~1.50~~ 1.51	~~1.50~~ 1.51	12/15 MS
AT6-638	A	150	29.11	56.95	27.84	18	~~1.50~~ 1.54	1.39	BO 12/12
	B	137	29.27	52.54	23.27	18	1.29	1.16	
	C	136	27.73	52.53	24.8	15	1.65	1.24	
12/8 MS	D	~~137~~ 143	30.02	69.59	39.57	20	1.97	1.98	
	E	5	28.98	62.90	33.92	20	~~1.69~~ 1.70	1.70	12/15 MS
AT6-639	A	15	29.64	57.95	28.31	18	1.57	1.42	
	B	9	29.56	59.88	30.32	17	1.78	1.52	
	C	~~52~~ 57	~~29.18~~ 29.63	64.15	34.52	18	1.91	1.73	
	D	55	28.41	58.19	29.78	18	1.65	1.49	
	E	~~37~~ 139	27.92	61.70	33.78	17	1.98	1.69	12/15 MS

Dry wt. calculations checked (date, initials): 12/15/16 MS

Biomass calculations checked (date, initials): 12/15/16 MS

WEIGHT DATA (Test Species: *L. plumulosus*)

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Tin Lot: Black/6oC

Oven Temp (°C): Start: 104 End: ~~12/12/16~~ 101° 12/12 MT

	Date	Time	Initials
Loaded tins placed in oven:	12/8/16	0910 37	JB
Loaded tins removed from oven:	12/12/16	1300	BO
Loaded tins weighed:	12/12/16	1500	BO

12/8 JB

Oven Number: BLM-01 Balance Number: P0115825

Test Concentration	Rep	Tin #	A Weight of Tin (mg)	B Weight of Tin and Dried Organisms (mg)	B-A Total Dry Organism Weight (mg)	C Number of Organisms Weighed	(B-A)/C Mean Dry Organism Weight (mg)	(if applicable) Mean Biomass (mg/exposed org.)
AT6-640	A	37	29.43	58.18	28.75	16	1.79	1.44
	B	1	30.01	62.54	32.53	17	1.91	1.63
	C	54	28.17	63.08	34.91	20	1.74	1.75
	D	~~112~~	—	—	—	~~16~~ 0	—	—
	E	13	28.86	60.40	31.54	18	1.75	1.57
AT6-641	A	145	28.18	65.79	37.61	20	1.88	1.88
	B	141	27.41	41.85	14.44	12	1.20	0.72
	C	124	27.72	59.30	31.58	15	2.10	1.58
	D	112 ~~112~~	28.71	58.94	30.23	16	1.88	1.51
	E	125	29.61	62.93	33.32	19	1.75	1.67
AT6-642	A	19	27.32	40.37	13.05	9	1.45	0.65
12/8 MS	B	~~10~~	28.71	73.51	44.8	20	2.24	2.24
	C	42	27.67	39.52	11.85	12	~~2~~ 0.98	0.59
	D	104	29.36	63.79	34.43	17	2.02	~~0~~ 1.72
	E	44	28.07	55.82	27.75	15	1.85	1.39

BO 12/12 12/15 m

12/8 JB

Dry wt. calculations checked (date, initials): 12/15/16 m

12/8 JB

Biomass calculations checked (date, initials): 12/15/16 m

TOXICITY TEST WATER QUALITY DATA SHEET - NEW SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/10/16 Time: 1409

Client: HGL Common Name: Amphipod Ending Date: 12/8/16 Time: 0930

QC Test Number: TN-16-396 Scientific Name: *Leptocheirus plumulosus*

TARGET VALUES: Temp: 25 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 20 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6
AT6-485	Lab Control	24.0							7.0							7.7							18.3						
AT6-638		24.0							7.1							7.6							19.5						
AT6-639		24.0							7.2							7.6							19.4						
AT6-640		24.0							7.3							7.6							19.6						
AT6-641		24.0							7.3							7.6							19.8						
AT6-642		24.0							7.3							7.7							19.2						
Meter Number		678							678							678							678						
Time		1107							1107							1107							1107						
Initials		MJ							MJ							MJ							MJ						

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 | TEST ORGANISM | Beginning Date: 11/10/16 Time: 1409

Client: HGL | Common Name: Amphipod | Ending Date: 12/8/16 Time: 0930

QC Test Number: TN-16-396 | Scientific Name: *Leptocheirus plumulosus*

TARGET VALUES Temp: 25 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 20 ppt Photoperiod: 16 L, 8 D Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
AT6-~~635~~	Lab Control	24.0	24.0	24.5	24.0	24.7	24.0	26.0	7.7	7.3	7.2	7.4	7.4	7.9	8.2	8.4	8.0	7.5	8.1	7.9	7.9	7.2	18.3	18.0	18.9	19.3	18.9	21.0	20.3
AT6-638		24.6	24.0	24.8	24.1	24.8	24.7	26.0	7.7	7.4	7.2	7.4	7.5	7.9	8.1	7.5	7.5	7.6	8.0	7.4	7.3	7.0	19.2	19.0	20.1	20.3	19.0	21.1	20.6
AT6-639		24.6	24.0	24.5	24.3	24.5	24.8	26.0	7.7	7.4	7.3	7.4	7.5	8.0	8.1	7.3	7.4	7.5	7.6	7.3	7.1	6.9	19.6	19.4	20.5	18.9	19.3	21.0	20.3
AT6-640		24.3	24.0	24.2	24.7	24.6	24.5	25.6	7.7	7.5	7.4	7.5	7.6	8.1	8.1	7.4	7.4	7.5	7.5	7.3	7.1	6.9	20.1	20.3	21.6	20.4	19.9	21.9	20.9
AT6-641		24.6	24.0	24.3	24.0	24.5	24.2	25.6	7.8	7.5	7.5	7.5	7.6	8.1	8.1	7.4	7.4	7.5	7.6	7.3	7.0	6.9	20.0	20.2	21.7	21.0	20.6	22.0	21.7
AT6-642		24.4	24.0	24.0	24.0	24.7	24.2	25.5	7.8	7.6	7.5	7.6	7.7	8.1	8.2	7.3	7.5	7.6	7.5	7.4	7.2	7.1	19.3	19.1	20.4	20.4	19.7	21.6	20.7
Meter Number		678	678	678	678	678	679	679	678	678	678	678	678	679	679	678	678	678	678	678	679	679	678	678	678	678	678	679	679
Time		1203	1438	1042	1003	1108	1200	1316	1203	1438	1042	1003	1108	1200	1316	1203	1438	1042	1003	1108	1200	1316	1203	1438	1042	1003	1108	1200	1316
Initials		NM	MJ	JB	NM	MJ	MJ	NM	NM	MJ	JB	NM	MJ	MJ	NM	NM	MJ	JB	NM	MJ	MJ	NM	NM	MJ	JB	NM	MJ	MJ	NM

ATS-T14
06/21/06

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15
Client: HGL
QC Test Number: TN-16-396

TEST ORGANISM
Common Name: Amphipod
Scientific Name: *Leptocheirus plumulosus*

Beginning Date: 11/10/16 Time: 1409
Ending Date: 12/8/16 Time: 0930

TARGET VALUES Temp: 25 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 20 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14
AT6- ~~635~~	Lab Control	25.6	24.3	24.8	24.2	24.2	24.0	25.8	7.7	7.9	7.6	7.3	7.8	7.3	7.9	7.7	8.0	7.5	8.1	7.7	7.7	6.8	20.6	21.0	21.4	21.1	21.6	22.0	21.3
AT6-638		26.0	25.5	25.3	25.4	25.2	24.1	25.7	7.8	7.9	7.6	7.4	7.9	7.3	7.1	7.3	7.9	7.2	7.5	7.1	7.6	7.0	20.5	20.7	21.0	20.5	21.0	21.6	20.8
AT6-639		26.0	25.6	25.0	25.2	25.3	24.6	25.3	7.9	7.9	7.7	7.4	7.9	7.4	7.3	7.1	7.3	7.1	7.2	6.9	7.4	7.1	20.1	20.3	21.0	21.3	21.8	22.0	21.5
AT6-640		26.0	25.4	24.9	24.4	24.0	24.7	24.6	7.9	7.9	7.8	7.4	7.9	7.4	7.5	7.1	7.1	7.2	7.3	7.1	7.3	7.1	20.8	21.0	21.7	21.5	22.0	22.0	22.0
AT6-641		25.7	25.3	24.8	24.9	24.1	24.9	24.6	7.9	7.9	7.8	7.4	7.9	7.5	7.6	7.1	7.1	7.2	7.3	7.1	7.3	7.2	21.6	21.6	22.0	22.0	22.0	22.0	22.0
AT6-642		25.2	25.3	25.2	25.0	24.5	25.1	24.6	8.0	7.9	7.8	7.5	7.9	7.5	7.7	7.2	7.2	6.8	7.3	7.2	7.3	7.2	20.9	21.0	21.6	21.2	21.7	21.9	21.3
Meter Number		678	678	678	678	678	678	679	678	678	678	678	678	678	679	678	678	678	678	678	678	679	678	678	678	678	678	678	679
Time		1244	0941	0953	0910	0917	0917	0934	1244	0941	0953	0910	0917	0917	0934	1244	0945	0953	0910	0917	0917	0934	1244	0941	0953	0910	0917	0917	0934
Initials		NM	MJ	NM	MJ	MJ	NM	JB	NM	MJ	NM	MJ	MJ	NM	JB	NM	MJ	NM	MJ	MJ	NM	JB	NM	MJ	NM	MJ	MJ	NM	JB

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 | TEST ORGANISM | Beginning Date: 11/10/16 Time: 1409
Client: HGL | Common Name: Amphipod | Ending Date: 12/8/16 Time: 0930
QC Test Number: TN-16-396 | Scientific Name: *Leptocheirus plumulosus*

TARGET VALUES Temp: 25 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 20 ppt Photoperiod: 16 L, 8 D Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21
AT6-~~465~~	Lab Control	24.0	24.4	26.0	24.1	24.4	25.0	25.2	6.4	7.3	7.7	7.6	7.5	7.1	7.3	8.0	6.8	7.4	6.9	7.5	7.3	7.2	22.0	21.6	22.0	21.9	22.0	18.9	19.7
AT6-638		25.0	25.5	25.4	25.7	25.4	25.8	25.6	6.6	7.3	7.8	7.6	7.6	7.3	7.4	7.6	5.8	7.2	6.5	6.9	6.9	7.1	21.6	20.9	21.6	21.7	21.3	19.6	20.1
AT6-639		25.2	25.6	24.7	25.7	25.3	25.9	25.7	6.5	7.4	7.8	7.6	7.6	7.3	7.4	7.4	6.6	7.2	5.6	6.7	6.8	6.9	22.0	21.5	22.0	22.0	19.4	22.0	21.7
AT6-640		24.5	24.9	~~24.8~~ 24.7	24.9	25.1	25.9	25.4	6.6	7.8	7.8	7.6	7.7	7.4	7.5	7.4	6.9	7.3	6.4	6.7	6.6	6.8	22.0	21.5	22.0	22.0	22.0	20.1	20.4
AT6-641		24.5	24.9	25.0	24.7	25.1	25.9	25.2	6.7	7.9	7.8	7.7	7.7	7.5	7.5	7.4	7.0	7.2	6.8	6.7	6.6	~~6.7~~ 6.8	21.2	20.9	21.9	22.0	22.0	19.2	19.9
AT6-642		24.6	24.7	24.9	24.4	25.0	25.6	24.8	6.7	7.9	7.8	7.7	7.7	7.5	7.6	7.3	7.0	7.3	6.8	6.7	6.5	6.9	22.0	22.0	22.0	22.0	22.0	20.2	20.8
Meter Number		678	679	678	678	678	678	678	678	679	678	678	678	678	678	678	679	678	678	678	678	678	678	679	678	678	678	678	678
Time		1304	0914	1115	0901	1140	1051	0845	1304	0914	1115	0901	1140	1051	0845	1304	0914	1115	0901	1140	1051	0845	1304	0914	1115	0901	1140	1051	0845
Initials		MS	MJ	MM 1211 MS	NM	MS	MJ	MS	MJ	MJ	MM	NM	MJ	MJ	MJ	MS	MJ	MM	NM	MJ	MJ	MJ 1211 MS	MJ	MJ	MM	NM	MJ	MJ	MJ

ATS-T14
06/21/06

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15
Client: HGL
QC Test Number: TN-16-396

TEST ORGANISM
Common Name: Amphipod
Scientific Name: *Leptocheirus plumulosus*

Beginning Date: 11/10/16 Time: 1409
Ending Date: 12/8/16 Time: 0930

TARGET VALUES Temp: 25 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 20 ppt Photoperiod: 16 h, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28
AT6-485	Lab Control	24.4	24.0	24.4	24.2	24.1	24.2	25.4	7.7	7.1	7.3	7.4	7.7	7.8	8.0	7.7	7.7	7.6	8.0	7.6	7.6	7.7	20.7	21.4	20.4	21.1	21.3	21.6	21.9
AT6-638		24.7	24.3	24.9	24.6	25.1	24.2	25.5	7.7	7.3	7.3	7.6	7.8	7.8	7.7	7.4	7.3	7.1	7.3	7.1	7.2	7.2	20.9	21.5	21.8	22.0	21.9	21.4	22.0
AT6-639		24.5	24.5	24.9	24.6	24.9	24.2	25.0	7.8	7.3	7.4	7.7	7.8	7.8	7.8	7.3	7.3	7.2	7.1	6.9	7.0	7.0	22.0	22.0	21.3	21.7	21.7	21.3	22.0
AT6-640		24.8	24.6	24.4	25.2	24.8	24.9	25.3	7.8	7.4	7.4	7.8	7.9	7.9	7.9	7.3	7.2	7.3	7.1	7.0	7.0	7.2	21.2	21.5	21.8	22.0	22.0	21.9	22.0
AT6-641		25.1	24.6	24.6	24.6	24.6	24.6	25.0	7.8	7.4	7.4	7.9	8.0	8.0	8.0	7.3	7.2	7.3	7.1	7.0	7.0	7.1	20.7	21.3	21.7	22.0	22.0	21.0	22.0
AT6-642		24.7	24.6	24.6	24.3	24.3	24.6	24.7	7.8	7.4	7.5	8.0	8.0	8.0	8.1	7.3	7.2	7.3	7.2	7.0	7.0	7.2	21.9	22.0	20.0	20.8	21.3	21.4	22.0
Meter Number		678	678	678	679	679	677	679	678	678	678	679	679	677	679	678	678	678	679	679	679	679	678	678	678	679	679	677	679
Time		1016	0913	1138	0903	0913	1330	0632	1016	0913	1138	0903	0913	1330	0632	1016	0913	1138	0903	0913	1330	0632	1016	0913	1138	0903	0913	1330	0632
Initials		JB	MJ	JB	MJ	MJ	~	JB	JB	MJ	JB	MJ	MJ	~	JB	JB	MJ	JB	MJ	MJ	~	JB	JB	MJ	JB	MJ	MJ	~	JB

12/8 JB

TOXICOLOGY LABORATORY BENCH SHEET - FEEDING RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Food: Tetramin (0-13 20mg/chamber) (14-28 40mg/chamber)

Day	Date	Time	Initials
0			
(1)	11/11/16	1545	JB
2			
3			
(4)	11/14/16	1115	NM/MJ
5			
(6)	11/16/16	1611	BO
7			
(8)	11/18/16	1414	NM
9			
10			
(11)	11/21/16	1500	BO
12			
(13)	11/23/16	1409	NM
14			
(15)	11/25/16	1309	MJ
16			
17			
(18)	11/28/16	0930	MJ
19			
(20)	11/30/16	1105	MJ
21			
(22)	12/2/16	1045	JB
23			
24			
(25)	12/5/16	1022	MJ
26			
(27)	12/7/16	~~1344~~ 1440	NM
28			

12/7 NM

TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Overlying Water: 20 ppt Crystal Sea Artificial Seawater

TEST ORGANISM

Common Name: Amphipod

Scientific Name: *Leptocheirus plumulosus*

Sample Number	Preparation Time, Date	Initials	Date of First Use	Date of Final Use
LDC-511	11/5/16 1500	JB	11/9/16 1530	11/21/16 1254
LDC 537	11/23/16 1400	MT	11/23/16	12/8/16

TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Day	Date	Time	Initials
0			
1			
2			
3			
(4)	11/14/16	1020	BO
5			
(6)	11/16/16	1610	BO
7			
(8)	11/18/16	1205	NM
9			
10			
(11)	11/21/16	1254	MJ/NM
12			
(13)	11/23/16	0931	MJ/NM
14			
(15)	11/25/16	1308	MJ
16			
17			
(18)	11/28/16	0930	MJ/NM
19			
(20)	11/30/16	1105	MJ
21			
(22)	12/2/16	1040	JB
23			
24			
(25)	12/5/16	0950	NM/MJ
26			
(27)	12/7/16	1430	MLL
28			

TOXICOLOGY LABORATORY BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-396

Date/Time/Initials	Comments/Activity
11/23/16 1401 NC	646 D Spilled over

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5	0.428	2.500	0.2948
AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5	1.055	2.500	0.2948
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4	0.768	2.500	0.3127
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5	1.477	2.500	0.2948
AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5	2.399	2.500	0.2948

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.98108		0.898		0.16629	0.07623
Bartlett's Test indicates equal variances (p = 0.08)	9.99494		15.0863			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Bonferroni t Test indicates no significant differences	0.19815	0.20879	0.04917	0.03478	0.25648	5, 23

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5	0.503	1.860	0.1867
AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5			
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4			
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5			
AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5			

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.88348	0.781	-0.6536	-0.5955
F-Test indicates equal variances (p = 0.73)	1.44637	23.1545		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.1112	0.11717	0.00637	0.02521	0.62868	1, 8

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5			
*AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5	1.861	1.860	0.1243
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4			
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5			
AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.8506		0.781		-1.4226	3.33532
F-Test indicates equal variances (p = 0.03)	11.9095		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates significant differences	0.06792	0.07157	0.03868	0.01117	0.09981	1, 8

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5			
AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5			
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4	0.971	1.895	0.1875
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5			
AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96803		0.764		-0.2248	-0.2273
F-Test indicates equal variances (p = 0.87)	1.13002		24.2591			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.11174	0.11774	0.02049	0.02176	0.36411	1, 7

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5			
AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5			
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4			
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5	1.431	1.860	0.2263
AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.97325		0.781		-0.1127	-0.6887
F-Test indicates equal variances (p = 0.38)	2.59282		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.14139	0.14899	0.07582	0.03702	0.19028	1, 8

Growth and Survival Test-Survival

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	0.9500	1.0000	0.9500	1.0000
AT6-638	0.9000	0.9000	0.7500	1.0000	1.0000
AT6-639	0.9000	0.8500	0.9000	0.9000	0.8500
AT6-640	0.8000	0.8500	1.0000	0.9000	
AT6-641	1.0000	0.6000	0.7500	0.8000	0.9500
AT6-642	0.4500	1.0000	0.6000	0.8500	0.7500

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9400	1.0000	1.3430	1.1071	1.4588	10.689	5			
AT6-638	0.9100	0.9681	1.2926	1.0472	1.4588	13.357	5			
AT6-639	0.8800	0.9362	1.2187	1.1731	1.2490	3.413	5			
AT6-640	0.8875	0.9441	1.2470	1.1071	1.4588	12.238	4			
AT6-641	0.8200	0.8723	1.1689	0.8861	1.4588	19.776	5			
*AT6-642	0.7300	0.7766	1.0601	0.7353	1.4588	26.160	5	2.026	1.860	0.2597

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.94875		0.781		0.23475	0.41539
F-Test indicates equal variances (p = 0.23)	3.73176		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates significant differences	0.16839	0.17744	0.20016	0.04876	0.07732	1, 8

Growth and Survival Test-Growth Rate

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5	S.D.
Control	0.0668	0.0370	0.0483	0.0588	0.0539	0.01121
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606	0.00887
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710	0.0062
AT6-640	0.0642	0.0683	0.0623	0.0626		0.00278
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626	0.01211
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661	0.01776

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5	-0.768	2.500	0.0176
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5	-1.528	2.500	0.0176
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4	-1.531	2.500	0.0186
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5	-1.443	2.500	0.0176
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5	-1.159	2.500	0.0176

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.965		0.898		-0.6441	0.67474
Bartlett's Test indicates equal variances (p = 0.10)	9.34482		15.0863			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Bonferroni t Test indicates no significant differences	0.01758	0.33206	9.1E-05	0.00012	0.60444	5, 23

Growth and Survival Test-Growth

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.0668	0.0370	0.0483	0.0588	0.0539
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710
AT6-640	0.0642	0.0683	0.0623	0.0626	
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5	-0.845	1.860	0.0119
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5			
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4			
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5			
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96321		0.781		-0.2049	-0.4169
F-Test indicates equal variances (p = 0.66)	1.59456		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.01189	0.22455	7.3E-05	0.0001	0.42287	1, 8

Growth and Survival Test-Growth

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.0668	0.0370	0.0483	0.0588	0.0539
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710
AT6-640	0.0642	0.0683	0.0623	0.0626	
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5			
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5	-1.876	1.860	0.0106
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4			
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5			
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.9829		0.781		-0.3017	0.18283
F-Test indicates equal variances (p = 0.28)	3.26726		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.01065	0.20118	0.00029	8.2E-05	0.0975	1, 8

Growth and Survival Test-Growth

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.0668	0.0370	0.0483	0.0588	0.0539
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710
AT6-640	0.0642	0.0683	0.0623	0.0626	
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5			
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5			
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4	-1.965	1.895	0.0110
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5			
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.953		0.764		-0.3862	1.84838
F-Test indicates equal variances (p = 0.04)	16.2855		46.1946			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.01101	0.20799	0.00029	7.5E-05	0.09016	1, 7

Growth and Survival Test-Growth

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.0668	0.0370	0.0483	0.0588	0.0539
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710
AT6-640	0.0642	0.0683	0.0623	0.0626	
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5			
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5			
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4			
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5	-1.375	1.860	0.0137
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.92072		0.781		-0.7862	-0.0366
F-Test indicates equal variances (p = 0.88)	1.16871		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.01372	0.25923	0.00026	0.00014	0.20636	1, 8

Growth and Survival Test-Growth

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	0.0668	0.0370	0.0483	0.0588	0.0539
AT6-638	0.0552	0.0462	0.0590	0.0707	0.0606
AT6-639	0.0562	0.0637	0.0685	0.0591	0.0710
AT6-640	0.0642	0.0683	0.0623	0.0626	
AT6-641	0.0672	0.0430	0.0752	0.0675	0.0626
AT6-642	0.0518	0.0800	0.0353	0.0723	0.0661

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5			
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5			
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	4.315	4			
AT6-641	0.0631	1.1917	0.0631	0.0430	0.0752	19.202	5			
AT6-642	0.0611	1.1540	0.0611	0.0353	0.0800	29.077	5	-0.868	1.860	0.0175

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96742		0.781		-0.5591	-0.3659
F-Test indicates equal variances (p = 0.39)	2.51282		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.01747	0.32993	0.00017	0.00022	0.41067	1, 8

Reviewed by:

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5	0.199	2.500	1.0362
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5	0.080	2.500	1.0362
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4	0.312	2.500	1.0991
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5	1.545	2.500	1.0362
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5	0.204	2.500	1.0362

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91966		0.898		1.0522	1.25244
Bartlett's Test indicates equal variances (p = 0.19)	7.39116		15.0863			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Bonferroni t Test indicates no significant differences	1.03622	0.71076	0.28464	0.42954	0.65535	5, 23

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5	0.198	1.860	0.7730
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5			
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4			
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5			
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91019		0.781		0.95406	0.58005
F-Test indicates equal variances (p = 0.10)	6.24129		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.77305	0.53025	0.01695	0.43205	0.84793	1, 8

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5			
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5	0.057	1.860	1.0791
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4			
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5			
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.80399		0.781		1.27136	0.26982
F-Test indicates equal variances (p = 0.83)	1.2609		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	1.07913	0.7402	0.00273	0.84193	0.95597	1, 8

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5			
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5			
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4	0.280	1.895	0.9299
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5			
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.89939		0.764		0.66126	-0.2189
F-Test indicates equal variances (p = 0.41)	2.90828		46.1946			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.92989	0.63783	0.04185	0.53534	0.78788	1, 7

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5			
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5			
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4			
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5	1.571	1.860	0.7584
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.89588		0.781		1.08055	0.9592
F-Test indicates equal variances (p = 0.06)	8.58029		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.75836	0.52017	1.02568	0.41579	0.15491	1, 8

Reproduction Test-Reproduction

Start Date:	11/10/2016	Test ID:	TN-16-396	Sample ID:	HGL
End Date:	12/8/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Comments:					

Conc-	1	2	3	4	5
Control	2.7500	1.9474	0.8000	0.8421	0.9500
AT6-638	1.8333	0.9444	1.4000	1.5500	1.1500
AT6-639	0.6667	3.1176	1.2222	1.0000	1.1176
AT6-640	1.7500	0.5882	1.5000	1.4444	
AT6-641	0.6000	1.3333	0.6667	0.7500	0.7368
AT6-642	2.0000	0.6500	1.3333	0.8824	2.0000

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	1.4579	1.0000	1.4579	0.8000	2.7500	59.195	5			
AT6-638	1.3756	0.9435	1.3756	0.9444	1.8333	25.113	5			
AT6-639	1.4248	0.9773	1.4248	0.6667	3.1176	68.012	5			
AT6-640	1.3207	0.9059	1.3207	0.5882	1.7500	38.318	4			
AT6-641	0.8174	0.5606	0.8174	0.6000	1.3333	36.045	5			
AT6-642	1.3731	0.9419	1.3731	0.6500	2.0000	45.353	5	0.178	1.860	0.8850

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.87016		0.781		0.63056	-0.9949
F-Test indicates equal variances (p = 0.54)	1.9204		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.88503	0.60706	0.01796	0.5663	0.86308	1, 8

ATTACHMENT III

Neanthes arenaceodenata 20-Day Whole Sediment Test
Data Sheets and Statistical Analyses
(33 pages)

SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-399

TEST ORGANISM INFORMATION

Common Name: Polychaete

Scientific Name: *Neanthes arenaceodentata*

Lot Number: NA-028

Source: ATS

Adults Isolated (Time, Date): _____

Neonates Pulled (Time, Date): _____

Acclimation: 4246 Age: 11/2 Emerge

Culture Water (T/S): 20.2 °C 30.2 ppt

TEST INITIATION

Date	Time	Initials	Activity
11/16/16	1200	BO	Sediment Added to Chambers
	1200		Overlying Water Added to Chambers
11/17/16	1313		Organisms Transferred

TEST SET-UP

Sample Number(s): AT6-485, AT6-638 to 642

Overlying Water: 30 ppt Crystal Sea (LD6-513)

Treatment	Volume Test Sediment	Volume Overlying Water
AT6- (Lab Control)	175 ml	725 ml
AT6-638	↓	↓
AT6-639		
AT6-640		
AT6-641		
AT6-642		

TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM RECOVERY RECORD

oject Number: 70005.15 TEST ORGANISM

Client: HGL Common Name: Polychaete

QC Test Number: TN-16-397 Scientific Name: *Neanthes arenaceodentata*

Organisms Recovered (date, time, initials): 12/7/16 1237 m

Treatment	Replicate	Number of Organisms Loaded	Number of Organisms Recovered
AT6- 485	A	5	4
(Lab Control)	B	5	5
	C	5	5
	D	5	5
	E	5	5
AT6-638	A	5	5
	B	5	5
	C	5	5
	D	5	5
	E	5	5
AT6-639	A	5	5
	B	5	5
	C	5	~~5~~ 4 12/7m
	D	5	5
	E	5	4
AT6-640	A	5	4
	B	5	5
	C	5	5
	D	5	4
	E	5	5
AT6-641	A	5	5
	B	5	4
	C	5	5
	D	5	4
	E	5	5
AT6-642	A	5	5
	B	5	4
	C	5	5
	D	5	5
	E	5	5

ASH-FREE DRY WEIGHT DATA (Test Species: *N. arenaceodentata*)

Project Number: 70005.15 Client: HGL QC Test Number: TN-16-397

	Date	Time	Initials		Date	Time	Initials
Loaded pans in oven:	12/7/16	1330	MM	Loaded pans in furnace:	12/12/16	1100	MM
Loaded pans out oven:	12/12/16	1500	MM	Loaded pans out furnace:	12/12/16	1300	MM
Loaded pans weighed:	12/12/16	1604	JB	Loaded pans weighed:	12/14/16	1300	JB

Oven Temp (°C): 100°C Furnace Temp (°C): 550 °C

Test Concentration	Rep	Pan #	A Weight of Pan (mg)	B Weight of Pan and Oven-Dried Organisms (mg)	C Weight of Pan and Furnace-Dried Organisms (mg)	B-C Total Ash-Free Dry Weight (mg)	D Number of Organisms Weighed	(B-C)/D Mean Ash-Free Dry Organism Weight (mg)
AT6- 485	A	49	3860.96	3921.04	3870.66	50.98	4	12.75
	B	Y	3655.55	3710.83	3666.37	44.46	5	8.89
	C	A	3730.08	3785.04	3739.31	45.73	5	9.15
	D	100	4258.14	4321.68	4271.04	50.64	~~5~~ 4	10.13
	E	116	4478.09	4537.05	4488.49	48.56	5	9.71
AT6-638	A	K	3761.96	3825.18	3777.14	48.04	5	9.61
	B	109	4620.88	4691.59	4636.94	52.65	~~5~~ 4	10.53
	C	121	4374.31	4448.55	4393.96	54.59	5	10.92
	D	108	4280.00	4347.92	4296.06	51.86	~~5~~ 4	10.37
	E	M	3808.93	3882.5	3828.67	53.83	5	10.77
AT6-639	A	I	3659.32	3734.29	3683.05	51.24	5	10.25
	B	Q	3650.15	3728.84	3674.09	54.75	5	10.95
	C	Z	3737.99	3807.30	3756.77	50.53	84	12.63
	D	W	3681.18	3752.98	3698.87	54.11	5	10.82
	E	J	3638.90	3706.59	3654.76	51.83	84	12.96

MM

Dry wt. calculations checked (date, initials): 12/15/16 MM Ash-Free calculations checked (date, initials): 12/15/16 MM

ASH-FREE DRY WEIGHT DATA (Test Species: *N. arenaceodentata*)

Project Number: 70005.15 Client: HGL QC Test Number: TN-16-397

	Date	Time	Initials		Date	Time	Initials
Loaded pans in oven:	12/7/16	1330	[illegible]	Loaded pans in furnace:	12/12/16	1100	[illegible]
Loaded pans out oven:	12/12/16	1500	[illegible]	Loaded pans out furnace:	12/12/16	1300	[illegible]
Loaded pans weighed:	12/12/16	1604	JB	Loaded pans weighed:	12/14/16	1300	JB

Oven Temp (°C): 100°C Furnace Temp (°C): 550 °C

Test Concentration	Rep	Pan #	A Weight of Pan (mg)	B Weight of Pan and Oven-Dried Organisms (mg)	C Weight of Pan and Furnace-Dried Organisms (mg)	B-C Total Ash-Free Dry Weight (mg)	D Number of Organisms Weighed	(B-C)/D Mean Ash-Free Dry Organism Weight (mg)
AT6-640	A	95	4759.01	4842.58	4793.94	48.64	4	12.16
	B	H	3731.72	3803.31	3751.45	51.86	5	10.37
	C	L	3763.52	3832.43	3780.52	51.91	5	10.38
	D	O	4294.53	4353.60	4306.96	46.64	~~5~~ 4	11.66
	E	119	4465.32	4537.15	4483.40	53.75	5	10.75
AT6-641	A	103	3613.24	3677.76	3629.65	48.11	5	9.62
	B	F	3862.11	3925.50	3877.07	48.43	~~5~~ 4	12.11
	C	106	3626.15	3693.72	3642.92	50.80	5	10.16
	D	38	3616.13	3691.92	3640.09	51.83	~~5~~ 4	12.96
	E	41	3598.71	3669.59	3617.12	52.47	5	10.49
AT6-642	A	40	3656.80	3719.03	3670.67	48.36	5	9.67
	B	46	3503.29	3564.25	3515.53	48.72	~~5~~ 4	12.18
	C	39	3534.20	3613.13	3560.03	53.10	~~5~~ 5	10.62
	D	37	3522.81	3602.23	3551.65	51.08	5	10.22
	E	36	3529.36	3604.39	3550.80	53.59	~~5~~ 5	10.72

12/15/16

Dry wt. calculations checked (date, initials): 12/15/16 [illegible] Ash-Free calculations checked (date, initials): 12/15/16 [illegible]

WEIGHT DATA (Test Species: *N. arenaceodenata*)

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-397

Tin Lot: Cruciblus

Oven Temp (°C): Start: 100 End: 110

	Date	Time	Initials
Loaded tins placed in oven:	11/17/16	1337	m
Loaded tins removed from oven:	11/18/16	1400	m
Loaded tins weighed:	11/18/16	1500	m

Oven Number: BLM-01 Balance Number: P0115825

Test Concentration	Rep	Tin #	A Weight of Tin (mg)	B Weight of Tin and Dried Organisms (mg)	B-A Total Dry Organism Weight (mg)	C Number of Organisms Weighed	(B-A)/C Mean Dry Organism Weight (mg)	(if applicable) Mean Biomass (mg/exposed org.)
Initials	A	33	3609.86	3612.01	2.15	5	0.43	0.43
	B	34	3489.83	3492.95	3.12	5	0.62	0.62
	C	42	3608.19	3609.99	1.80	5	0.36	0.36
	D	33	3587.18	3589.96	2.78	5	0.56	0.56

Dry wt. calculations checked (date, initials): 12/15/16 m

Biomass calculations checked (date, initials): 12/15/16 m

TOXICITY TEST WATER QUALITY DATA SHEET - NEW SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/17/16 Time: 1313

Client: HGL Common Name: Polychaete Ending Date: 12/7/16 Time: 1237

QC Test Number: TN-16-397 Scientific Name: *Neanthes arenceodentata*

TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6
AT6-	Lab Control	20.4							7.5							7.4							28.9						
AT6-638		21.0							7.6							7.3							27.7						
AT6-639		21.0							7.7							7.3							28.0						
AT6-640		21.0							7.7							7.3							28.0						
AT6-641		21.0							7.7							7.3							28.3						
AT6-642		21.0							7.8							7.2							28.3						
Meter Number		678							678							678							678						
Time		1252							1252							1252							1252						
Initials		MJ							MJ							MJ							MJ						

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/27/16 Time: 1313

Client: HGL Common Name: Polychaete Ending Date: 12/7/16 Time: 1237

QC Test Number: TN-16-397 Scientific Name: *Neanthes arenceodentata*

TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperiod: 16 L, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
AT6-	Lab Control	21.0	20.3	19.6	19.1	19.8	19.7	19.7	7.6	7.7	7.8	7.1	7.8	7.9	8.1	7.1	7.8	7.9	7.9	6.9	7.6	7.5	29.0	29.6	30.4	29.8	31.0	32.0	31.2
AT6-638		21.0	20.8	20.3	20.0	20.2	20.4	20.1	7.6	7.8	7.9	7.1	7.7	8.0	8.1	7.1	7.9	7.6	7.7	7.2	7.4	7.5	28.0	28.5	28.9	29.3	29.2	29.8	29.7
AT6-639		21.0	20.6	21.0	20.4	20.3	20.7	20.2	7.7	7.8	7.9	7.1	7.7	8.1	8.1	7.1	8.3	7.5	7.6	7.4	7.4	7.5	28.1	28.2	28.3	27.6	28.3	28.5	28.5
AT6-640		21.0	21.0	21.0	20.6	20.7	19.7	20.7	7.7	7.8	8.0	7.2	7.7	8.2	8.1	7.0	7.9	7.4	7.4	7.4	7.6	7.3	28.1	28.2	28.4	27.9	28.8	29.3	29.0
AT6-641		21.0	21.0	21.0	20.6	20.6	20.7	20.7	7.6	7.9	8.0	7.2	7.7	8.2	8.1	7.0	7.8	7.3	7.4	7.5	7.6	7.4	28.1	28.4	28.7	27.9	28.8	29.2	29.1
AT6-642		21.0	21.0	21.0	21.0	20.7	20.7	20.8	7.7	7.9	8.0	7.3	7.7	8.3	8.1	7.1	7.7	7.3	7.4	7.4	7.6	7.3	23.9	29.2	28.3	29.0	30.3	31.3	28.5
Meter Number		676	678	678	678	678	679	679	676	678	678	678	678	679	679	676	678	678	678	678	679	679	676	678	678	678	678	679	679
Time		0943	0937	1016	0905 1555	0850	1000	0945	0943	0937	1016	0905	0850	1000	0945	0943	0937	1016	0905	0850	1000	0945	0943	0937	1016	0905	0850	1000	0945
Initials			MJ	NM	MJ	MJ	JB	JB		MJ	NM	MJ	MJ	JB	JB		MJ	NM	MJ	MJ	JB	JB		MJ	NM	MJ	MJ	JB	JB

11/30 NM

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/17/16 Time: 1313

Client: HGL Common Name: Polychaete Ending Date: 12/7/16 Time: 1232

QC Test Number: TN-16-397 Scientific Name: *Neanthes arenceodentata*

TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperiod: 16 & 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14
AT6-635	Lab Control	19.5	19.4	19.4	19.6	20.2	20.8	20.4	6.9	7.8	7.7	7.0	7.9	7.4	6.9	8.2	7.8	7.9	7.0	7.6	7.0	7.3	32.8	32.8	32.9	33.0	33.0	32.8	33.0
AT6-638		20.0	19.9	19.9	19.7	20.7	20.9	20.6	7.0	7.9	7.7	7.3	7.7	7.5	7.0	8.0	7.4	7.7	7.2	7.4	7.2	7.3	30.9	30.7	31.4	32.0	32.1	31.8	32.3
AT6-639		20.1	20.0	20.2	20.2	21.0	21.0	21.0	7.0	8.0	7.7	7.4	7.7	7.6	7.1	8.0	7.5	7.6	7.4	7.3	7.2	7.3	29.3	28.9	30.7	30.7	30.4	30.6	30.5
AT6-640		20.4	20.4	20.6	20.6	21.0	21.0	21.0	7.1	8.0	7.8	7.4	7.7	7.6	7.1	7.7	7.3	7.5	7.4	7.3	7.2	7.3	30.0	29.6	30.6	30.8	30.6	30.6	30.7
AT6-641		20.5	20.5	20.8	20.9	21.0	21.0	21.0	7.1	8.0	7.8	7.5	7.7	7.6	7.2	7.7	7.3	7.4	7.3	7.3	7.2	7.2	30.0	29.6	30.8	30.6	30.4	30.5	30.4
AT6-642		20.5	20.4	20.2	20.2	21.0	21.0	21.0	7.2	8.0	7.8	7.5	7.7	7.6	7.2	7.6	7.2	7.5	7.5	7.2	7.1	7.1	31.6	31.3	31.7	32.2	32.4	31.9	32.1
Meter Number		678	679	628	628	678	678	678	678	679	628	679	678	678	678	678	679	628	628	678	678	678	678	679	628	628	678	678	678
Time		1321	0920	1108	0843	1133	1115	0835	1321	0920	1108	0843	1133	1115	0835	1321	0920	1108	0843	1133	1115	0835	1321	0920	1108	0843	1133	1115	0835
Initials		MJ	MJ	MM	MM	MJ	MJ	MJ	MJ	MJ	MM	MM	MJ	MJ	MJ	MJ	MJ	MM	MM	MJ	MJ	MJ	MJ	MJ	MM	MM	MJ	MJ	MJ	MJ

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/27/16 Time: 1313

Client: HGL Common Name: Polychaete Ending Date: 12/7/16 Time: 1237

QC Test Number: TN-16-397 Scientific Name: *Neanthes arenceodentata*

TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21
AT6-635	Lab Control	19.7	19.0	19.0	19.0	19.0	19.0		7.5	7.7	7.3	7.5	7.8	7.9		7.8	7.8	7.9	7.0	7.0	7.7		33.0	33.0	29.2	29.9	29.9	33.0	
AT6-638		19.7	19.1	19.0	19.0	19.0	19.0		7.5	7.9	7.2	7.7	7.9	7.8		7.7	7.6	7.8	7.4	7.9	7.8		33.0	33.0	29.8	30.3	30.0	31.3	
AT6-639		20.1	19.1	19.0	19.3	19.0	19.0		7.5	8.0	7.2	7.8	8.0	8.0		7.8	7.5	7.7	7.4	8.0	7.6		31.3	32.3	32.3	32.2	30.5	31.2	
AT6-640		20.5	19.1	19.0	19.5	19.3	19.0		7.6	8.1	7.2	7.9	8.1	8.1		7.5	7.4	7.6	7.3	7.9	7.5		31.4	32.4	32.4	32.5	30	31.6	
AT6-641		20.4	19.2	19.2	19.6	19.3	19.1		7.6	8.1	7.2	8.0	8.0	8.1		7.5	7.5	7.5	7.2	7.4	7.4		31.2	32.2	32.1	32.3	30.6	31.2	
AT6-642		20.8	19.3	19.0	19.2	19.3	19.0		7.6	8.1	7.3	8.1	8.0	8.1		6.9	7.4	7.6	7.2	7.1	7.4		33.0	33.0	29.1	29.7	29.6	30.5	
Meter Number		678	679	678	679	679	679		678	679	678	679	679	679		678	679	678	679	679	679		678	679	678	679	679	679	
Time		0956	0904	1058	1030	0918	0906		0956	0904	1058	1030	0918	0906		0956	0904	1058	1030	0918	0906		0956	0904	1058	1030	0918	0906	
Initials		JB	MJ	NM	NM	MJ	NM		JB	MJ	NM	NM	MJ	NM		JB	MJ	NM	NM	MJ	NM		JB	MJ	NM	NM	MJ	NM	

TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-397

Overlying Water: 30 ppt Crystal Sea Artificial Seawater

TEST ORGANISM

Common Name: Polychaete

Scientific Name: *Neanthes arenceodenata*

Sample Number	Preparation Time, Date	Initials	Date of First Use	Date of Final Use
LDC-531	11/14/16 1300	NM	11/20/16	11/23/16
LDC-540	11/23/16 1300	NM	11/28/16	11/28/16
LDC-544	11/28/16 1038	MT	11/28/16	12/2/16

ATS-T30
03/01/00

TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-397

Day	Date	Time	Initials
0			
1			
2			
(3)	11/20/16	1409	NM
4			
5			
(6)	11/23/16	1015	JB
7			
8			
(9)	11/28/16	1119	MT
10			
11			
(12)	11/29/16	1254	MT
13			
14			
(15)	12/2/16	1000	JB
16			
17			
(18)	12/5/16	1050	BO
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			

TOXICOLOGY LABORATORY BENCH SHEET - FEEDING RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-397

Food: Tetramin (40 mg/chamber)

Day	Date	Time	Initials
0			
1			
(2)	11/19/16	1100	MJ
3			
(4)	11/21/16	1530	MJ
5			
(6)	11/23/16	1414	NM
7			
(8)	11/25/16	1222	MJ
9			
(10)	11/27/16	1115	JB
11			
(12)	11/29/16	1210	MJ/NM/JB
13			
(14)	12/1/16	1300	NM
15			
(16)	12/3/16	1325	BO
17			
(18)	12/5/16	1055	BO
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			

TOXICOLOGY LABORATORY BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-397

Date/Time/Initials	Comments/Activity

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	30.00	16.00
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	16.00
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	16.00
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	16.00
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5	27.50	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p <= 0.01$)	0.79376	0.9	-0.8175	-0.9097
Equality of variance cannot be confirmed				
Hypothesis Test (1-tail, 0.05)				
Steel's Many-One Rank Test indicates no significant differences				

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	30.00	19.00
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.62485	0.781	-2.5156	7.15179
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5		
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	19.00
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.75876	0.781	-0.9546	-1.0157
F-Test indicates equal variances (p = 0.70)	1.5	23.1545		

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5		
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	19.00
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.75876	0.781	-0.9546	-1.0157
F-Test indicates equal variances (p = 0.70)	1.5	23.1545		

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5		
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	25.00	19.00
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.75876	0.781	-0.9546	-1.0157
F-Test indicates equal variances (p = 0.70)	1.5	23.1545		
Hypothesis Test (1-tail, 0.05)				
Wilcoxon Two-Sample Test indicates no significant differences				

Growth and Survival Test-Survival

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
Control	0.8000	1.0000	1.0000	1.0000	1.0000
AT6-638	1.0000	1.0000	1.0000	1.0000	1.0000
AT6-639	1.0000	1.0000	0.8000	1.0000	0.8000
AT6-640	0.8000	1.0000	1.0000	0.8000	1.0000
AT6-641	1.0000	0.8000	1.0000	0.8000	1.0000
AT6-642	1.0000	0.8000	1.0000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
AT6-638	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5		
AT6-639	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-640	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-641	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		
AT6-642	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5	27.50	19.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.50963	0.781	-1.7788	1.40625
F-Test indicates equal variances (p = 1.00)	1	23.1545		

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5	-0.441	2.360	0.0838
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5	-1.967	2.360	0.0838
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5	-1.324	2.360	0.0838
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5	-1.329	2.360	0.0838
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5	-0.784	2.360	0.0838

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.9352	0.9	0.81087	0.0472
Bartlett's Test indicates equal variances (p = 0.40)	5.11293	15.0863		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates no significant differences	0.08381	0.16556	0.00316	0.00315	0.43795	5, 24

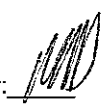
Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5	-0.431	1.860	0.0675
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5			
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5			
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5			
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.85468		0.781		1.60689	3.74839
F-Test indicates equal variances (p = 0.05)	9.15982		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.06754	0.13341	0.00061	0.0033	0.67791	1, 8

Reviewed by: 

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5			
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5	-1.600	1.860	0.0812
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5			
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5			
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.87507		0.781		1.06078	0.1585
F-Test indicates equal variances (p = 0.64)	1.65914		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.08118	0.16037	0.0122	0.00476	0.14817	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5			
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5			
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5	-1.208	1.860	0.0724
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5			
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.87598		0.781		1.4193	1.97758
F-Test indicates equal variances (p = 0.24)	3.66051		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.07236	0.14293	0.00552	0.00379	0.26149	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5			
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5			
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5			
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5	-1.011	1.860	0.0867
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.87874		0.781		0.9817	-0.2869
F-Test indicates equal variances (p = 0.86)	1.20493		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.08675	0.17136	0.00556	0.00544	0.34145	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	AFDW				

Conc-	1	2	3	4	5
Control	0.6373	0.4446	0.4573	0.5064	0.4856
AT6-638	0.4804	0.5262	0.5459	0.5186	0.5383
AT6-639	0.5124	0.5475	0.6316	0.5411	0.6479
AT6-640	0.6080	0.5186	0.5191	0.5830	0.5375
AT6-641	0.4811	0.6054	0.5080	0.6479	0.5247
AT6-642	0.4836	0.6090	0.5310	0.5108	0.5359

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.5062	1.0000	0.5062	0.4446	0.6373	15.232	5			
AT6-638	0.5219	1.0309	0.5219	0.4804	0.5459	4.882	5			
AT6-639	0.5761	1.1380	0.5761	0.5124	0.6479	10.391	5			
AT6-640	0.5532	1.0929	0.5532	0.5186	0.6080	7.285	5			
AT6-641	0.5534	1.0932	0.5534	0.4811	0.6479	12.694	5			
AT6-642	0.5341	1.0550	0.5341	0.4836	0.6090	8.741	5	-0.690	1.860	0.0750

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.85063		0.781		1.38815	1.57443
F-Test indicates equal variances (p = 0.35)	2.72881		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.07496	0.14808	0.00194	0.00406	0.50949	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5		
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5	34.00	16.00
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5	38.00	16.00
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5	36.00	16.00
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5	37.00	16.00
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5	37.00	16.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.89404	0.9	1.31126	2.09918
Bartlett's Test indicates equal variances (p = 0.23)	6.93738	15.0863		

Hypothesis Test (1-tail, 0.05)

Steel's Many-One Rank Test indicates no significant differences

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5			
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5	-1.886	1.860	0.0810
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5			
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5			
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5			
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.89703		0.781		1.04084	1.35432
F-Test indicates equal variances (p = 0.24)	3.65355		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.08098	0.1312	0.01687	0.00474	0.09598	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5			
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5			
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5	-3.694	1.860	0.0887
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5			
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5			
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91541		0.781		0.8703	0.00919
F-Test indicates equal variances (p = 0.55)	1.89144		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.08871	0.14374	0.07765	0.00569	0.00609	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5		
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5		
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5		
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5	36.00	19.00
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5		
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.74429	0.781	1.77448	2.49762
F-Test indicates equal variances (p = 0.32)	2.95306	23.1545		

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5			
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5			
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5			
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5			
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5	-2.053	1.860	0.1238
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.87915		0.781		1.09086	0.20961
F-Test indicates equal variances (p = 0.53)	1.97737		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.12381	0.2006	0.04672	0.01108	0.07412	1, 8

Growth and Survival Test-Growth

Start Date:	11/17/2016	Test ID:	TN-16-399	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAM 87-EPA Marine	Test Species:	NA-Neanthes arenaceodentata
Comments:	MDW				

Conc-	1	2	3	4	5
Control	0.7585	0.5528	0.5496	0.6354	0.5896
AT6-638	0.6322	0.7071	0.7424	0.6792	0.7357
AT6-639	0.7497	0.7869	0.8664	0.7180	0.8461
AT6-640	1.0446	0.7159	0.6891	0.7384	0.7183
AT6-641	0.6452	0.7924	0.6757	0.9474	0.7088
AT6-642	0.6223	0.7620	0.7893	0.7592	0.7503

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.6172	1.0000	0.6172	0.5496	0.7585	13.979	5			
AT6-638	0.6993	1.1331	0.6993	0.6322	0.7424	6.455	5			
AT6-639	0.7934	1.2856	0.7934	0.7180	0.8664	7.907	5			
AT6-640	0.7813	1.2659	0.7813	0.6891	1.0446	18.978	5			
AT6-641	0.7539	1.2215	0.7539	0.6452	0.9474	16.093	5			
AT6-642	0.7366	1.1935	0.7366	0.6223	0.7893	8.898	5	-2.465	1.860	0.0901

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95549		0.781		0.33698	0.60505
F-Test indicates equal variances (p = 0.61)	1.73262		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.09011	0.146	0.03566	0.00587	0.03902	1, 8

ATTACHMENT IV

Nereis virens 28-Day Bioaccumulation Test
Data Sheets and Statistical Analyses
(19 pages)

SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

TEST ORGANISM INFORMATION

Common Name: Sand worm

Scientific Name: *Neries virens*

Lot Number: NV-057

Source: ARO

Adults Isolated (Time, Date): _____

Neonates Pulled (Time, Date): _____

Acclimation: 1 day Age: Adult

Culture Water (T/S): ~ °C ~ ppt

TEST INITIATION

Date	Time	Initials	Activity
11/7/16	1500	MJBO	Sediment Added to Chambers
↓	↓	NM	Overlying Water Added to Chambers
11/9/16	1330	MJBO	Organisms Transferred

TEST SET-UP

Sample Number(s): AT6-681, AT6-638 TO 642

Overlying Water: 30 ppt Crystal Sea (LD6-504)

Treatment	Volume Test Sediment	Volume Overlying Water
AT6- (Lab Control)	5L	22L
AT6-638	↓	↓
AT6-639		
AT6-640		
AT6-641		
AT6-642		

TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM LOADING RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

TEST ORGANISM

Common Name: Sand worm

Scientific Name: *Neries virens*

Lot Number: NV-057 Source: ARO

Acclimation: <24 hour Age: Adult

Organisms Transferred (date, time, initials): 11/9/11 MJ/BO

Treatment	Replicate	Number of Organisms Loaded
AT6- 687	A	
(Control)	B	
	C	
AT6-638	A	
	B	
	C	
	D	
	E	
AT6-639	A	
	B	
	C	
	D	
	E	
AT6-640	A	
	B	
	C	
	D	
	E	
AT6-641	A	
	B	
	C	
	D	
	E	

TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM LOADING RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

TEST ORGANISM

Common Name: Sand worm

Scientific Name: *Neries virens*

Lot Number: NV-057 Source: ARO

Acclimation: <24 hour Age: Adult

Organisms Transferred (date, time, initials): 12/9/16 1330 MJ/BO

Treatment	Replicate	Number of Organisms Loaded
AT6-642	A	25
	B	25
	C	25
	D	25
	E	25

ATS-T30
03/01/00

TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM RECOVERY RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

TEST ORGANISM

Common Name: Sand worm

Scientific Name: *Neries virens*

Organisms Recovered (date, time, initials): 12/7/16 1500 MK/WM

Treatment	Replicate	Number of Organisms Loaded	Number of Organisms Recovered
AT6- 687	A	25	24
(Lab Control)	B	25	23
	C	25	25
	D	25	23
	E	25	25
AT6-638	A	25	22
	B	25	24
	C	25	25
	D	25	~~24~~ 23 12/7 MK
	E	25	24
AT6-639	A	25	23
	B	25	24
	C	25	21
	D	25	24
	E	25	25
AT6-640	A	25	25
	B	25	22
	C	25	24
	D	25	23
	E	25	24
AT6-641	A	25	~~25~~
	B	25	22
	C	25	22
	D	25	~~23~~ 25 WM 12/7/16
	E	25	25
AT6-642	A	25	25
	B	25	25
	C	25	24
	D	25	25
	E	25	24

TOXICITY TEST WATER QUALITY DATA SHEET - NEW SOLUTIONS

Project Number: 70005.15 TEST ORGANISM Beginning Date: 11/9/16 Time: 1330

Client: HGL Common Name: Sand worm Ending Date: 12/7/16 Time: 1500

QC Test Number: TN-16-395 Scientific Name: *Neries virens*

TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6
AT6-637	Lab Control	19.0							8.0							7.3							29.3						
AT6-638		19.0							8.1							7.4							29.0						
AT6-639		19.0							8.2							7.4							28.5						
AT6-640		19.0							8.2							7.4							28.8						
AT6-641		19.0							8.1							7.3							28.6						
AT6-642		19.0							8.2							7.4							29.1						
Meter Number		619							619							619							619						
Time		0958							0958							0958							0958						
Initials		MJ							MJ							MJ							MJ						

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15
Client: HGL
QC Test Number: TN-16-395

TEST ORGANISM
Common Name: Sand worm
Scientific Name: *Neries virens*

Beginning Date: 11/9/16 Time: 1330
Ending Date: 12/7/16 Time: 1500

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 30 ppt Photoperiod: 16 & 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
AT6-~~637~~ 637	Lab Control		19.0			19.0	19.0			7.9			7.6	7.9			6.8			7.0	6.9			28.9			30.4	28.3	
AT6-638			19.0			19.0	19.0			8.0			7.6	7.9			7.0			7.1	6.8			28.2			29.6	28.4	
AT6-639			19.0			19.0	19.0			8.0			7.6	7.9			6.9			7.2	6.8			28.5			29.3	28.2	
AT6-640			19.0			19.0	19.0			8.0			7.6	8.0			6.9			7.3	7.0			26.7			28.5	28.0	
AT6-641			19.0			19.0	19.0			8.1			7.6	8.0			7.5			7.5	7.0			28.5			29.3	28.0	
AT6-642			19.0			19.0	19.1			8.1			7.6	7.9			7.4			7.6	6.7 7.9			28.0			28.9	28.0	
Meter Number			679			678	679			676		676		679			679			678	679			679			678	679	
Time			1108			0844	0922			1108		0844		0922			1108			0844	0922			1108			0844	0922	
Initials			NM			NM	JB			NM		NM		JB			NM			NM	JB 11/16 JB			NM			NM	JB	

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 | TEST ORGANISM | Beginning Date: 11/9/16 Time: 1330

Client: HGL | Common Name: Sand worm | Ending Date: 12/7/16 Time: 1530

QC Test Number: TN-16-395 | Scientific Name: *Neries virens*

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 30 ppt Photoperiod: 16 h, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14	8	9	10	11	12	13	14
AT6-637	Lab Control		19.0	20		20.3		19.7		7.9			7.6		7.8		7.0			5.7		6.6		29.1			30.3		31.9
AT6-638			19.0			19.7		19.6		7.9			7.8		7.9		7.1			6.7		6.7		29.3			30.5		31.6
AT6-639			19.0			19.6		19.6		7.9			7.8		8.0		7.2			6.7		7.1		28.9			30.2		31.4
AT6-640			19.0			19.6		19.7		7.9			7.8		8.0		7.0			6.7		6.8		29.9			30.0		31.2
AT6-641			19.0			19.1		19.7		8.0			7.9		7.9		6.9			7.0		6.6		29.2			30.5		31.6
AT6-642			19.0			19.0		19.7		7.9			7.9		7.9		7.1			7.2		5.9		29.1			30.3		31.4
Meter Number			678			629		678		678			678		678		679			679		678		678			679		678
Time			0731			0901		0949		0731			0901		0949		0731			0901		0949		0731			0901		0949
Initials			NM			NM		NM		NM			NM		NM		NM			NM		NM		NM			NM		NM

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15
Client: HGL
QC Test Number: TN-16-395

TEST ORGANISM
Common Name: Sand worm
Scientific Name: *Neries virens*

Beginning Date: 11/9/16 Time: 1330
Ending Date: 12/7/16 Time: 1500

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 30 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21	15	16	17	18	19	20	21
AT6-~~687~~	Lab Control			19.9		19.7		20.6			7.9		7.5	~~7.4~~	7.4			6.3		6.4	~~7.1~~	7.1			30.3		31.9	~~30.4~~	30.4	BO 11/30
AT6-638				19.9		19.6		20.7			7.9		7.5	~~7.6~~	7.6			6.5		6.7	~~7.1~~	7.1			30.5		31.5	~~30.4~~	30.4	BO
AT6-639				19.9		19.6		20.7			7.9		7.5	~~7.7~~	7.7			6.7		6.8	~~7.1~~	7.1			30.7		31.5	~~3~~	30.6	11/30
AT6-640				19.9		19.7		20.7			8.0		7.6		7.8			6.9		6.9		7.1			30.5		31.1		30.6	BO 11/30
AT6-641				19.9		19.7		20.7			8.0		7.6		7.8			6.9		6.8		6.8			30.4		31.3		30.5	
AT6-642				19.9		19.7		20.7			7.9		7.6		7.8			6.7		6.5		6.7			30.3		31.1		30.4	
11/29 BAS	Meter Number	~~679~~		679		678		679	~~679~~		679		678		679	679		679		678		679	~~679~~		679		678		679
	Time			0931		0851		1325			0931		0851		1325			0931		0851		1325			0931		0851		1325
	Initials			MJ		NM		BO			MJ		~~NM~~ 11/28 NM		BO			MJ		~~NM~~ NM 11/28		BO			MJ		NM		BO

TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15 | TEST ORGANISM | Beginning Date: 11/9/16 Time: 1330

Client: HGL | Common Name: Sand worm | Ending Date: 12/7/16 Time: 1500

QC Test Number: TN-16-395 | Scientific Name: *Neries virens*

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 30 ppt Photoperiod: 16 ℓ, 8 d Light Intensity: 50 - 100 fc

Sample #		Temperature (°C)							pH							Dissolved Oxygen (mg/L)							Salinity (ppt)						
		22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28	22	23	24	25	26	27	28
AT6- 637	Lab Control		20.2			19.0		19.0		7.4			7.9		7.7	7.7	7.7			7.4		7.4		31.9			32.5		31.7
AT6-638			19.7			19.0		19.0		7.4			7.9		7.8		7.4			7.2		6.4		31.9			32.2		31.3
AT6-639			19.6			19.0		19.0		7.4			7.9		7.7		7.3			6.8		6.6		31.9			32.5		31.5
AT6-640			19.9			19.0		19.0		7.4			7.9		7.8		7.0			6.8		6.7		31.7			32.3		31.4
AT6-641			19.9			19.0		19.0		7.4			7.9		7.9		6.7			6.9		7.1		31.8			32.7		31.6
AT6-642			19.8			19.0		19.0		7.4			7.9		7.9		6.7			6.7		7.2		31.7			32.7		31.5
Meter Number			678			679		679		678			679		679		678			679		679		678			679		679
Time			0911			1032		0847		0911			1032		0847		0911			1032		0847		0911			1032		0847
Initials			NM			NM		NM		NM			NM		NM		NM			NM		NM		NM			NM		NM

NM 12/12 NM 12/15

TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

Overlying Water: 30 ppt Crystal Sea Artificial Seawater

TEST ORGANISM

Common Name: Sand worm

Scientific Name: *Neries virens*

Sample Number	Preparation Time, Date	Initials	Date of First Use	Date of Final Use
LD6-504	11/4/16 1500	NM	11/7/16	11/8/16
LD6-510	11/5/16 1100	JB	11/11/16	11/14/16
LD6-513	11/8/16 1425	MJ	11/15/16	11/18/16
LD6-531	11/14/16 1300	NM	11/21/16	11/23/16
LD6-540	11/23/16 1300	NM ~~NAAT~~	11/26/16	11/28/16
LD6-544	11/28/16 1038	MJ	11/30/16	12/2/16

11/26 MS

TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

Day	Overlying Water	Date	Time	Initials
0				
1				
(2)	LD6-510	11/11/16	1315	NM/JB
3				
4				
(5)	LD6-510	11/14/16	0919	MJ/NM
6	LD6-513	11/15/16	1030	JB
(7)				
8				
(9)	LD6-513	11/18/16	0750	[illegible]
10				
11				
(12)	LD6-531	11/21/16	1343	MJ/NM
13				
(14)	~~LD6-~~ LD6-531	11/23/16	1038	MJ/NM
15				
(16)				
17	LD6-540	11/26/16	1105	MJ
18				
(19)	LD6-540	11/28/16	1010	MJ/NM
20				
(21)	LD6-544	11/30/16	1419	BO/MJ
22				
(23)	LD6-544	12/2/16	1011	NM
24				
25				
(26)	LD6-553	12/5/16	1120	NM/MJ
27				
28				

11/21 MJ

TOXICOLOGY LABORATORY BENCH SHEET

Project Number: 70005.15

Client: HGL

QC Test Number: TN-16-395

Date/Time/Initials	Comments/Activity

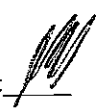
28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5	0.518	2.360	0.1531
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5	0.697	2.360	0.1531
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5	0.518	2.360	0.1531
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5	0.101	2.360	0.1531
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5	-0.839	2.360	0.1531

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93114		0.9		-0.2836	-1.0753
Bartlett's Test indicates equal variances (p = 0.70)	2.97954		15.0863			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test indicates no significant differences	0.07882	0.0819	0.00661	0.01052	0.6798	5, 24

Reviewed by: 

28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5	0.561	1.860	0.1115
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5			
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5			
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93081		0.781		0.03417	-1.4882
F-Test indicates equal variances (p = 0.96)	1.06185		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.05349	0.05558	0.00283	0.00899	0.59014	1, 8

Reviewed by:

28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5	0.677	1.860	0.1241
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5			
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95986		0.781		-0.296	-0.8618
F-Test indicates equal variances (p = 0.68)	1.55293		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.06085	0.06323	0.00511	0.01113	0.51726	1, 8

28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5			
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5	0.561	1.860	0.1115
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5			
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.93081		0.781		0.03417	-1.4882
F-Test indicates equal variances (p = 0.96)	1.06185		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.05349	0.05558	0.00283	0.00899	0.59014	1, 8

28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5			
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5	0.088	1.860	0.1392
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5			

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.78849		0.781		-0.3749	-1.9547
F-Test indicates equal variances (p = 0.46)	2.21308		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.07004	0.07277	0.00011	0.014	0.93235	1, 8

Reviewed by:

28-Day Survival Test-Survival

Start Date:	11/9/2016	Test ID:	TN-16-395	Sample ID:	HGL
End Date:	12/7/2016	Lab ID:		Sample Type:	Sediment
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NV-Nereis virens
Comments:					

Conc-	1	2	3	4	5
Control	0.9600	0.9200	1.0000	0.9200	1.0000
AT6-638	0.8800	0.9600	1.0000	0.9200	0.9600
AT6-639	0.9200	0.9600	0.8400	0.9600	1.0000
AT6-640	1.0000	0.8800	0.9600	0.9200	0.9600
AT6-641	1.0000	0.8800	0.8800	1.0000	1.0000
AT6-642	1.0000	1.0000	0.9600	1.0000	0.9600

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
Control	0.9600	1.0000	1.3758	1.2840	1.4706	6.786	5			
AT6-638	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-639	0.9360	0.9750	1.3306	1.1593	1.4706	8.744	5			
AT6-640	0.9440	0.9833	1.3421	1.2171	1.4706	7.168	5			
AT6-641	0.9520	0.9917	1.3692	1.2171	1.4706	10.144	5			
AT6-642	0.9840	1.0250	1.4302	1.3694	1.4706	3.875	5	-1.120	1.860	0.0903

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.88611		0.781		-0.0308	-1.6456
F-Test indicates equal variances (p = 0.34)	2.83749		23.1545			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Homoscedastic t Test indicates no significant differences	0.04167	0.04329	0.0074	0.00589	0.29508	1, 8

ATTACHMENT V

Report Quality Assurance Record
(2 pages)

REPORT QUALITY ASSURANCE RECORD

Client: HGL Project Number: 70005.15

Author: Michael Chaney EA Report Number: 7953

REPORT CHECKLIST

QA/QC ITEM	REVIEWER	DATE
1. Samples collected, transported, and received according to study plan requirements.		12/16/16
2. Samples prepared and processed according to study plan requirements.		12/16/16
3. Data collected using calibrated instruments and equipment.		12/16/16
4. Calculations checked:		
- Hand calculations checked		12/16/16
- Documented and verified statistical procedure used.		12/16/16
5. Data input/statistical analyses complete and correct.		12/28/16
6. Reported results and facts checked against original sources.		12/28/16
7. Data presented in figures and tables correct and in agreement with text.		12/28/16
8. Results reviewed for compliance with study plan requirements.		12/16/16

	AUTHOR	DATE
9. Commentary reviewed and resolved.		12/20/16

10. All study plan and quality assurance/control requirements have been met and the report is approved:

	12/29/16
PROJECT MANAGER	DATE
	12/28/16
QUALITY CONTROL OFFICER	DATE
	12/28/16
SENIOR TECHNICAL REVIEWER	DATE