APPENDIX F

Supplemental Investigation Reports

Appendix F.1

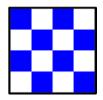
Peck Property Warehouse, Maintenance and Sheer Building Structural Condition Assessment Portsmouth, Va



PECK PROPERTY

Warehouse, Maintenance and Shear Building Structural Condition Assessment Portsmouth, VA

Prepared by:



NAVIGATOR CS, LLC

1523 Kinnaird Ter NE Leesburg, VA 20176 (Tel) 571-309-7995

www.navigatorcs.com

For

HydroGeoLogic, Inc.

11107 Sunset Hills Road Suite 400 Reston, VA 20190



INTRODUCTION/SUMMARY

The three buildings investigated at the Peck Site, vary in condition. All three can be entered to a limited or greater degree to conduct sampling. Specifically, the Warehouse Building has portions that are in reasonably good condition structurally and offer full access. Other areas are nearly completely collapsed with the remaining structure in danger of imminent collapse and should be avoided. Some other areas can be accessed with reasonable precaution with about 50% of the area off-limits due to collapse or impending collapse. The Shear Building is in reasonably good condition structurally and is fully accessible for survey. The Maintenance building exterior walls are in very bad condition but would not preclude cautious entry for very short periods for sampling. One area in the Maintenance Building is suffering roof collapse and is off-limits.

Any personnel conduction sampling should at minimum wear a hard hat, safety glasses, and work boots in additional to normal protective clothing required for the sampling. Any sampling should also be conducted by a two person team, with one person sampling while the second provides safety oversight. The safety oversight person should remain a minimum of 20' from the Sampler to independently listen and look for any signs of structural failure in the sampling area. Both personnel should have capability of calling for emergency response if necessary. No time should be spend in any of the buildings other than as necessary to conduct the sampling.

SCOPE OF INVESTIGATION

Navigator CS, LLC was hired by HydroGeoLogic, Inc. to perform a structural evaluation of three buildings on the Peck Site located in Portsmouth, Virginia. The scope of the evaluation included visual inspection to determine if buildings are structurally sound for field sampling crews to enter the buildings to conduct non-invasive sampling (asbestos sampling of friable material and PCB/lead wipe sampling of multiple flat surfaces). Sampling activities performed by the HGL field crew will require approximately 2 days total between all three buildings. Buildings to be inspected include:

A one-story maintenance building constructed in 1950 and totaling 3,312 square feet;

The one-story brick warehouse (main building) constructed in 1913 and totaling 54,204 square feet; and

The shear building, a one-story building constructed in 1986 and totaling 828 square feet

During your structural inspection, HGL crew members will be present. Documentation of the inspection including field notes, photographs and diagrams, if determined to be needed, should be recorded. A formal report will not be required; rather the results of the inspection (photographs or diagrams) or areas field personnel should not enter shall be email to the HGL PM (Brett Brodersen) and Field Team Leaders (FTLs): Kyle Stark and Andrew Solomon.

METHOD OF EVALUATION

A visual inspection of the three buildings was performed on May 20, 2015 by Paul Beckwith, PE, CCM from Navigator CS, LLC with assistance from Brett Brodersen and Andrew Solomon of HydroGeoLogic. The inspection focused on areas that posed a threat of imminent collapse as indicated by sagging and/or failed ceilings, roofs, floors, beams, and walls, excessive beam deflection, cracked plaster or brick and other visible physical indications of potential structural damage and failure. The investigation began with a walk around the building exteriors to determine a general condition and areas of potentially higher

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hazard prior to entering the building. Following that we entered the building and walked all accessible areas, inspecting all visible structural elements. No roofs were accessed or inspected from above. The inspection was visual with some very limited exploration of the material condition. In a few locations we poked/explored the condition of a structural element with a demolition tool to determine the apparent soundness of the wood or brick. No formal testing of any material was conducted and the conclusions are based on the engineer's experience and judgment. It is noted that with the brick and timber construction, any failure would likely be preceded by distinctive cracking sounds and likely would not be catastrophic unless caused by an event such as an earthquake or high-wind storm. Any such sounds heard during the sampling process should result in immediate evacuation of the area.

EXISTING CONDITIONS

The following sections review the conditions of the buildings. For each building, we provide an overview of the method of construction, followed by our opinion on the overall condition as suitable for sampling along with specific items of concerns. We conclude with a list of recommendations.

Brick Warehouse

Method of Construction

The Warehouse Building appears to have been completed in several phases. It appears that six or more sections were present at one time but now only four sections remain. Refer to the Warehouse Building Diagram at Appendix A for more details. Building sections A, B, and F are brick exterior walls with interior heavy Timber and steel column framing. The building section composed of C, D, and E likewise has brick walls, but area E has steel columns, roof joists and decking, while areas C and D appear to have a combination of steel and concrete (or concrete encased steel) columns and decking. Area C had rigid insulation on the walls and ceiling with a plaster coating. Areas A and F were two story. We did not inspect the second floor or underside of roof in those areas since the second floor deck was either collapsed or in very poor condition.

Condition/Findings

The condition varied throughout with some areas already collapsed or ready to collapse with other area in reasonably good condition. In areas A and B the heavy timber framing appeared to have suffered significant termite damage. Approximately 50% of the frame and/or decking had already collapsed or was approaching collapse. The brick on the north-west corner of area A was failing and peeling away from the building. It will collapse shortly which will likely take part of the roof corner with it. The north-west corner of area A should be avoided. Area C appears to be structurally sound, but the plaster and rigid insulation is falling from the roof and beams. Caution should be used while sampling in area C to avoid falling plaster and rigid insulation. Areas D and E appear to be structurally sound for sampling purposes. One note of concern in area E was the large garage door opening. Specifically the opening has been enlarged from its original construction and the lintel has been removed. Consequently the brick above the opening is unsupported. While this area did not appear to be failing, a large section of brick above the opening could collapse at any moment. Personnel should not stand under or near the garage door opening in area E. The heavy timer structure in area F is collapsed or in the process of collapsing. Most of the exterior walls are reasonably sound, though we observed some loose and failing brick. Referring to the building diagram, areas noted in red (single line) cross hatch are off-limits and caution for falling debris should be exercised in area C (noted in gray double-line cross hatch). Please refer to photos at Appendix B for samples of findings.

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Maintenance Building

Method of Construction

The Maintenance Building was built with concrete masonry unit (CMU) block exterior walls with brick pilasters supporting very deep (approx. 24") steel beams and a timber roof structure. The beams appear to have been used as crane or hoisting rails. There is also a small office area in one corner constructed with CMU walls and a lumber roof. Refer to the Maintenance Building Diagram for more details.

Condition/Findings

The exterior walls were in very poor condition. They have significant cracking and some displacement (pushed-in) in several areas, and could easily collapse with little horizontal force. One area of the roof had already started collapsing and other areas are experiencing deterioration. The building is generally sound enough for limited sampling. Due to danger of collapse, the areas hatched in red on the Maintenance Building diagram should be avoided during sampling. Caution should be exercised when standing/sampling near an exterior wall. Referring to the building diagram, areas noted in red (single line) cross hatch are off-limits. Please refer to photos at Appendix B below for samples of findings.

Shear Building

Method of Construction

The Maintenance Building was built with concrete masonry unit (CMU) block exterior walls with steel roof framing and decking. No diagram was made of the Shear building.

Condition/Findings

The building is sound enough for limited sampling. As noted above, we did not inspect the roof. The roof appeared sound, as observed from the underside of the roof deck, but even though the roof is readily accessible, we recommend not going on the roof for sampling. There are no areas inside the building or in close proximity to the outside of the building that need to be avoided during sampling. Please refer to photos at Appendix B below for samples of findings.

RECOMMENDATIONS

Sampling can be conducted in many areas within the three building. However, we recommend the following:

- 1. Avoid do not enter all areas noted in red (single line) cross hatch on building diagrams.
- 2. Beware of falling material in all areas but particularly in Warehouse Building area C, also noted with gray (double line) cross-hatching.
- 3. Any sampling should also be conducted by a two person team, with one person sampling while the second provides safety oversight.
- 4. Wear proper PPE during any sampling.
- 5. Do not conduct sampling during periods of high wind or storm.

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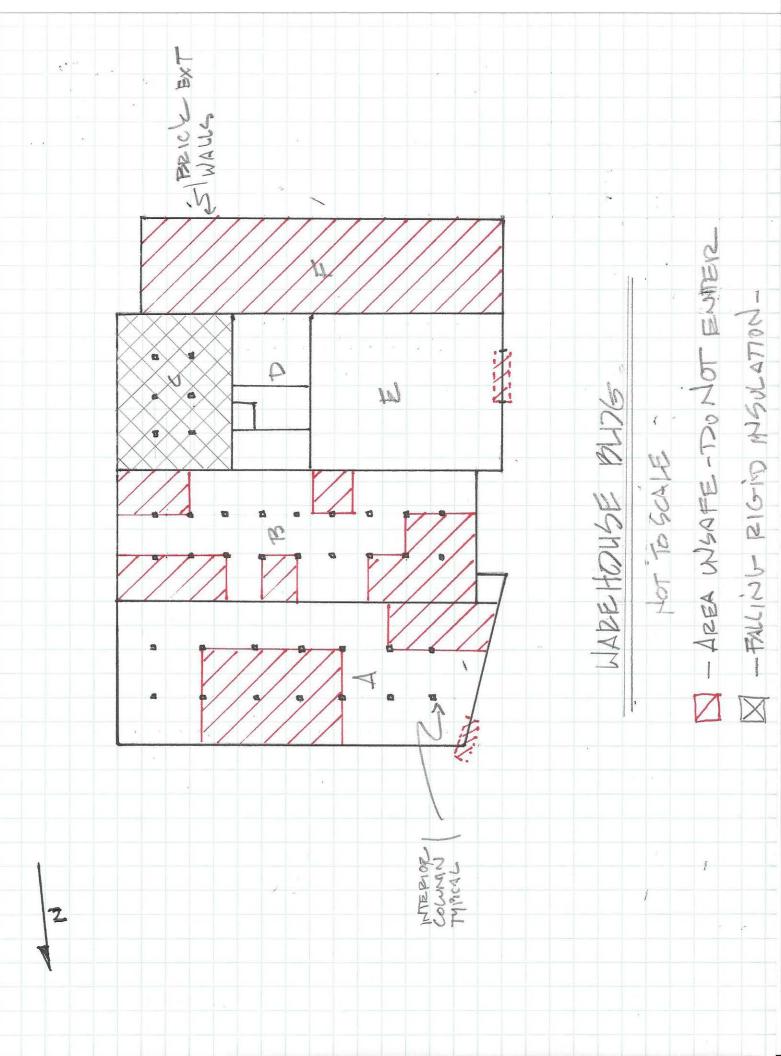
April 4, 2012 Page 4

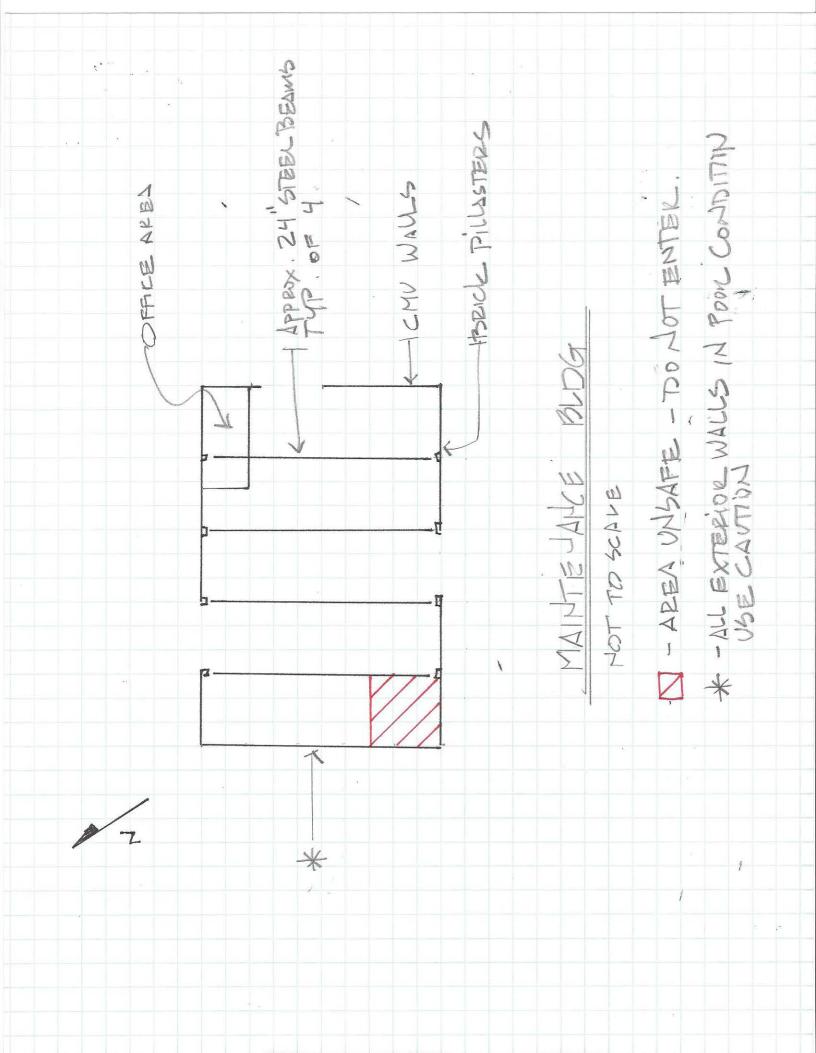
ADDITIONAL ITEMS OF CONCERN

Conditions change! Many areas of the Warehouse and the walls of the Maintenance Building are in poor conditions. If a significant wind, storm or earthquake event occurs between the time of this inspection and the sampling events, the condition should be reviewed again prior to sampling.

Appendix B - Building Diagrams

Navigator CS, LLC Appendix C





Appendix B - Project Site Photographs, May 20, 2015



Warehouse - NE Corner



Warehouse - Area B



Warehouse – Area E Door



Warehouse - Area A Roof



Warehouse – Area C



Warehouse - Area F

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Maintenance Building – Exterior Wall



Maintenance Building – Failed Wall



Shear Building - Underside of roof



Maintenance Building - Collapsed Roof



Shear Building

Navigator CS, LLC Appendix C

Appendix F.2 Asbestos Inspection at Peck Iron Works, 3850 Elm Avenue, Portsmouth, Virginia



Eastern Virginia Environmental, LLC

June 8, 2015

Mr. Brett Broderson, P.G. HydroGeologic, Inc. 11107 Sunset Hills, Suite 400 Reston, Virginia 20190

RE: Asbestos Inspection at Peck Iron Works, 3850 Elm Avenue, Portsmouth, Virginia

Dear Mr. Broderson:

On June 3, 2015 Eastern Virginia inspected the Warehouse, Maintenance Building and Shear Building at the site for friable suspect building materials only. Suspect Friable building materials were found and sampled in the Warehouse. The samples were turned over to HGL to be sent to a laboratory for analysis. There were some areas of the warehouse that could not be entered due to severe structural damage. Caution should be taken when demolishing the building. If any suspect friable building materials are found during the demolition that were not found in the initial inspection all work should cease until the material can be tested for asbestos content. Eastern Virginia tested pipe insulation, plaster, debris on the ground and material from inside of a fire door which was severely damaged in the warehouse.

No suspect friable asbestos-containing building materials were found in the Maintenance Building and the Shear Building.

Please see the attached Eastern Virginia Environmental Bulk Sample Collection.

If you have any questions, please give me a call.

Sincerely,

Fred Guest

VA Asbestos Building Inspector

VA# 3303 001534

Fre Cours

Eastern Virginia Environmental, LLC

1539 Eagle Glen Drive Chesapeake, VA 23322

1539 Eagle Glen Drive Chesapeake, VA 23322 Phone: (757) 436-0795 Fax: (757) 549-1368

Project Name:	PECK	IRON	CO.
Project Location:	3850	ELM	AVE
Client Name/Contact:	BRETT	BROD	DERSEN
Client Reference #:	The second secon	Annual public and the second s	Account of the second of the s

BULK SAMPLE COLLECTION FORM

Inspector(s):	FRED GUEST /STERMEN VIERRETHER
Time on site:	
Date Sampled:	3 JUN 15
Requested TAT:	WIIZ
EVE Report/Batch #:	The second secon

SAMPLE NUMBER	HGA#		FLOOR	TYPE	DIAMETER/ SIZE	QUANTITY	CONDITION	FRIABLE (Y/N)	SAMPLE DESCRIPTION	CORNERTS
7	/	INTERIOR RM	/		3"XZ	4"			WATER PIPE TSI	STAND PIPE
2	2	READ RM	/		Х				WALL FLASER	
3	2	CENTER RM FRONT WALL CENTER RM SIDE WALK	1		2				11 01	
4	2	CENTER RM SIDE WALK	1						11 11	
5	3	FAR LEFT RM	1						DEBRIS ON THE GROUND	-
6	4	FLOOR FARLEFT RM FRONT DOOR							FIRE DOOR ?	-
									X	
									× .	CLIENT
	1-	BBINCK WAREH	0U5E			· · · · ·			6	CLIENT KEPT JAMPLES TO ANALYZE
	2-	BRINCK WAREH MAINT BLG- SHEAR BLG								

CHAIN OF CUSTODY RECORD									
	SIGNATURE	DATE/TIME	PRINTED NAME						
SAMPLED BY:	JC Tand	37UN 15	VIERRETHER						
DELIVERED BY:									
RECEIVED BY:									

Appendix F.3

Munitions Reports

- Date: Summary Email, December 11, 2013
- June 4, 2015 Munitions MD01 Report
- June 5, 2015 Munitions MD02 and MD03 Report
- June 5, 2015 Munitions MD04 Report
- July 29, 2015 Munitions MD05 Report
- July 29, 2015 Munitions MD06 and MD07 Report
- July 29, 2015 Munitions MD08 Report
- July 30, 2015 Munitions MD09 Report



Brodersen, Brett

From: Brodersen, Brett

Sent: Wednesday, December 11, 2013 8:27 AM

To: EPA RPM
Cc: Brodersen, Brett

Subject: WA44 Peck - status of MD surface inspection MD01

The MEC/MD inspection was completed last Friday, Dec 6th. It took all week for the crew to inspect the site and the wetlands bordering Paradise Creek was completely under water during the entire week. HGL crew tried to access the wetlands for the inspection but the water was too deep. Only the 1 item was identified (Malcolm Pirnie 50'x50' grid location: U13). Per previous emails, the item was removed by Navy EOD after City of Portsmouth police were informed. Also, all onsite subsurface soil sampling locations and corners of the Decision Units were staked/flagged for the upcoming gamma ray survey to be conducted in early to mid January along with utility clearances after that.

Brett T. Brodersen, P.G.

Project Manager HydroGeoLogic, Inc. 11107 Sunset Hills Road, Ste 400 Reston, VA 20190

office: 703-736-4526 fax: 703-471-4180 bbrodersen@hgl.com



UXO Technician:	Frank Cota / Rebecca Powers	Team:	One	Date:	4 June 2015		
Anomaly ID No.			MD02				
Actual Anomaly Cod	ordinates (Latitude= Longitude=Y)	X:	12124999.5386563	Y:	3460788.07732571		
Object Depth (from	center of mass):		0.0 Inches				
Object length:			12.9 Inches				
Object Diameter/Thi	ckness:		3 Inches				
Object Weight (Estin	mated):		Estimated 13 lbs.				
Slope of terrain (Ch	eck one box):	Flat	☐ <10°	10° to 30°	□ >30		
Vegetation cover (C	heck one box):	Grassy	⊠ Clear □ -	Tundra	☐ Swamp		
Soil type (Check on	e box):	Gravel	⊠ Sand □ 0	Clay	Rock		
Inclination:		⊠ 0°	☐ 45° ☐ 90°	☐ 135°	☐ 180°		
Orientation:		NE -	- SW; Nose pointed NE				
Item Description/Just	stification/Comments:						
fuze or ballistic win	n located: 3 inch or 75mm projendscreen; solid or possibly press 31 Blank/AP/Practice round.	,	· 1 3	υ,			
Anomaly type categ	ories (Check Appropriate Box)						
☐ MEC ☐	_ , _	tice Ordna		_	tal Waste		
	No Find No Dig Rust	-	☐ Dig Abandoned	☐ Tar	get >4 ft		
Was photo taken?		File Nam					
	dentification (If Known, Record B	selow and	d record fuze condition a	and dispositi	ion):		
Callantity: 1	spected MK31 Nose Fu	uze Mark/N	Mod: N/A Tail Fuze	Mark/Mod: N/	'A		
Ordnance Filler:	☐ Explosive ☐ Propel	liani .	Pyrotec Other onic	E.W			
Ordnance Category							
☐ Bomb ☐ Guided Missile				yrotechnics an	nd Flares		
☐ Cluster/Dispenser ☐ Land Mine ☐			•	Small Arms			
Grenade Misc. Explosive Device			ckets	Inderwater Ord	dnance		
Fuzing Types: N/A, No Fuze.							
☐ All-ways Acting ☐ Base Detonating ☐			e	□lm	pact		
☐ Mechanical Time ☐ Mechanical long delay ☐		☐MT Sup	er-quick Piezoele	ectric Po	oint Detonating (PD)		
☐Point-initiating, Base-	detonating Powder Train Tim	ne Fuze (P	TTF) Pressure	e 🗆 🏻 Pro	oximity (VT)		
Status of MEC:							



Physical Condition of MEC:	Intact	en 🗌 Soil Staining 🗎 Filler Visible 🗎 Soil Sample Taken							
MEC/MPPEH Disposition:									
Disposition: (Clarify Under Remarks)			☐ Leave In Place	☐ Other	Date: 4 June 2015				
Notifications To EOD: Matthew Giova	annelli; Fire Marshal	Signature:			Date 4 June 2015				
Transported By: Naval Station Norfol	k EOD	Signature:			Date: 4 June 2015				
Transferred To:		Signature:			Date:				
Storage Location: No storage, no des	struction. Naval Stati	on Norfolk EOD arr	ived to pick up and tra	ansport to their fa	cilities.				
Destroyed By:	5	Signature			Date: 4 June 2015				
remained with HGL personnel and co Cota and Rebecca Powers escorted unfired, no fuze; they picked it up and MK31 three inch projectile was share	Navy EOD to the pro	ojectile. Once there sponse vehicle for t	EOD identified the ite ransport. Information	em as an armor pi gathered from re	iercing or practice round,				
SUXOS/UXO Team Leader Signature	e: Frank Cota		EOD Personne	el Signature (whe	n applicable):				
Abandoned—MEC that was disposed of by abandonment; may have been fuzed or armed, but was not employed. Inert—Same physical features as an ordnance item but does not and never did contain energetic material. MEC—Military munitions that may pose unique explosives safety risks, Unexploded ordnance (UXO), Discarded military munitions (DMM), Munitions constituents (e.g., TNT, RDX); present in high enough concentrations to pose an explosive hazard. MPPEH—Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use, demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard. MDEH—Material documented as an explosive hazard that contains an energetic material.									
MDAS—Material documented as safe that does not contain an energetic material.									











UXO Technician	:	Frank Co	ta, Rebecca Powers	Team:	One		Date:	05 June 2015
Anomaly ID No.		MD-001	MI	D03				
Actual Anomaly	Coord	dinantes (Easting=X Northing=Y)	X:	383446	mE	Y:	4074290mN
Object Depth (fro	om ce	nter of m	ass):			0 Inches		
Object length:						4.5 Inches		
Object Diameter	/Thick	ness:				40mm		
Object Weight (E	Estima	ited):				75 Lbs.		
Slope of terrain	(Chec	k one box	x):	Surface <10°		☐ 10° to 30)° [] >30
Vegetation cove	r (Che	ck one b	ox):		r	☐ Tundra] Swamp
Soil type (Check	one k	oox):		⊠ Sand	t	☐ Clay		Rock
Inclination:				⊠ 0°	□ 45	5° 🗌 90°	13	35° 🔲 180°
Orientation:				N-S				
Item Description	/Justi	fication/C	omments:					
One unfired anti-aircraft 40mm projectile, no fuze, interior visible to show no filler.								
Anomaly type categories (Check Appropriate Box)								
☐ MEC	□ A	bandoned	⊠ Scrap ☐ Prac	tice Ordna	ance	☐ Inert Ordnan	се	☐ Metal Waste
Other		lo Find	☐ No Dig ☐ Rus	t Layer				
Was photo taker	າ?	⊠ Yes	□ No	File Name: MD 05June15				
Ordnance Positi	ve Ide	entification	n (If Known, Record E	Below and	d record	fuze condition	on and dis	sposition):
Quantity: 1	Ordna Unkn	ance Mark/N own	Mod: N	lose Fuze	Mark/Mod	d: Tail F	uze Mark/N	lod:
Ordnance Filler:	N/A	☐ Explos	ive Propellant	☐ Pyro	technic	⊠ No Filler	N.E.W.	0
Ordnance Categ	ory:	Munition	s Debris					
Bomb			Guided Missile	□Мо	ortars		☐ Pyrotech	nics and Flares
☐ Cluster/Dispense	er		Land Mine	⊠ Pro	ojectiles		☐ Small Arı	ms
☐ Grenade ☐ Misc. Explosive Device			☐ Ro	ckets		Underwa	ter Ordnance	
Fuzing Types: N	o Fuz	е						
☐ All-ways Acting ☐ Base Detonating ☐			□Influenc	е	□Elect	tric	□Impact	
☐Mechanical Time ☐Mechanical long delay [☐MT Sup	er-quick	□Piezo	oelectric	☐Point Detonating (PD)	
☐Point-initiating, B	ase-de	etonating	☐Powder Trai	n Time Fuz	ze (PTTF)) Pres	sure	☐Proximity (VT)
Status of MEC: N	N/A	Armed	☐ Unarmed					
Physical Conditi	on of	MEC:	☐ Broken Open ☐] Soil Stair	ning	⊠ No Filler-voi	id 🗌 So	il Sample Taken
MEC/MPPEH Dis	MEC/MPPEH Disposition:							



Disposition: (Clarify Under Remarks)	☐ Transport	⊠Leave In Place	Date: 05 June 2015							
Notifications To EOD By: N/A	Signature:			Date						
Transported By: N/A	Signature:			Date:						
Transferred To: N/A	Signature:			Date:						
Storage Location: N/A										
Destroyed By: N/A	Signature			Date:						
Remarks: Non-hazardous MD, empty – no filler, never fired.										
SUXOS/UXO Team Leader Signatu	re: Frank Cota	EOI	D Personnel Si	gnature (when applicable): N/A						
Abandoned—MEC that was disposed of by abandonment; may have been fuzed or armed, but was not employed. Inert—Same physical features as an ordnance item but does not and never did contain energetic material. MEC—Military munitions that may pose unique explosives safety risks, Unexploded ordnance (UXO), Discarded military munitions (DMM), Munitions constituents (e.g., TNT, RDX); present in high enough concentrations to pose an explosive hazard.										
MPPEH—Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use, demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard. MDEH—Material documented as an explosive hazard that contains an energetic material. MDAS—Material documented as safe that does not contain an energetic material.										







UXO Technician:	Frank Co	ta, Rebecca Powers	Team:	One		Date:	05 June 2015	
Anomaly ID No.			MD 002	and MD 003	MD04	and M	D05	
Actual Anomaly Co	ordinantes	(Easting=X Northing=Y)	X:	383446mE		Y:	4074290mN	
Object Depth (from	center of m	ass):		0 lr	nches			
Object length:				2 lr	nches			
Object Diameter/Th	ickness:			20n	mm			
Object Weight (Esti	mated):			.2 L	_bs.			
Slope of terrain (Ch	eck one bo	x):	Surface	□ <10° [10° to 30°] >30	
Vegetation cover (C	heck one b	ox):	⊠ Clea	r [Tundra] Swamp	
Soil type (Check on	e box):		⊠ Sand] t	Clay] Rock	
Inclination:			⊠ 0°	☐ 45°	☐ 90°	□ 13	5° 180°	
Orientation:			E-W					
Item Description/Ju	stification/0	Comments:						
Two unfired 20mm projectiles, no filler, interior exposed, no fuzing.								
Anomaly type categ	ories (Ched	k Appropriate Box)						
☐ MEC ☐] Abandoned	⊠ Scrap ☐ Prac	ctice Ordna	ance 🗌 I	nert Ordnance	[Metal Waste	
	No Find	☐ No Dig ☐ Rus						
Was photo taken?	⊠ Yes		File Name: MD 05June15					
Ordnance Positive I	dentificatio	n (If Known, Record E	Below and	d record fuz	ze condition	and dis	position):	
	lnance Mark/ known	Mod: N	lose Fuze	Mark/Mod:	Tail Fuz	e Mark/M	od:	
Ordnance Filler: N/	A ☐ Explo	sive Propellant	☐ Pyrc	technic 🛚	No Filler N.	. E.W.)	
Ordnance Category	: Munitio	ns Debris						
Bomb		Guided Missile		ortars		•	nics and Flares	
☐ Cluster/Dispenser		Land Mine		ojectiles		Small Arn		
☐ Grenade ☐ Misc. Explosive Device			Ro	ckets		Underwat	er Ordnance	
Fuzing Types: No F	uze							
☐ All-ways Acting ☐ Base Detonating ☐			□Influenc	е	□Electric		□Impact	
☐Mechanical Time ☐Mechanical long delay [☐MT Sup	er-quick	□Piezoel	ectric	☐Point Detonating (PD)	
☐Point-initiating, Base-detonating ☐Powder Train			n Time Fu	ze (PTTF)	□Pressur	е	☐Proximity (VT)	
Status of MEC: N/A	☐ Armed	☐ Unarmed						
Physical Condition	of MEC:	☐ Broken Open] Soil Stair	ning 🛛 🖾 N	No Filler-void	Soi	l Sample Taken	
MEC/MPPEH Dispos	MEC/MPPEH Disposition:							



Disposition: (Clarify Under Remarks)	☐ Transport	⊠Leave In Place	☐ Other	Date: 05 June 2015						
Notifications To EOD By: N/A	Signature:			Date						
Transported By: N/A	Signature:			Date:						
Transferred To: N/A	Signature:			Date:						
Storage Location: N/A										
Destroyed By: N/A	Signature			Date:						
Remarks: Non-hazardous MD, empty – no filler, never fired.										
SUXOS/UXO Team Leader Signatur				gnature (when applicable): N/A						
Abandoned—MEC that was disposed of	•			• •						
Inert—Same physical features as an ordnance item but does not and never did contain energetic material. MEC—Military munitions that may pose unique explosives safety risks, Unexploded ordnance (UXO), Discarded military munitions (DMM), Munitions constituents (e.g., TNT, RDX); present in high enough concentrations to pose an explosive hazard.										
MPPEH—Material potentially containing										
munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use, demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of										
explosives such that the material presents an explosive hazard.										
MDEH-Material documented as an explosive hazard that contains an energetic material.										
MDAS—Material documented as safe that does not contain an energetic material.										







UXO Technician:	Frank Co	ta, Rebecca Powers	Team:	One	Date:	05 June 2015	
Anomaly ID No.			MD-004	MD06			
Actual Anomaly Coo	ordinantes	(Easting=X Northing=Y)	X:	383446mE	Y:	4074290mN	
Object Depth (from o	center of m	ass):		0 Inches			
Object length:				2 Inches			
Object Diameter/Thic	ckness:			40mm			
Object Weight (Estin	nated):			.2 Lbs. each			
Slope of terrain (Che	eck one bo	c) :	Surface	□ <10° □ 10° to	30°	□ >30	
Vegetation cover (CI	heck one b	ox):	□ Clea	r 🔲 Tund	ra [Swamp	
Soil type (Check one	e box):		⊠ Sand	d 🔲 Clay		Rock	
Inclination:			⊠ 0°	☐ 45° ☐	90° 🗌 13	35° □ 180°	
Orientation:			N/A				
Item Description/Jus	stification/C	Comments:	•				
Six fired 40mm projectile casings, no filler, interior exposed.							
Anomaly type categories (Check Appropriate Box)							
	Abandoned	_ · _	tice Ordna			☐ Metal Waste	
	No Find	☐ No Dig ☐ Rust		☐ Dig Aban	doned	☐ Target >4 ft	
Was photo taken?	⊠ Yes		File Name				
Ordnance Positive Id	dentificatio	n (If Known, Record B	selow and	d record fuze cond	lition and dis	sposition):	
	nance Mark/l k nown	Mod: N	lose Fuze I	Mark/Mod: Ta	ail Fuze Mark/N	Mod:	
Ordnance Filler: N/A	∟ □ Explo	sive	☐ Pyro	technic 🛛 No Fille	er N.E.W.	0	
Ordnance Category:	Munition	ns Debris					
Bomb		Guided Missile		ortars	•	nics and Flares	
☐ Cluster/Dispenser		Land Mine		ojectiles	☐ Small Ar		
☐ Grenade ☐ Misc. Explosive Device				ockets	Underwa	ter Ordnance	
Fuzing Types: No Fu	Fuzing Types: No Fuze						
☐ All-ways Acting ☐ Base Detonating ☐			□Influence	_	lectric	☐Impact	
☐Mechanical Time ☐Mechanical long delay [☐MT Supe	-	iezoelectric	☐Point Detonating (PD)	
☐Point-initiating, Base-	detonating	☐Powder Trai	n Time Fuz	ze (PTTF)	ressure	☐Proximity (VT)	
Status of MEC: N/A	☐ Armed	☐ Unarmed					
Physical Condition of	of MEC:	☐ Broken Open ☐] Soil Stair	ning 🛛 No Filler	-void 🗌 So	il Sample Taken	
MEC/MPPEH Disposition:							



Disposition: (Clarify Under Remarks)	☐ Transport	⊠Leave In Place	☐ Other	Date: 05 June 2015						
Notifications To EOD By: N/A	Signature:			Date						
Transported By: N/A	Signature:			Date:						
Transferred To: N/A	Signature:			Date:						
Storage Location: N/A										
Destroyed Dy N/A	Cianatura			Data						
Destroyed By: N/A	Signature			Date:						
Remarks: Non-hazardous MD, empty – no filler, expended/fired.										
SUXOS/UXO Team Leader Signatur	e: Frank Cota	EOI	D Personnel Si	ignature (when applicable): N/A						
Abandoned—MEC that was disposed of	by abandonmer	nt; may have been f	uzed or arme	ed, but was not employed.						
Inert—Same physical features as an ordi	nance item but d	oes not and never	did contain e	nergetic material.						
MEC—Military munitions that may pose u	inique explosive:	s safety risks, Unex	ploded ordna	ance (UXO), Discarded military						
munitions (DMM), Munitions constituents	(e.g., TNT, RDX	(); present in high e	nough conce	ntrations to pose an explosive						
hazard.										
MPPEH—Material potentially containing	explosives or mu	ınitions (e.g., muniti	ions containe	ers and packaging material;						
munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use,										
demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of										
explosives such that the material presents an explosive hazard.										
MDEH-Material documented as an explosive hazard that contains an energetic material.										
MDAS—Material documented as safe that does not contain an energetic material.										







UXO Technician	ı:	Adam Sto Powers	offel/ Rebecca	Team:	One		Date:	29 July 2015			
Anomaly ID No.				Md-005 MD07							
Actual Anomaly Coordinates (Latitude= Longitude=Y)				X:	N/A		Y:	N/A			
Object Depth (from center of mass):				0.0 Inches							
Object length:				12.9 Inches							
Object Diameter/Thickness:					3 Inches						
Object Weight (Estimated):					Estimated 10 lbs.						
Slope of terrain (Check one box):					Flat ⊠ <10°						
Vegetation cover (Check one box):					Grassy ⊠ Clear ☐ Tundra ☐ Swamp						
Soil type (Check one box):					Gravel ⊠ Sand □ Clay ⊠ Rock						
Inclination:						45° 🔲 90°	☐ 135 [°]	☐ 180 [°]			
Orientation:					Item removed from DU19TP1 test pit						
Item Description	n/Justi	ification/0	Comments:								
Initial recon of Item located: 3 inch or 75mm projectile; unfired; projectile Body only-no casing; No Fuze; solid or possibly pressed base; 12.9 inches long, 3 inch diameter. Possible nomenclature: MK31 Blank/AP/Practice round.											
Anomaly type categories (Check Appropriate Box)											
☐ MEC ☐ Abandoned ☐ Scrap ☐ Practice Ordnance ☐ Inert Ordnance ☐ Metal Waste											
Other		No Find ⊠ Yes	☐ No Dig ☐ Rust	Layer File Nam	o. D	☐ Dig Abandone eck UXO-005	d ∐ la	rget >4 ft			
Was photo taker			□ No				and disposi	tion):			
Quantity: 1	Ordna	ance Mark/l	Mod: Possible	uze Mark/N			ze Mark/Mod: N				
Ordnance Filler:	- IMK31		lanı .	yrotec	Other I	N.E.W					
Ordnance Categ	ory:		Munitions Deb	ris							
Bomb	☐ Bomb ☐ Guided Missile			☐ Mortars ☐ Pyrotechnics and Flares							
☐ Cluster/Dispenser		☐ Land Mine		– ,		Small Arms					
☐ Grenade ☐ Misc. Explosive Device ☐ Rockets ☐ Underwater Ordnance								dnance			
Fuzing Types: N/A, No Fuze.											
☐ All-ways Acting ☐ Base Detonating			Detonating [☐Influence		☐ Electric ☐ Impact		npact			
☐Mechanical Time		□Mech	☐MT Super-quick ☐Piezoe		lectric DP	oint Detonating (PD)					
☐Point-initiating, Base-detonating ☐Powder Train Time				ne Fuze (P	TTF)	□Pressu	re 🔲 P	roximity (VT)			
Status of MEC:		Armed	⊠ Una	armed							
Physical Condition of MEC:					aining	No Filler Visible	☐ Soil Sam	nple Taken			



MEC/MPPEH Disposition:											
Disposition: (Clarify Under Remarks)		☐ Leave In Place		Date: 29 July 2015							
Notifications To EOD: N/A	Signature:	Date									
Transported By: N/A	Signature:	Date:									
Transferred To:N/A	Signature:	Date:									
Storage Location: N/A											
Destroyed By:N/A	nature		Date:								
Non-hazardous MD, empty-no filler											
SUXOS/UXO Team Leader Signature: Adam Stoffel			EOD Personnel Signature (when applicable):N/A								
Abandoned—MEC that was disposed of by abandonment; may have been fuzed or armed, but was not employed. Inert—Same physical features as an ordnance item but does not and never did contain energetic material. MEC—Military munitions that may pose unique explosives safety risks, Unexploded ordnance (UXO), Discarded military munitions (DMM), Munitions constituents (e.g., TNT, RDX); present in high enough concentrations to pose an explosive hazard. MPPEH—Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use, demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard. MDEH—Material documented as an explosive hazard that contains an energetic material.											

MDAS—Material documented as safe that does not contain an energetic material.













UXO Technician:	Adam St Powers	offel/ Rebecca	Team:	One		Date:	29 July 2015		
Anomaly ID No.			MD 006	and 007	MD08-09				
Actual Anomaly Co	ordinates (l	Latitude= Longitude=Y)	X:	N/A		Y:	N/A		
Object Depth (from	center of m	nass):		0.0 I	Inches				
Object length:				30 lı	nches				
Object Diameter/Th	ickness:			4 In	iches				
Object Weight (Est	mated):			Esti	imated 20 lbs. ea.				
Slope of terrain (Check one box):				⊠ <10°		10° to 30°	□ >30		
Vegetation cover (0	heck one b	ox):	Grassy	⊠ Clear		Tundra	Swamp		
Soil type (Check or	e box):		Gravel	⊠ Sand		Clay	⊠ Rock		
Inclination:			⊠ 0°		15 [°] □ 90 [°]	☐ 135 ⁰	☐ 180 ^o		
Orientation:			Items i	emoved	from DU19TP1	test pit			
Item Description/Ju	stification/	Comments:							
	Initial recon of Item located: 3 inch or 75mm projectile training aid; unfired; Projectile body and casing seem to be one solid piece, no break; No Fuze; No projectile base; 30 inches long, 4 inch diameter. Nomenclature: unknown.								
Anomaly type cate	ories (Che	ck Appropriate Box)							
☐ MEC [Abandoned	<u> </u>	tice Ordna		☐ Inert Ordnance		tal Waste		
	No Find	□ No Dig □ Rust			Dig Abandoned	∐ Tar	get >4 ft		
Was photo taken?	⊠ Yes		File Nam		ck UXO-006/007	and diamonis	iam\.		
		on (If Known, Record B Mod: Unknown Nose Fu	uze Mark/N			Mark/Mod: N/	,		
Ordnance Filler: No Filler	Explo		[llant	Pyrotec		E.W	<u> </u>		
Ordnance Category	':	Munitions Deb			,	•			
Bomb		Guided Missile	□ Мо	rtars	F	yrotechnics ar	nd Flares		
☐ Cluster/Dispenser		☐ Land Mine	⊠ Pro	ojectile		Small Arms			
Grenade		Misc. Explosive Device	☐ Ro	ckets		Inderwater Ord	dnance		
Fuzing Types: N/A,	No Fuze.								
☐ All-ways Acting	□Base	Detonating [Influence	е	□Electric	□lm	pact		
☐Mechanical Time	□Mech	nanical long delay	☐MT Sup	er-quick	□Piezoele	ectric Po	oint Detonating (PD)		
☐Point-initiating, Base	-detonating	☐Powder Train Tim	ne Fuze (P	TTF)	□Pressure	e □Pr	oximity (VT)		
Status of MEC:	☐ Armed	⊠ Una	armed						
Physical Condition	of MEC:	☐ Broken	☐ Soil Sta		⊠ No Filler Visible	☐ Soil Samp	ple Taken		



MEC/MPPEH Disposition:					
Disposition: (Clarify Under Remarks)			☐ Leave In Place		Date: 29 July 2015
Notifications To EOD: N/A		Signature:			Date
Transported By: N/A		Signature:			Date:
Transferred To:N/A		Signature:			Date:
Storage Location: N/A					
Destroyed By:N/A	Sigr	nature			Date:
Non-hazardous MD, empty-no filler, Item placed in site	desig	gnated MD area			
SUXOS/UXO Team Leader Signature: Adam Stoffel			EOD Personnel	Signature (when a	pplicable):N/A
Abandoned—MEC that was disposed of by abar Inert—Same physical features as an ordnance ite MEC—Military munitions that may pose unique exmunitions (DMM), Munitions constituents (e.g., Thazard. MPPEH—Material potentially containing explosive munitions documented as an explosive hazard (Memilitarization, or disposal; and range-related deexplosives such that the material presents an explosive hazard MDEH—Material documented as an explosive hazaman MDAS—Material documented as safe that does represent the same properties of th	em buxplos NT, R es or NDEH ebris) blosiv	ut does not and sives safety risk RDX); present in munitions (e.g. d) or material do or material pot the hazard.	e been fuzed or arm I never did contain of is, Unexploded ordr in high enough conc in, munitions contain ocument as safe (Materially containing a in energetic material	ned, but was not energetic materia nance (UXO), Dis entrations to pos ers and packagid (DAS) remaining a high enough co	employed. al. scarded military se an explosive ng material; after munitions use,



























	Adam St	offel/ Rebecca					
UXO Technician:	Powers	Onei/ Repecca	Team:	One		Date:	29 July 2015
Anomaly ID No.			MD-008	MD)10		
Actual Anomaly C	oordinates (Latitude= Longitude=Y)	X:	N/A		Y:	N/A
Object Depth (from	n center of m	nass):		0.0 I	Inches		
Object length:				2 Ind	ches		
Object Diameter/Thickness:				20m	ım		
Object Weight (Estimated):				.2 L	.bs.		
Slope of terrain (C	heck one bo	x):	Flat	⊠ <10°		10° to 30°	□ >30
Vegetation cover	Check one b	oox):	Grassy	⊠ Clear		Tundra	☐ Swamp
Soil type (Check o	ne box):		Gravel	⊠ Sand		Clay	⊠ Rock
Inclination:			⊠ 0°	<u> </u>	45 [°] □ 90 [°]	☐ 135 ⁰	☐ 180 [°]
Orientation:			Items	removed	I from DU19TP1	test pit (Su	rface)
Item Description/J	ustification/	Comments:	•				
15ea unfired 20m	m projectiles	s, No fuze, No visible	filler				
Anomaly type cate	egories (Che	ck Appropriate Box)					
☐ MEC		☐ Scrap ☐ Pra	ctice Ordna	ance [☐ Inert Ordnance		etal Waste
Other	☐ No Find	☐ No Dig ☐ Rus	t Layer	[☐ Dig Abandoned	□ Та	rget >4 ft
Was photo taken?		☐ No	File Nam		ck UXO-008		
		on (If Known, Record				-	•
Quantity: 15	ordnance Mark/	Mod: Unknown Nose F	uze Mark/N	/lod: N/A	Tail Fuze	e Mark/Mod: N	I/A
Ordnance Filler: No Filler	☐ Explo	sive Prope	:IIANI .	 Pyrotec nnic	Other N	.E.W	
Ordnance Catego	y:	Munitions Del	oris				
Bomb		Guided Missile	□Мо	ortars	□ F	Pyrotechnics a	nd Flares
☐ Cluster/Dispenser	[Land Mine		ojectile	-	Small Arms	
Grenade	[Misc. Explosive Device	☐ Ro	ckets		Jnderwater Or	dnance
Fuzing Types: N/A	, No Fuze.						
☐ All-ways Acting	□Base	Detonating	□Influenc	е	□Electric	□In	npact
☐Mechanical Time	□Mech	nanical long delay	☐MT Sup	er-quick	□Piezoele	ectric DP	oint Detonating (PD)
☐Point-initiating, Bas	se-detonating	☐Powder Train Ti	me Fuze (P	TTF)	□Pressur	e □P	roximity (VT)
Status of MEC:	☐ Armed	⊠ Uı	narmed				
Physical Conditio	n of MEC:	☐ Broken	☐ Soil St		⊠ No Filler Visible	☐ Soil Sam	nple Taken



MEC/MPPEH Disposition:					
Disposition: (Clarify Under Remarks)	⊠⊤	ransport	☐ Leave In Place		Date: 29 July 2015
Notifications To EOD: N/A	Sign	ature:			Date
Transported By: N/A	Sign	ature:			Date:
Transferred To:N/A	Sign	ature:			Date:
Storage Location: N/A					
Destroyed By:N/A	Signature	Э			Date:
Remarks: Non-hazardous MD, empty-no filler, Items placed in site	e designate	ed MD area			
SUXOS/UXO Team Leader Signature: Adam Stoffel			EOD Personnel	Signature (when a	pplicable):N/A
Abandoned—MEC that was disposed of by aban Inert—Same physical features as an ordnance its MEC—Military munitions that may pose unique exmunitions (DMM), Munitions constituents (e.g., Thazard. MPPEH—Material potentially containing explosive munitions documented as an explosive hazard (Memilitarization, or disposal; and range-related deexplosives such that the material presents an explosive hazard MDEH—Material documented as an explosive hazard.	em but doo xplosives NT, RDX); es or mun IDEH) or n ebris) or m blosive haz	es not and safety risk present in itions (e.g material de naterial pot zard.	I never did contain as, Unexploded ordrand high enough conden, munitions contain ocument as safe (Mentially containing as	energetic materian ance (UXO), Distentrations to posters and packagi (IDAS) remaining a high enough co	al. scarded military se an explosive ng material; after munitions use,

MDAS—Material documented as safe that does not contain an energetic material.













UXO Technician:		Adam Sto Powers	offel/ Rebecca	Team:	One		ı	Date:	30 July 2015
Anomaly ID No.				MD-009	M	D11			
Actual Anomaly (Coord	dinates (L	atitude= Longitude=Y)	X:	N/A		,	Y:	N/A
Object Depth (fro	m ce	nter of m	ass):		0.0) Inches			
Object length:					12	.9 Inches			
Object Diameter/Thickness:					3	Inches			
Object Weight (Estimated):					Es	stimated 10 lbs.			
Slope of terrain (Check one box):				Flat	∑ <10°)] 10	0° to 30°	□ >30
Vegetation cover	(Che	ck one b	ox):	Grassy	⊠ Clea	r	Tu	ındra	☐ Swamp
Soil type (Check	one b	oox):		Gravel	⊠ San	d	⊠ Cla	ay	Rock
Inclination:				⊠ 0°		45°)	☐ 135 [°]	☐ 180 [°]
Orientation:				Item re	moved	from DU06TF	1 tes	st pit	
Item Description/	Justi	fication/0	Comments:						
			inch or 75mm projec thes long, 3 inch diam						
			k Appropriate Box)						
☐ MEC		bandoned	_ · _	tice Ordna	ance	☐ Inert Ordnar			al Waste
☐ Other Was photo taken		lo Find ⊠ Yes	□ No Dig □ Rust □ No □	File Nam	a. D	☐ Dig Abandoi eck UXO-009	ieu		get >4 ft
-			n (If Known, Record B				on an	nd disnositi	on).
Quantity: 1			Mod: Possible	uze Mark/N				Mark/Mod: N/	-
Ordnance Filler: No Filler		☐ Explos	sive Propel	lanı .] Pyrotec nic	☐ Other	N.E.	.w	
Ordnance Catego	ory:		Munitions Deb	ris					
Bomb			Guided Missile	□ Мо	rtars		☐ Pyr	rotechnics an	d Flares
☐ Cluster/Dispense	er		Land Mine		jectile			nall Arms	
Grenade			Misc. Explosive Device	Ro	ckets		Un	derwater Ord	Inance
Fuzing Types: N/	A, No	Fuze.							
☐ All-ways Acting		□Base	Detonating [Influence	Э	□Elec	tric	□lmı	
☐Mechanical Time		□Mech	anical long delay	☐MT Supe	er-quick	□Piez	oelect	tric	int Detonating (PD)
☐Point-initiating, Ba	ase-de	etonating	☐Powder Train Tim	ne Fuze (P	TTF)	□Pres	sure	□Pro	oximity (VT)
Status of MEC:		☐ Armed	⊠ Una	armed					
Physical Condition of MEC:					aining	No Filler Visible		☐ Soil Samp	ole Taken



MEC/MPPEH Disposition:					
Disposition: (Clarify Under Remarks)	⊠ Tra	nsport	☐ Leave In Place		Date: 30 July 2015
Notifications To EOD: N/A	Signat	ure:			Date
Transported By: N/A	Signat	ure:			Date:
Transferred To:N/A	Signat	ure:			Date:
Storage Location: N/A					•
Destroyed By:N/A	Signature				Date:
Remarks: Non-hazardous MD, empty-no filler					
SUXOS/UXO Team Leader Signature: Adam Stoffel				Signature (when a	
Abandoned—MEC that was disposed of by aban Inert—Same physical features as an ordnance ite MEC—Military munitions that may pose unique expunitions (DMM), Munitions constituents (e.g., The hazard. MPPEH—Material potentially containing explosive munitions documented as an explosive hazard (Memilitarization, or disposal; and range-related de explosives such that the material presents an expunitional material documented as an explosive hazard (Memilitarization) and the material presents an expunitional material documented as an explosive hazard (Memilitarization).	em but does xplosives sa NT, RDX); p es or muniti IDEH) or ma losive haza	s not and and afety rish ons (e.gaterial portal por	d never did contain ks, Unexploded ording in high enough conding, munitions contain document as safe (Notentially containing)	energetic materinance (UXO), Discentrations to posters and packag (IDAS) remaining a high enough c	ial. iscarded military se an explosive ing material; g after munitions use,

MDAS—Material documented as safe that does not contain an energetic material.





Appendix F.4

Gamma Radiation Investigation Reports

- F.4.1 Gamma Radiation Scanning Survey Report, Final. March 26, 2014
- F.4.2 Radionuclide Identification and Characterization Survey, June 11, 2014
- F.4.3 AVESI Radiological Survey Report, December 12, 2016



Appendix F.4.1

Gamma Radiation Scanning Survey Report, Final. March 26, 2014



Peck Iron & Metal

Contract No: EP-S3-07-05 Subcontract No: EPA010AJ

Gamma Radiation Scanning Survey Report

Final

March 26, 2014

Prepared for:

Hydrogeologic (HGL) And the United States Environmental Protection Agency (USEPA)



Prepared by:

American Veteran Environmental Services, Inc. (AVESI)





EXECUTIVE SUMMARY

The Peck Iron and Metal Site is a former scrap metal storage facility that received scrap metal waste from multiple sources including the U.S. Navy. Because the Site received scrap metal from the Navy, a preliminary gamma radiation scanning survey of the Site was conducted to verify the presence or absence of radioactive material or contamination in the ground surface. The total accessible area available for the initial scan survey was 1,049,232 ft². This area was divided into five survey units and surveyed at 25% coverage. A total of 123 locations with elevated radioactivity measurements were identified, with locations identified on all five survey units. Since the survey only covered 25% of the Site and numerous areas with elevated radioactivity measurements were identified, some key recommendations were made. They include:

- developing a site Radiation Protection Plan and implementing a Radiation Protection Program to monitor individuals on the site and protect the public.
- It is recommended that a dose assessment be conducted based on current survey data for the reasonable maximally exposed scenario group (critical group). For example, what is the dose to a transient who accesses uncontrolled areas of the property? This dose assessment can be refined using data identified during further surveys.
- a more detailed investigation of the Site should be performed including radionuclide identification, a concentrated gamma radiation scan survey and areas with elevated radioactivity measurements should be controlled to preclude public access.
- a temporary Radioactive Materials Storage Area (RMSA) should be established to consolidate and isolate radioactive materials.

These recommendations are discussed in more detail in section 5.2 of this document.

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Figure 2-1 Peck Iron and Metal Survey Unit 2 Initial Survey

Figure 2-2 Peck Iron and Metal Survey Unit 2 Detailed Survey

Figure 3-1 Peck Iron and Metal Survey Unit 3 Initial Survey

Figure 3-2 Peck Iron and Metal Survey Unit 3 Detailed Survey

Figure 4-1 Peck Iron and Metal Survey Unit 4 Initial Survey

Figure 4-2 Peck Iron and Metal Survey Unit 4 Detailed Survey

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PHOTOS

Pic-Rad-01

Pic-Rad-02

Pic-Rad-04

Pic-Rad-05

Pic-Rad-08

Pic-Rad-09

Pic-Rad-09-1

Pic-Rad-10

Pic-Rad-11

Pic-Rad-12

Pic-Rad-13

Pic-Rad-14

Pic-Rad-15

ACRONYMS

μ micro

AHA Activity Hazard Analysis

AVESI American Veteran Environmental Services, Inc.

ANSI American National Standards Institute

BKG Background C-14 Carbon

cpm counts per minute cm² square centimeter

Co 60 Cobalt

COPCs Contaminants of Potential Concern

Cs 137 Cesium

dpm disintegrations per minute

USEPA United States Environmental Protection Agency

ft² square feet

GCPM gross counts per minute

GIS Geographical Information System

GPS Global Positioning System

HGL Hydrogeologic HP Health Physicist

Hr hour

HSP Health and Safety Plan

m milli M Million

NCPM net counts per minute (gross count-rate – background count-rate)

Ni 59 Nickel Ni 63 Nickel

NNSY Norfolk Navy Shipyard

NIST National Institute of Standards and Technology

NRC Nuclear Regulatory Commission
QA/QC Quality Control/ Quality Assurance

rem roentgen equivalent man
RA Radiation Program
RPP Radiation Protection Plan

RMSA Radioactive Materials Storage Area

SU Survey Unit Sr 90 Strontium

NAVY United States Navy

VA Virginia yr year

1. SURVEY OVERVIEW

The Peck Iron and Metal site is a former scrap metal storage facility that may have received scrap metal waste from multiple sources including power companies, manufacturing companies, and production facilities. A preliminary gamma radiation scan survey of the site needed to be conducted to verify the presence or absence of radiological contaminated material in the ground surface for assessing potential health and safety concerns to field sampling crews and the public.

The form of materials most likely associated with the radiological waste streams include metal cruds, deposits of nuclear reactor corrosion products removed during the servicing of nuclear powered vessels; nuclear activated metal components; and possibly nuclear gauges; sources; and/or related radioactive materials. Depending on the source material, radiological contaminants could include cobalt-60 (Co-60), nickel-59 (Ni-59), Nickel-63 (Ni-63), cesium-137 (Cs-137), strontium-90 (Sr-90), traces of plutonium isotopes, carbon-14 (C-14), and other radionuclides. At the Site, radionuclide contaminants of potential concern (COPCs) are expected to be bound to metallic materials, particulate materials or entrained in the metal matrix in the case of activation products such as C-14. Non-gamma emitting radionuclides for the purpose of this preliminary survey are assumed to be co-located with Co-60 and Cs-137.

The primary objective of this effort was to provide data sufficient to plan future actions such as demolition, remediation, characterization, decontamination, final status surveys, etc... Given the limited scope of these activities, the survey design was not necessarily intended to conclusively demonstrate compliance with regulatory standards, although data may ultimately be used to support that purpose. Data collected during this effort was to determine the presence of radiological activity within the property boundary.

Survey activities were conducted in accordance with the standard operating procedures of American Veteran Environmental Services, Inc. (AVESI). Field activities consisted of:

- Gamma radiation scan surveys of soils, asphalt, concrete, etc...
- Source dose rate surveys for whole body exposure of gamma radiation
- Beta radiation scans for field personnel, equipment, and supplies
- Alpha/Beta surface removable survey for personnel, equipment and supplies

1.1 SURVEY OBJECTIVES

The purpose of the Peck Iron and Metal Radiation Scan Survey is to identify elevated concentrations of gamma-emitting radionuclides (e.g., Co-60, Ni-59, Ni-63, Cs-137, Sr-90 and traces of plutonium isotopes) from materials contained within surface soils and bias sampling of soils with elevated gamma activity located within the Peck Iron property survey boundary. (Attachment A Figure A: Peck Iron and Metal Investigation Boundary Map) This radiation scan survey will include:

- an *initial scan* survey consisting of 25% coverage of accessible areas within the 32 acre property boundary; and
- a *detailed scan* survey consisting of 100% coverage of all areas identified during the initial scan survey as areas of elevated activity.

1.2 SCREENING CRITERIA

For personnel and equipment and supplies, dose-based limits have not yet been established. In the absence of site-specific limits, *Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86* average values for betagamma emitters were used for surface screening levels including 1000 dpm/100 cm² for removable alpha and beta activity and 5000 dpm/100 cm² for total alpha and beta activity.

For soil, gravel, concrete and asphalt media scan surveys, all material and materials that exceed 2 times the comparable reference area background (BKG) (2 X BKG) were flagged as isolated areas of elevated activity. Isolated areas of elevated activity were scanned at 100% to demonstrate size and magnitude.

Areas containing multiple isolated areas of elevated activity were combined during the detailed 100% scan survey to ensure size of elevated areas of activity were recorded.

1.3 SUMMARY OF SURVEY RESULTS

Although survey results are described in detail later in this report, the following summaries provide a brief overview.

1.3.1 Gamma Radiation Scan Survey Summary

For scanning survey purposes the 32 acre property was divided into five (5) manageable survey units based primarily on physical boundaries. (Attachment A Figure B: Peck Iron and Metal Survey Units)

<u>Survey Unit 1</u> – Eight (8) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 1 (SU-1). Upon further investigation, it was concluded that one location of elevated activity in the southern portion of SU-1 was due to the presence of a large piece of granite. The remaining seven (7) locations were surveyed at 100% and determined to be random isolated anomalies. During the detailed scan survey an additional one (1) location of isolated activity was identified in the northern central portion of SU-1 making a total of <u>8</u> confirmed radiologically impacted locations.

<u>Survey Unit 2</u> – Eight (8) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 2 (SU-2). Of these, 6 locations were located in close proximity of each other. The two remaining locations are random isolated anomalies. During the detailed scan survey an additional eight (8) locations of elevated activity were identified within the central portion of SU-2 making a total of <u>16</u> confirmed radiologically impacted locations.

<u>Survey Unit 3</u> – Six (6) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 3 (SU-3). Of these, all locations were scan surveyed at 100%. All six locations are random isolated anomalies. During the detailed scan survey an additional two (2) locations of elevated activity were identified within the central portion of SU-3 making a total of $\underline{8}$ confirmed radiologically impacted locations.

<u>Survey Unit 4</u> – Six (6) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 4 (SU-4). Of these, all locations were scan surveyed at 100%. All six locations are random isolated anomalies. During the detailed scan survey no additional locations of elevated activity were identified within SU-4 making a total of **6** confirmed radiologically impacted locations.

<u>Survey Unit 5</u> – Forty six (45) locations of elevated activity were flagged during the initial 25% scan survey of Survey Unit 5 (SU-5). Thirty one (31) locations were located in close proximity of each other. One area

contained three (3) locations in close proximity of each other and two other areas each had two (2) locations in close proximity of each other. The remaining eight (8) locations are random isolated anomalies. During the detailed scan survey an additional forty (40) locations of elevated activity were identified within SU-5 making a total of <u>85</u> confirmed radiologically impacted locations.

A total of 123 areas were confirmed to be radiologically impacted throughout the Peck Iron and Metal Property.

2. SURVEY METHODS

The following discussion presents an overview of field measurement methods used during investigation and an overview of the quality assurance/quality control (QA/QC) measures employed to assure that the data are adequate to meet project objectives.

2.1 SURVEY METHOD OVERVIEW

The survey method discusses the characteristics that make up the Gamma Radiation Scan Survey including the Site Reconnaissance, Survey Units, Reference Area Gamma Radiation Scan Survey, Initial Survey, Detailed Survey and Dose Rate Measurements.

2.1.1 Site Reconnaissance

Upon site arrival, a Site Reconnaissance was performed to orientate the Gamma Scan Surveyors with the site with regard to terrain, potential safety hazards, inaccessible areas, physical boundaries, scan survey material types and overall extent of the Peck Iron and Metal property boundaries. Potential safety hazards were addressed in the AVESI Health and Safety Plan (HSP) and Activity Hazard Analysis (AHA).

Inaccessible areas include wet and/or steep inclines, large rubble piles, debris-piles, areas of debris with overgrown vegetation, machinery, dumpsters, roll-off boxes, trailers, and areas where water was present and preventing access to other areas. Every effort was made to access as much of the site as physically possible, safely without debris or vegetation removal.

2.1.2 Survey Units

Physical boundaries were utilized to the extent possible to divide the site into manageable survey units. (Attachment A Figure C: Peck Iron Survey Unit)

- <u>SU-1</u> is bound by chain link metal fencing on the northern, western, and eastern sides. The southern boundary for SU-1 is a gravel access road that travels east and west.
- <u>SU-2</u> is not within the fenced property boundary of Peck Iron and Metal. SU-2 consists of a fence outlining the western and southern borders. An active railroad borders the northern extent of the property and the eastern border extends to the curbed right of way of Elm Ave.
- <u>SU-3</u> is bound by a chain link fence on the western border extending south until it meets the bank of the Paradise Creek and wetland area on the southern border. During the scan survey a substantial amount of snow and rain contributed to a larger inaccessible area. The northern border runs along the east west gravel road and is consistent with a fence that runs along the north eastern border. The eastern border runs a long an abandoned road that runs north and south.
- <u>SU-4</u> the western border extends along an abandoned road that runs north and south and extends to the fenced northern border. The western border terminates in the south at a specific point rather than a physical boundary. The southern border follows the Site's property boundary. The western border has no physical border and runs north and south just east of a small building.
- <u>SU-5</u> consists of a chain link fence on all sides with the exception of the western border that is shared with SU-4.

2.1.3 Reference Area Gamma Radiation Scan Survey

Reference area radiation scan surveys were conducted at the Craddock Recreational Center located at 4300 George Washington Hwy, Portsmouth, VA 23702. (Attachment A: Figure 5-1 Peck Iron & Metal Reference Area) Reference area radiation scan surveys were conducted to establish BKG radioactivity levels in soil, concrete, gravel and other materials. Background radioactivity levels in these materials are used for comparison to radioactivity level data collected during the radiation scan surveys within the Peck Iron and Metal site investigation area.

The corner coordinates for each reference area were flagged prior to the gamma walkover survey. The gamma walkover survey covered approximately 2 acres of land at 25% coverage. In addition, data was collected from similar material types found within the investigation area during the site reconnaissance. Data for soil, concrete, and asphalt material types were transferred or downloaded into Microsoft Access and a mean activity level was established. Below are the results of the reference area Gamma Scan Survey:

Media Type	Mean (cpm)	Median (cpm)	Established Background
Asphalt	11080	11145	11000
Soil	6169	5742	5700
Concrete	7481	7428	7500

Table 1-1: Reference Area Background Results

Reference Area Soil/Asphalt: After further inspection of the reference area asphalt it was determined that the asphalt at the reference area contained small fragments of granite. This was consistent with materials contained in the soils at the investigation site. Therefore, to establish consistency at both locations the soil and asphalt background was combined and the higher background was used (11,000 counts per minute [cpm]). The Asphalt mean at the reference area was 11,080 cpm. The background was established at 11,000 cpm subsequently designating the investigation level for Soil/Asphalt material to be 22,000 cpm.

<u>Reference Area Concrete:</u> the concrete mean at the reference area was 7,481 cpm. The background was established at 7,500 cpm subsequently designating the investigation level for concrete material to be 15,000 cpm (2 x BKG).

2.1.4 Data Processing and Graduated Color Assignment

Radiation scan survey data processing was completed using ArcView Geographic Information System (GIS) software and creating a graduated color range table that was applied to the radiation scan survey data. Once the data was imported into the GIS software the color ranges were set by observing the backgrounds established at the reference area and the investigation level (2 x BKG) as outlined in the tables below:

Reference Area Soil/Asphalt

Range color	Range	Range Representation
Blue	0 - 10499	Negative Background
Green	11000 - 15999	Positive Background
O Yellow	16000 - 21999	Suspected Radioactivity
Red	22000 - 1000000	Probable Radioactivity

Table 2-1: Established background for soil/asphalt

Reference Area Concrete

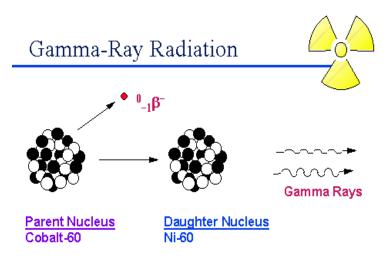
	Range color	Range	Range Representation
•	Blue	0 - 7499	Negative Background
0	Green	75000 - 11249	Positive Background
0	Yellow	11250 - 14999	Suspected Radioactivity
•	Red	15000 - 1000000	Probable Radioactivity

Table 2-2: Established background for concrete

2.1.5 Gamma Radiation

Gamma radiation is an electromagnetic wave or photon emitted from the nuclei of excited atoms following radioactive transformations (such as alpha or beta), and has no electrical charge. Because it has no mass and no charge, gamma radiation is very penetrating. Gamma rays and x rays can be thought of as physically identical. The only difference is in their origins. Gamma rays are generally emitted from the nucleus during radioactive decay, while x-rays are emitted from orbital electrons. Gamma radiation ionizes atoms as a result of direct interactions with orbital electrons.

Range - Because gamma radiation has no charge and no mass, its penetrating ability is very high (put another way, the radiation has a low probability of interacting with matter).



Terrestrial sources exist because a number of materials have remained radioactive since the formation of the earth. These natural radioactive materials are found in the ground, rocks and building materials. Some of the contributors to terrestrial sources are the natural radioactive elements radium, uranium and thorium. In fact, there are some areas in Brazil and India where the natural background radiation levels reach 3,000 mrem/year. The average dose from terrestrial sources in the United States is approximately 28 millirem per year (mrem/year).

Internal sources; our bodies contain various, naturally occurring radioactive elements, including potassium (K 40) which is one of the major contributors to non-occupational internal dose. <u>The average dose from internal sources in the United States is approximately 40 mrem/year.</u>

Major man-made sources that contribute radiation dose to the general public include:

Medical/dental sources; this includes diagnostic (such as a chest or dental x-ray) and therapeutic uses of radiation (such as radiation therapy for tumors). Because medical and dental doses are so individualized, the dose may vary from a few mrem to several thousand mrem.

The average dose from medical and dental sources in the United States is approximately 54 mrem/year.

Consumer products; some consumer products contain small amounts of radioactive material. Examples include certain ceramic dishes (usually with an orange glaze), some luminous dial watches, and some smoke detectors. These consumer products account for a very minor contribution to the background dose. The average dose from consumer products in the United States is approximately 10 mrem/year.

Other; this category includes dose from fallout caused by bomb testing, and accidents such as Chernobyl. The average dose from other sources in the United States is approximately 3 mrem/year.

Overall, the average radiation dose to a member of the general population in the United States, from background and man-made sources is approximately **360 mrem/year** or approximately **1 mrem/day**.

2.1.6 Dose Rate Measurements

Dose rates were measured with a Ludlum Model 9 meter and recorded in units of μ rem/hr and mrem/hr. All dose rates were typically obtained either on contact or at a distance of three feet. The site background dose rate is approximately 14 μ rem/hr.

 $1 \text{ rem/hr} = 10^3 \text{ mrem/hr or } 10^6 \text{ } \mu\text{rem/hr}$

2.2 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of field operations, QA/QC measures were taken to assure the usability and reproducibility of the data. The following subsections summarize these measures.

2.2.1 Instrument Quality Control

Radiological instrumentation and associated detectors were calibrated (annually) using National Institute of Standards and Technology (NIST) traceable sources and calibration equipment. Check Source Certificates, Instrument Calibration Certificates, Instrument Initial Check In paperwork, and Daily Response Check Log are in Attachment C. Instrumentation was calibrated in accordance with guidance contained in American National Standards Institute (ANSI) N323 (ANSI, 1978) and manufacturers' instructions.

An instrument identifier (A or B) was assigned to each combination of Global Positioning System (GPS) Trimble Geo XH and Ludlum 2221/44-10.

The following information was produced for each instrument:

- a background acceptance criteria was calculated; and
- a source check acceptance range was calculated.

3. GAMMA RADIATION SCAN SUMMARIES

For ease of presentation, the following subsections focus on gamma activity results as opposed to the dose rate results. Dose rates were obtained during sampling activities and will be discussed in the sampling section of this report.

3.1 RADIATION SCAN SURVEY SUMMARY

This section discusses the results of the site radiation scan survey in detail including the initial scan survey results and the detailed scan survey results for each survey unit.

3.1.1 Initial Scan Survey

The initial Scan Survey was completed at 25% coverage. The site area was 32 acres of which at least 6 acres is tidal wetlands and/or overgrown with wetland shrubs including phragmites, saw grass, and (primarily) cattails. Large areas of debris piles and buried rubble were present and in some cases impeded the scan survey. Every effort was made to complete the initial scan survey in a safe yet productive manner.

Audible response of the instrument was monitored, and locations of elevated audible response were investigated. The initial field investigation level for the gamma scans were set at 2 x BKG for each specific material present at the site. Areas exceeding 2 x BKG were flagged and investigated further during the detailed scan. The investigation level may be adjusted by the scan survey supervisor based on the deviation of the count rates encountered as the survey progresses.

<u>Survey Unit 1</u> – Seven (7) confirmed locations of elevated activity were flagged during the initial scan survey of SU-1. (Attachment A Figure 1-1: Peck Iron and Metal Survey Unit 1 Initial Survey)

<u>SU-1</u> physical description: The northern portion of SU-1 contains visible concrete pads, visible roads, subsurface concrete pads, subsurface roads and subsurface railroad bed. There were many obstacles that impeded the survey as well as buildings that may have disrupted communication with satellite signals. The southern portion of SU-1 contained more obstacles such as, machinery, trailers, abandoned vehicles, rubble, debris piles, dumpsters, roll-off boxes and mobile homes. In the southern portion of the survey unit the ground materials are more uniform and consistent. On the southwestern portion of the property access was difficult due to an existing water filled ditch and wet land. The southeastern portion of the property was not passible in areas where the rubble piles and debris piles were too dense. It was not possible to get to the property line in this area.

<u>Elevated activity</u>: In the northern portion of SU-1, seven (7) locations of elevated activity were identified during the initial scan survey ranging in activity from 150k cpm to 550k cpm. In the southern portion of SU-1, one (1) location of elevated activity was identified however, after further investigation it was determined that the activity was originating from a large piece of granite rock. Seven locations were detail scan surveyed.

<u>Survey Unit 2</u> – Eight (8) locations of elevated activity were flagged during the initial scan survey of SU-2. (Attachment A Figure 2-1: Peck Iron and Metal Survey Unit 2 Initial Survey)

<u>SU-2 physical description</u>: The northern border of SU-2 is an active railroad with a ditch that runs from east to west. One location of slightly elevated activity was located in the northern portion of SU-2 however, the activity of this location never exceeded the investigation level. Crushed debris, gravel, granite, asphalt, brick etc... are present on the north end SU-2 near the Elm street right of way and becomes more apparent when moving toward the southern end of SU-2.

<u>Elevated activity</u>: In the central portion of SU-2, six (6) locations of elevated activity were flagged during the initial scan survey ranging from 28k cpm to 310k cpm. Two other isolated areas of elevated activity were also detected, one on the bank of the ditch that runs north and south in the central portion of SU-2 and the second located at the southern border of SU-2. The activity at these locations were 150k cpm and 700k cpm respectively.

<u>Survey Unit 3</u> – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-3. (Attachment A Figure 3-1: Peck Iron and Metal Survey Unit 3 Initial Survey)

<u>Survey unit description</u>: The northern portion of SU-3 contains visible concrete pads, visible roads, subsurface concrete pads, and subsurface road. There were many obstacles that impeded the survey including large debris piles, large rubble piles and large piles of tires. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-3. The southern portion of SU-3 is bordered by Paradise Creek and contains a large area of wetlands.

Elevated activity: In the north eastern corner of SU-3, one (1) location of elevated activity was flagged during the initial scan survey at 125k cpm. In the central western portion of SU-3, two (2) locations of elevated activity were flagged during the initial scan survey at 290k cpm and 185k cpm. In the central portion of SU-3, one (1) location of elevated activity was flagged during the initial scan survey just west of the access road at 200k cpm. In the south central portion of SU-3, one (1) location of elevated activity was flagged during the initial scan survey near the bank of the Paradise Creek at 60k cpm. In the south eastern portion of SU-3, near the SU-4 border, one (1) location of elevated activity was flagged during the initial scan survey at 100k cpm.

<u>Survey Unit 4</u> – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-4. (Attachment A Figure 4-1: Peck Iron and Metal Survey Unit 4 Initial Survey)

<u>Survey unit description</u>: The northern portion of SU-4 contains visible gravel roads, subsurface concrete pads, and subsurface road. There are many obstacles that impeded the survey including large debris piles, large rubble piles and large piles of tires. One small abandoned building is located in the central western portion of the property near the access road. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-4. The southern portion of SU-4 contains large debris piles, large rubble piles and large piles of tires as well as a ditch and water retention area near the tree line. In the tree line, the slope to the adjacent property is steep and not accessible.

<u>Elevated activity</u>: One (1) location of isolated elevated activity was recorded in the north western corner of SU-4 at 40k cpm. Four (4) locations of isolated elevated activity were recorded in the south central portion of SU-4 just south of the gravel access road at 225k, 90k, 190k and 450k cpm. One (1) location of isolated elevated activity was recorded near the south western border of SU-4 at 125k cpm.

<u>Survey Unit 5</u> – Forty five (45) locations of elevated activity were flagged during the initial scan survey of Survey Unit 5 (SU-5). (**Attachment A Figure 5-1: Peck Iron and Metal Survey Unit 5 Initial Survey**)

<u>Survey unit description</u>: SU-5 contains visible gravel roads, subsurface concrete pads, and subsurface road. There were very few obstacles that impeded the survey. One large abandoned building (the former Maintenance Garage) is located in the central portion of the property near the access gravel road and one smaller building (the Shear Building) near the western border. Crushed debris, gravel, granite, asphalt, brick etc... are present throughout SU-5. The southern portion of SU-5 contains a tree line that slopes sharply to the adjacent property.

<u>Elevated activity</u>: Forty five (45) locations of elevated activity were flagged during the initial scan survey of Survey Unit 5. Thirty one (31) locations of isolated elevated activity were concentrated in the central portion

of SU-5 east of the existing large building ranging from 30k cpm to 1M cpm. Two (2) locations of isolated elevated activity were recorded in the central portion of SU-5 south of an existing building up to 150k cpm. Two (2) locations of isolated elevated activity were recorded in the south eastern portion of SU-5 up to 1M cpm. Two (2) location of isolated elevated activity were recorded in the western central area of SU-5 up to 150k cpm. Three (3) locations of isolated elevated activity were recorded in the south western corner of SU-5 up to 160k cpm. Three (3) locations of isolated elevated activity were recorded in the western portion of SU-5 up to 250k cpm. Finally, two (2) locations of isolated elevated activity were recorded in the eastern portion of SU-5 up to 250k cpm.

3.1.2 Detailed Scan Survey

<u>Survey Unit 1</u> – seven (7) locations of elevated activity were flagged during the initial scan survey of SU-1. Of these, seven locations were detailed scan surveyed in a total area of 6,272 ft². (Attachment A Figure 1-2: Peck Iron and Metal Survey Unit 1 Detailed Survey)

- Four (4) locations of elevated activity were combined and detailed scan surveyed in the northern western portion of SU-1. A total of 4,092 ft² were detailed scan surveyed. Zero (0) additional locations of elevated activity were recorded.
- Two (2) locations of elevated activity were detailed scan surveyed in the north central portion of SU-1 near the northwest corner of the building. A total of 1,570 ft² were detailed scan surveyed. One (1) additional location of elevated activity was recorded.
- One (1) location of isolated elevated activity in the north central portion of SU-1 was detailed scan surveyed. A total of 614 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity in the south central portion of SU-1 was investigated and upon further investigation, it was concluded that the activity was originating from a large piece of visible granite and this location was not detail scan surveyed.

A total of seven (7) locations of elevated activity were recorded during the initial scan survey. Another one (1) location of elevated activity was recorded during the detailed scan survey. A total of eight (8) locations of elevated activity were recorded on SU-1.

There were no locations of elevated activity identified on Concrete.

<u>Survey Unit 2</u> – Eight (8) locations of elevated activity were flagged during the initial scan survey of SU-2. All eight locations were detailed scan surveyed in a total area of 4,425 ft². (Attachment A Figure 2-2: Peck Iron and Metal Survey Unit 2 Detailed Survey)

- Six (6) locations of elevated activity were combined and detailed scan surveyed in the central portion of SU-2. A total of 3,640 ft² were detailed scan surveyed. Eight (8) additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the southern central portion of SU-2. A total of 435 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

 One (1) location of isolated elevated activity was detailed scan surveyed near the southern boundary of SU-2. A total of 350 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of eight (8) locations of elevated activity were recorded during the initial scan survey. Another eight (8) locations of elevated activity were recorded during the detailed scan survey. A total of sixteen (16) locations of elevated activity were recorded on SU-2.

There were no locations of elevated activity identified on Concrete.

<u>Survey Unit 3</u> – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-3. All six locations were detailed scan surveyed in a total area of 2,828 ft². (Attachment A Figure 3-2: Peck Iron and Metal Survey Unit 3 Detailed Survey)

- Three (3) locations of isolated elevated activity were combined and detailed scan surveyed in the north western portion of SU-3. A total of 1,469 ft² were detailed scan surveyed. Two (2) additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north eastern corner of SU-3. A total of 603 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the south eastern border
 of SU-3 near the Paradise Creek bank. A total of 378 ft² were detailed scan surveyed. Zero additional
 locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the eastern border of SU-3 just north of the access road. A total of 378 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of six (6) locations of elevated activity were recorded during the initial scan survey. Another two (2) locations of elevated activity were recorded during the detailed scan survey. A total of eight (8) locations of elevated activity were recorded on SU-3.

There were no locations of elevated activity identified on concrete.

<u>Survey Unit 4</u> – Six (6) locations of elevated activity were flagged during the initial scan survey of SU-4. All six locations were detailed scan surveyed in a total area of 2,510 ft². (Attachment A Figure 4-2: Peck Iron and Metal Survey Unit 4 Detailed Survey)

- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner
 of SU-4. A total of 381 ft² were detailed scan surveyed. Zero additional locations of elevated activity
 were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner of SU-4. A total of 318 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner
 of SU-4. A total of 500 ft² were detailed scan surveyed. Zero additional locations of elevated activity
 were recorded.

- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner
 of SU-4. A total of 373 ft² were detailed scan surveyed. Zero additional locations of elevated activity
 were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western corner
 of SU-4. A total of 557 ft² were detailed scan surveyed. Zero additional locations of elevated activity
 were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed near the south western border of SU-4. A total of 381 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of six (6) locations of elevated activity were recorded during the initial scan survey. Zero (0) locations of elevated activity were recorded during the detailed scan survey. A total of six (6) locations of elevated activity were recorded on SU-4.

There were no locations of elevated activity identified on Concrete.

<u>Survey Unit 5</u> – Forty five (45) locations of elevated activity were flagged during the initial scan survey of SU-5. All 45 locations were detailed scan surveyed in a total area of 25,287 ft². (Attachment A Figure 5-2: **Peck Iron and Metal Survey Unit 5 Detailed Survey**)

- Thirty one (31) locations of isolated elevated activity were <u>combined</u> and detailed scan surveyed in the northern central portion of SU-5 east of an existing large building. A total of 19,471 ft² were detailed scan surveyed. Thirty Seven (37) additional locations of elevated activity were recorded.
- Two (2) locations of isolated elevated activity were <u>combined</u> and detailed scan surveyed in the central portion of SU-5 south of an existing building. A total of 641 ft² were detailed scan surveyed. Two (2) additional locations of elevated activity were recorded.
- Two (2) locations of isolated elevated activity were <u>combined</u> and detailed scan surveyed in the south eastern portion of SU-5. A total of 1,328 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- Three (3) location of isolated elevated activity were <u>combined</u> and detailed scan surveyed in the western central area of SU-5. A total of 1500 ft² were detailed scan surveyed. One (1) additional location of elevated activity was recorded.
- Three (3) locations of isolated elevated activity were <u>combined</u> and detailed scan surveyed in the south western corner of SU-5. A total of 1,221 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the north western portion of SU-5. A total of 380 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the central western portion of SU-5. A total of 373 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

- One (1) location of isolated elevated activity was detailed scan surveyed in the south western portion of SU-5. A total of 196 ft² were detailed scan surveyed. The most elevated point of this location is just north of the existing concrete pad. Zero additional locations of elevated activity were recorded.
- One (1) location of isolated elevated activity was detailed scan surveyed in the far western portion of SU-5 near the western border. A total of 177 ft² were detailed scan surveyed. Zero additional locations of elevated activity were recorded.

A total of forty five (45) locations of elevated activity were recorded during the initial scan survey. Another forty (40) locations of elevated activity were recorded during the detailed scan survey. A total of eighty five (85) locations of elevated activity were recorded on SU-5.

There were no locations of elevated activity identified on concrete.

4. SOIL SAMPLING

A total of 15 soil samples were collected for radiological analysis. Samples were collected at the highest and lowest activity recorded on each survey unit totaling ten (10) samples. The remaining five (5) samples were discretionary samples obtained at elevated locations near possible migration routes such as ditches, low lying areas creek banks, existing traffic areas, etc... The analysis of these samples were not complete prior to the conclusion of this report.

4.1 SOIL SAMPLING SUMMARY

This section discusses the description of the collected samples including the location, depth, activity and if possible the identity of the source and origin of the gamma radiation activity. Although in most cases the source and origin of the radioactivity were obtained, the source of the activity was <u>not</u> included in any of the samples. The samples focused on the collection of soil only.

4.1.1 Survey Unit 1

<u>Soil sample RAD-04</u> was obtained at the 2nd lowest activity location identified as SU1-07. Due to a substantial amount of rain and snow, the lowest activity location (SU1-01 @ 150,000 cpm) was under water and therefore not sampled. The source of the radioactivity was due to a piece of what looks to be copper wire insulation. (**Attachment B Photo: Pic-Rad-04**)

<u>Soil sample RAD-05</u> was obtained at the highest activity location identified SU1-04. The source of the radioactivity was due a piece of what looks to be copper wire insulation. (**Attachment B Photo: Pic-Rad-05**) After the soil samples were collected, the pieces of what looks to be copper wire insulation were returned to the sample location.

Table 4-1: SU-1 soil sample and source material supplementary data

				Depth of	Size of				
				Point	Point		Dose @3		
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample
		_					, , ,	/ · · · · · · · · · · · · · · · · ·	
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(μrem/hr)	(BKG 10708 cpm)	Type
RAD-04	2/5/2014	Time 1101	SU1-07	(inches) 6"	(inches) 3"	Source (µrem/hr)	(μrem/hr) 14	(BKG 10708 cpm) 11984	Type L

Note: Dose BKG is 14 µrem
L = Lowest cpm sample location in the Survey Unit
H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm QC = Quality Control Split sample location D = Discretionary sample location

4.1.2 Survey Unit 2

<u>Soil sample RAD-01</u> is a discretionary sample obtained due to its proximity to an existing drainage ditch that runs north and south. The source of the radioactivity was the result of a 2" non-magnetic circular disk. (**Attachment B Photo: Pic-Rad-01**)

<u>Soil sample RAD-02</u> was obtained at the lowest activity location identified on SU-2. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. (**Attachment B Photo: Pic-Rad-02**)

<u>Soil sample RAD-03</u> was obtained at the highest activity location identified on SU-2. The source of the radioactivity was never identified. Approximately 8" below the ground surface the sampler encountered a concrete or asphalt obstruction. The gamma readings at this location exceeded the scale of the gamma

detector and the dose rate meter. The soil sample was collected and the sample location was filled in. No photo was taken.

After the soil samples were collected, the circular disk and deteriorated metal pieces were returned to the respective sample locations.

Table 4-2: SU-2 soil sample and source material supplementary data

					menui y uuu							
				Depth of	Size of							
				Point	Point		Dose @3					
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample			
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(µrem/hr)	(BKG 10708 cpm)	Туре			
RAD-01	2/5/2014	0918	SU2-08	0-6"	1.5"	900	20	14716	D			
RAD-02	2/5/2014	0950	SU2-02	3-6"	>1"	110	14	20721	L			
RAD-03	2/5/2014	1010	SU2-07	NA	NA	NA	NA	10647	Н			

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit H = Highest cpm sample location in the Survey Unit Gamma Activity BKG = 10.708 cpm QC = Quality Control Split sample location D = Discretionary sample location

4.1.3 Survey Unit 3

<u>Soil sample RAD-06</u> a discretionary sample was obtained due to its proximity to Paradise Creek. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. No picture was taken.

<u>Soil sample RAD-07</u> was obtained at the highest activity location identified on SU-3. The source of the radioactivity was due to a rusted and deteriorated object. There was activity present in the sample and at the sample location after sampling. No picture was taken.

<u>Soil sample RAD-08</u> was obtained at the lowest activity location identified on SU-3. The source of the radioactivity was due to a rock material.

After the soil samples were collected the rock like item and rusted material were returned to the respective sample locations. (Attachment B Photo: Pic-Rad-08)

Table 4-3: SU-3 soil sample and source material supplementary data

				Depth of	Size of				
				Point	Point		Dose @3		
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(µrem/hr)	(BKG 10708 cpm)	Type
RAD-06	2/5/2014	1235	SU3-05	NA	NA	NA	NA	21921	D
RAD-07	2/5/2014	1445	SU3-02	NA	NA	NA	NA	27814	Н
RAD-08	2/5/2014	1514	SU3-06	0-3'	1"	135	14	12744	L

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit H = Highest cpm sample location in the Survey Unit

Gamma Activity BKG = 10.708 cpm QC = Quality Control Split sample location D = Discretionary sample location

4.1.4 Survey Unit 4

<u>Soil sample RAD-09</u> was obtained at the highest activity location identified on SU-4. The source of the radioactivity was due to a button shaped object with a crystal or glass center. After the soil sample was collected the button shaped object was returned to the sample location. (**Attachment B Photo: Pic-Rad-09 and Pic-Rad-09-1**)

<u>Soil sample RAD-10</u> was obtained at the lowest activity location identified on SU-4. The source of the radioactivity was due to a liquid filler aviation gauge. The gauge was solid brass painter black. The face of gauge is black with white markings. After the soil sample was collected the liquid filler aviation gauge was returned to the sample location. (**Attachment B Photo: Pic-Rad-10**)

Table 4-4: SU-4 soil sample and source material supplementary data

				Depth of	Size of				
				Point	Point		Dose @3		
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(µrem/hr)	(BKG 10708 cpm)	Type
RAD-09	2/5/2014	1540	SU4-05	0-3"	>1"	2100	14	14279	Н
RAD-10	2/5/2014	1630	SU4-01	12"	8" X 3"	2500	25	14445	1

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit H = Highest cpm sample location in the Survey Unit Gamma Activity BKG = 10.708 cpm QC = Quality Control Split sample location

D = Discretionary sample location

4.1.5 Survey Unit 5

<u>Soil sample RAD-11</u> was obtained at one of the highest activity locations identified on SU-5. The source of the radioactivity was a piece of broken curved plastic. (**Attachment B Photo: Pic-Rad-11**)

<u>Soil sample RAD-12</u> was obtained at the 3rd lowest activity location (80,000 cpm) identified on SU-5. The lowest activity sample location in SU5 (SU5-02 @ 50,000 cpm) was sampled as a discretionary sample due to its proximity to flowing water. Due to excessive amounts of precipitation, the second lowest activity sample location (SU5-06 @ 60,000 cpm) was under water and therefore not sampled. The source of the radioactivity was a button shaped object. (**Attachment B Photo: Pic-Rad-12**)

<u>Soil sample RAD-13</u> was obtained due to its proximity to Elm St. The source of the radioactivity was a plastic circular disk. After the soil sample was collected a duplicate sample was also collected. The plastic circular disk was falling apart. (**Attachment B Photo: Pic-Rad-13**)

<u>Soil sample RAD-14</u> was obtained due to its proximity to a water migration pathway. The source of the radioactivity was a button shaped object with a crystal or glass center. (**Attachment B Photo: Pic-Rad-14-1**)

<u>Soil sample RAD-15</u> was obtained at the lowest activity location identified on SU-5. The source of the radioactivity was a metal circular disk. (**Attachment B Photo: Pic-Rad-15-1**)

Two additional locations were chosen for Quality Control spilt samples RAD-12 and RAD-13. After the soil samples were collected the broken piece of plastic, button shaped objects, the plastic circular disk and the metal circular disk was returned to the respective sample locations.

Table 4-5: SU-5 soil sample and source material supplementary data

				Depth of Point	Size of Point		Dose @3		
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(µrem/hr)	(BKG 10708 cpm)	Type
RAD-11	2/6/2014	0830	SU5-08	6-9"	1.5"	<5000	150	34192	Н
RAD-12	2/6/2014	0905	SU5-09	0-3"	1"	1000	14	11367	L/QC1
RAD-13	2/6/2014	0935	SU5-10	6"	1.5"	1800	15	12234	D/QC2
RAD-14	2/6/2014	1011	SU5-12	3"	1"	800	14	11534	D
RAD-15	2/6/2014	1030	SU5-02	>1"	2.5"	180	14	11532	D

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit H = Highest cpm sample location in the Survey Unit Gamma Activity BKG = 10.708 cpm QC = Quality Control Split sample location

D = Discretionary sample location

The supplemental data for all soil samples collected on all survey units are listed in Table 4-6: All soil sample and source material supplementary data.

Table 4-6: All soil sample and source material supplementary data

<u> </u>	TITE SOIL SWITE	e mila boar	ce material ba	promonent y					
				Depth of	Size of				
				Point	Point		Dose @3		
Sample				Source	Source	Dose on Contact	Feet Source	Soil Sample CPM	Sample
ID	Date	Time	Hot Spot ID	(inches)	(inches)	Source (µrem/hr)	(µrem/hr)	(BKG 10708 cpm)	Type
RAD-01	2/5/2014	0918	SU2-08	0-6"	1.5"	900	20	14716	D
RAD-02	2/5/2014	0950	SU2-02	3-6"	>1"	110	14	20721	L
RAD-03	2/5/2014	1010	SU2-07	NA	NA	NA	NA	10647	Н
RAD-04	2/5/2014	1101	SU1-07	6"	3"	250	14	11984	L
RAD-05	2/5/2014	1202	SU1-04	1"	2.5"	900	14	11179	Н
RAD-06	2/5/2014	1235	SU3-05	NA	NA	NA	NA	21921	D
RAD-07	2/5/2014	1445	SU3-02	NA	NA	NA	NA	27814	Н
RAD-08	2/5/2014	1514	SU3-06	0-3'	1"	135	14	12744	L
RAD-09	2/5/2014	1540	SU4-05	0-3"	>1"	2100	14	14279	Н
RAD-10	2/5/2014	1630	SU4-01	12"	8" X 3"	2500	25	14445	L
RAD-11	2/6/2014	830	SU5-08	6-9"	1.5"	<5000	150	34192	Н
RAD-12	2/6/2014	905	SU5-09	0-3"	1"	1000	14	11367	L/QC1
RAD-13	2/6/2014	935	SU5-10	6"	1.5"	1800	15	12234	D/QC2
RAD-14	2/6/2014	1011	SU5-12	3"	1"	800	14	11534	D
RAD-15	2/6/2014	1030	SU5-02	>1"	2.5"	180	14	11532	D

Note: Dose BKG is 14 µrem

L = Lowest cpm sample location in the Survey Unit H = Highest cpm sample location in the Survey Unit Gamma Activity BKG = 10.708 cpm

QC = Quality Control Split sample location D = Discretionary sample location

Table 4-7: Detailed Survey and Sample Log

Flagged ID	Northing	Easting	44-10 CPM (Contact)	Dose Rate on Contact (Micro Rem/hr)	Dose Rate @ 3 Feet (Micro Rem/hr)	Size (sqft)
SU1-01	3461915	12124307	150K	140	15	>1
SU1-02	3461951	12124304	210K	190	14	>1
SU1-03	3461969	12124295	280K	28	16	>1
SU1-04	3462000	12124298	550K	310	18	>2
SU1-05	3461993	12124436	380K	420	18	>2
SU1-06	3461881	12124360	290K	380	24	>2
SU1-07	3461849	12124348	160K	180	24	>1
SU2-01	3461396	12125595	210K	110	19	>1
SU2-02	3461368	12125600	28K	39	10	>1
SU2-03	3461363	12125581	310K	210	26	>1
SU2-04	3461350	12125572	85K	90	13	>1
SU2-05	3461375	12125561	100K	110	23	>1
SU2-06	3461219	12125616	42K	45	14	>1
SU2-07	3461078	12125614	700K	900	60	>2
SU2-08	3461328	12125614	150K	60	19	>1
SU3-01	3461043	12124432	125K	120	14	>1
SU3-02	3460829	12124100	290K	190	23	>2
SU3-03	3460814	12124115	185k	120	18	>1
SU3-04	3460719	12124180	200K	200	24	>1
SU3-05	3460507	12124198	60K	60	14	>1
SU3-06	3460590	12124449	100K	50	14	>1
SU4-01	3461065	12124612	40K	40	14	>1
SU4-02	3460693	12124793	225K	110	14	>1
SU4-03	3460654	12124704	90K	50	14	>1
SU4-04	3460589	12124660	190K	100	15	>1
SU4-05	3460582	12124617	450K	210	20	>2
SU4-06	3460490	12124470	125K	130	14	>1
SU5-01	3461056	12125417	<1000K	2900	170	6
SU5-02	3460936	12124947	50K	40	14	>1
SU5-03	3461023	12124966	225K	120	14	>1
SU5-04	3460896	12125082	250K	200	30	>1
SU5-05	3460958	12125117	250K	200	20	>1
SU5-06	3460968	12125212	60K	50	14	>1
SU5-07	3460937	12125239	150K	300	18	>1
SU5-08	3460904	12125501	<1000K	1000	150	6
SU5-09	3460943	12125634	80K	40	14	>1
SU5-10	3460912	12125729	240K	280	15	>2
SU5-11	3460803	12124961	160K	60	16	>1
SU5-12	3461076	12126368	150K	220	14	>1

Note 1: Bold Italicized IDs denotes sampled locations Note 2: Dose BKG is 14 µrem

Table 4-7: Detailed Survey and Sample Log

5. CONCLUSION

5.1 Results

The total site area is 33.49 acres or 1,458,824 ft². Of which, 24.9 acres or 1,049,232 ft² was accessible and subjected to initial scan survey. Results of the initial scan survey identified 123 locations requiring a more detailed 100% scan survey totaling 0.95 acres or 41,326 ft².

A total of 85 elevated activity locations were recorded during the initial scan survey and 38 elevated locations were identified during a more concentrated detailed scan survey for a total of 123 elevated activity locations.

A total of 15 samples were obtained and in most cases, the source of the radioactivity was obtained and photographed.

All locations of radioactivity were relatively small in size (<2 ft²) suggesting activity emanating from single point sources. At three locations the objects that were the origin of radioactivity had corroded and deteriorated leaving behind small rust particles of radioactivity which may have spread into the soil.

During personnel and equipment surveying, there were no incidents of removable or easily transferrable radioactivity. All personnel and equipment were free released from the site.

There were no locations of elevated activity recorded on concrete.

Survey Unit 1

The total area of the SU-1 is approximately 8 acres or 348,464 ft² of which approximately 75% or 261,348 ft² (6 acres) were accessible for initial scan survey. Of the 261,348 ft² of area that was subjected to initial scan survey only 6,276 ft² (0.144 acres) required detailed scan survey. A total of 8 locations of elevated radioactivity were recorded.

Survey Unit 2

The total area of the SU-2 is approximately 2.73 acres or 118,843 ft² of which approximately 85% or 101,017 ft² (2.32 acres) were accessible for initial scan survey. Of the 101,017 ft² of area that was subjected to initial scan survey only 4,425 ft² (0.10 acres) required detailed scan survey. A total of 16 locations of elevated radioactivity were recorded.

Survey Unit 3

The total area of the SU-3 is approximately 9.84 acres or 428,634 ft² of which approximately 60% or 257,180 ft² (5.90 acres) were accessible for initial scan survey. Of the 257,180 ft² of area that was subjected to initial scan survey only 2,828 ft² (0.065 acres) required detailed scan survey. A total of 8 locations of elevated radioactivity were recorded.

Survey Unit 4

The total area of the SU-4 is approximately 7.46 acres or 324,916 ft² of which approximately 70% or 227,441 ft² (5.22 acres) were accessible for initial scan survey. Of the 227,441 ft² of area that was subjected to initial scan survey only 2510 ft² (0.058 acres) required detailed scan survey. A total of 6 locations of elevated radioactivity were recorded.

Survey Unit 5

The total area of the SU-5 is approximately 5.46 acres or 237,937 ft² of which approximately 85% or 202,246 ft² (4.64 acres) were accessible for initial scan survey. Of the 202,246 ft² of area that was

subjected to initial scan survey 25,287 ft² (0.58 acres) required detailed scan survey. A total of 85 locations of elevated radioactivity were recorded.

Future soil intrusion activities at the Peck Iron and Metal site may pose a few challenges when considering the safety of the public and workers. AVESI has confirmed the presence of radioactive materials within the soils of the Peck Iron and Metal site however, the extent of the hazard is still unknown.

The total accessible area available for initial scan survey was 1,049,232 ft². This area was surveyed at 25% coverage where 85 locations of elevated activity were identified on all five survey units. A statistical argument could be made that as many as 340 elevated areas could be recorded if a detailed survey were performed on the entire property.

The radiation scan survey characterizes elevated radioactivity within the top 6 inches of soil. Radioactive materials in subsurface soils remains unknown due to the fact that site soils have been disturbed, removed or replaced with non-native fill materials.

5.2 Recommendations

It is recommended that a Radiation Protection Program (RA) with a site Radiation Protection Plan (RPP) be developed and implemented to assist and protect the public and site personnel during future intrusive soil activities. The RPP at a minimum should include sections addressing radiological hazards, radiological controls, training, dosimetry, monitoring, and posting and labeling.

It is recommended that an effort to identify the existing areas of elevated activity be performed using a handheld radionuclide identifier such as the "identiFidner". The identification of these areas by radionuclide will be the basis of the development of the RA and RPP.

It is recommended that a dose assessment be conducted based on current survey data for the reasonable maximally exposed scenario group (critical group). For example, what is the dose to a transient who accesses uncontrolled areas of the property? This dose assessment can be refined using data identified during further surveys.

It is recommended that all known areas of elevated activity that are <u>not controlled</u> (SU-2) within the fenced area of Peck Iron and Metal be removed and stored within the fenced area.

It is recommended that <u>all</u> future soil intrusion work is supported by the radiation protection plan and health physicists (HP).

It is recommended that a temporary Radioactive Materials Storage Area (RMSA) be established in the rear of the property.

The previous recommendations will serve the purpose to identify and control radioactive materials while providing a safe work environment for the future.

6. GLOSSARY

Accessible area – For the purposes of this plan, areas where safety considerations or other restrictions allowed access for survey activities.

CPM, counts per minute – For purposes of this survey, the count-rate measured by the Ludlum Model 2221/44-10. CPM = counts per minute (as read).

Detailed Scan Survey – For purposes of this survey, is a scan performed with the intent to cover 100% of the investigation area.

Exposure rate – The amount of ionization produced per unit time in air by X-rays or gamma rays. For purposes of this survey, the unit of exposure rate is microrem per hour (μ rem/hr), i.e., 10^{-6} rem/hr or milliRem per hour (μ Rem/hr), i.e., 10^{-3} rem/hr.

Initial Scan Survey – For purposes of this survey, is scan a performed with the intent to cover 25% of the investigation area.

Investigation level – For purposes of this survey, is two times the natural background (2 x BKG) obtained outside of the known investigation area.

Discretionary Sample – Samples obtained at locations selected using professional judgment based on unusual appearance, location relative to known contaminated areas, high potential for residual radioactivity, general supplemental information, etc...

Reference area – For purposes of this survey, the Craddock Recreational Facility is the reference area. This is the area from which representative reference measurements are performed for comparison with measurements performed in specific Investigation Area.

Scan survey – An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

Survey unit – For purposes of this survey, a portion of the property boundary investigation area with a common point-of-origin. For purposes of summarizing data.

7. REFERENCES

- NRC (United States Nuclear Regulatory Commission) 1974, *Termination of Operating Licenses for Nuclear Reactors*, NUREG-1.86, June.
- NRC (United States Nuclear Regulatory Commission) 1997, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, NUREG-1.86, December.
- NRC 2006. Decommissioning Process for Materials Licensees, NUREG-1757, September.
- ANSI (American National Standards Institute) 1997. American National Standards Radiation Protection Instrumentation Test and Calibration, ANSI N323A-1997.

ATTACHMENT A: FIGURES

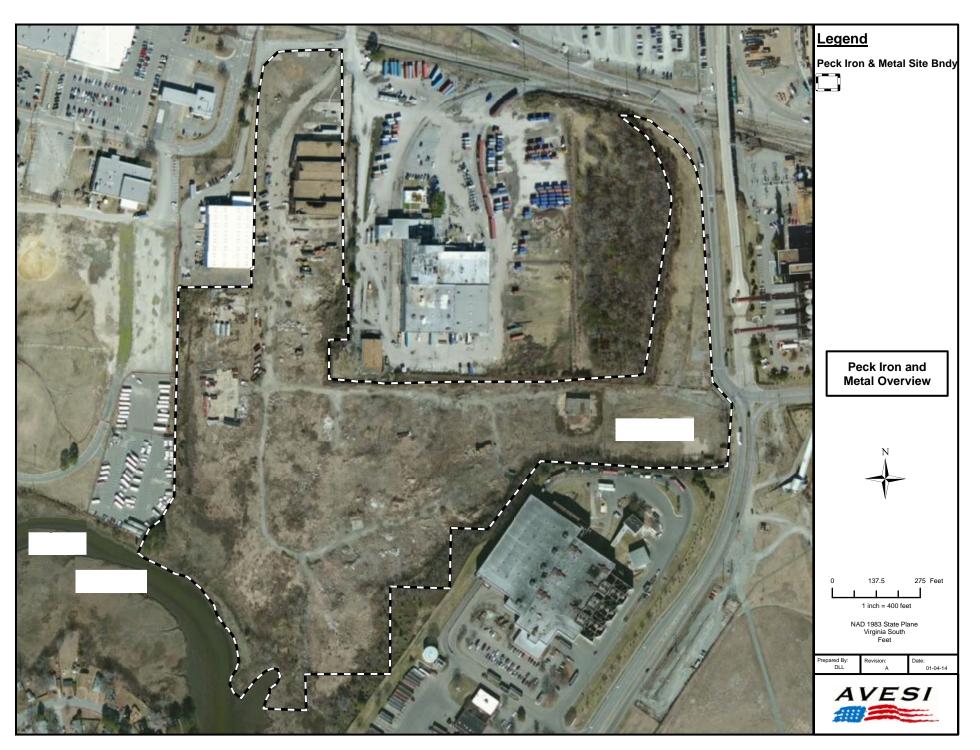


Figure A: Peck Iron and Metal Investigation Boundary

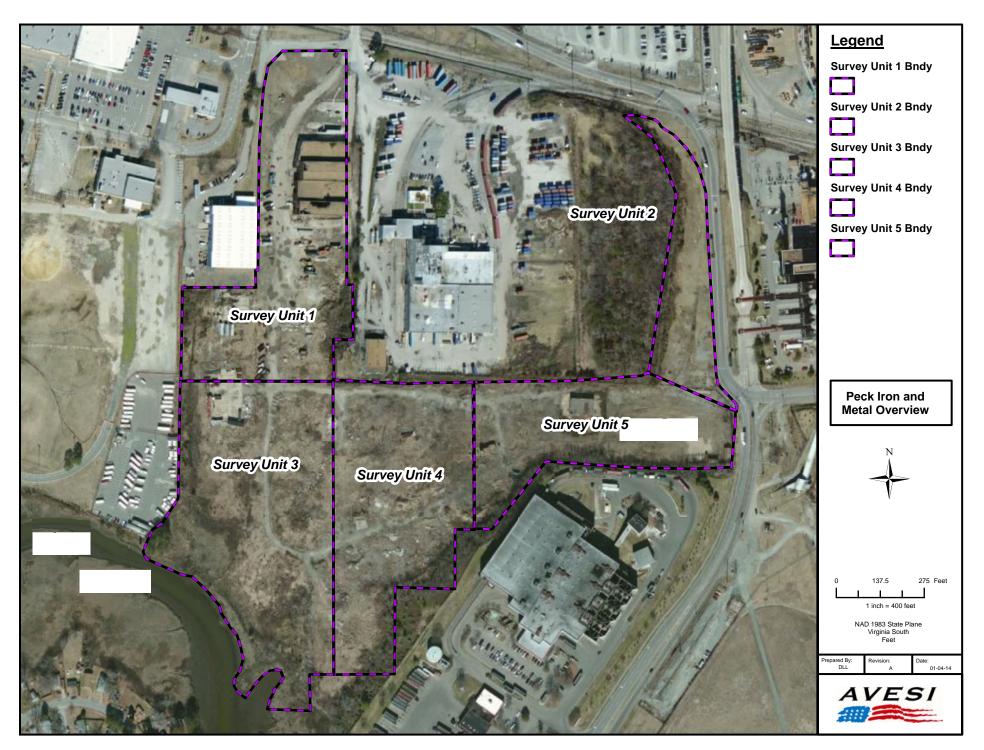


Figure B: Peck Iron and Metal Survey Units

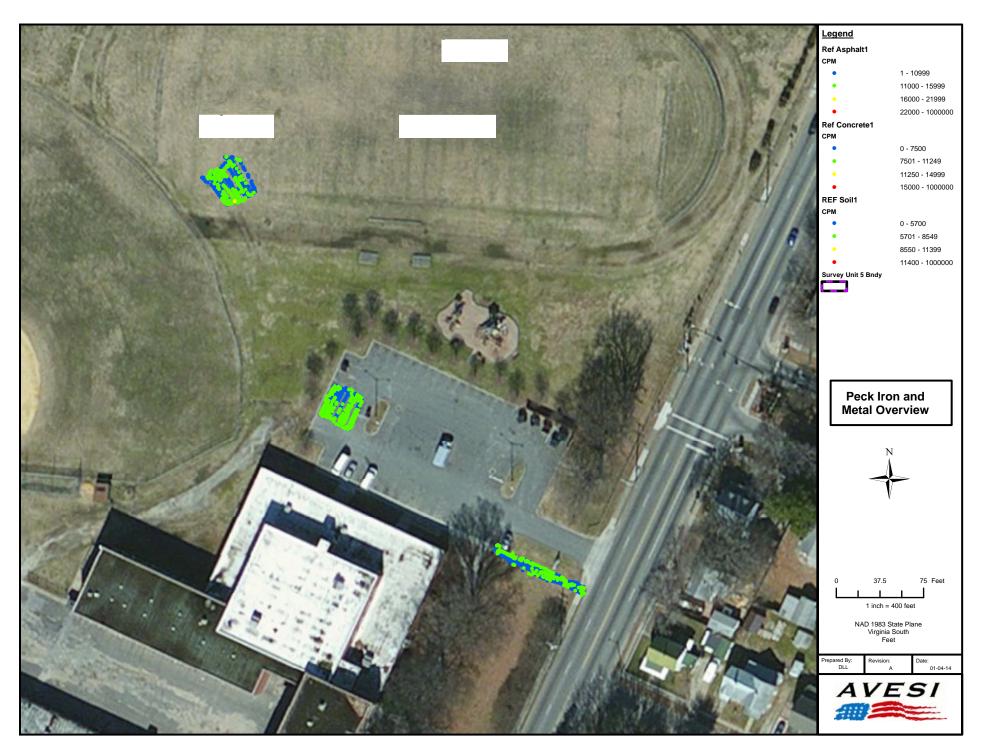


Figure C: Peck Iron and Metal Reference Area



Figure 1-1: Peck Iron and Metal Survey Unit 1 Initial Survey

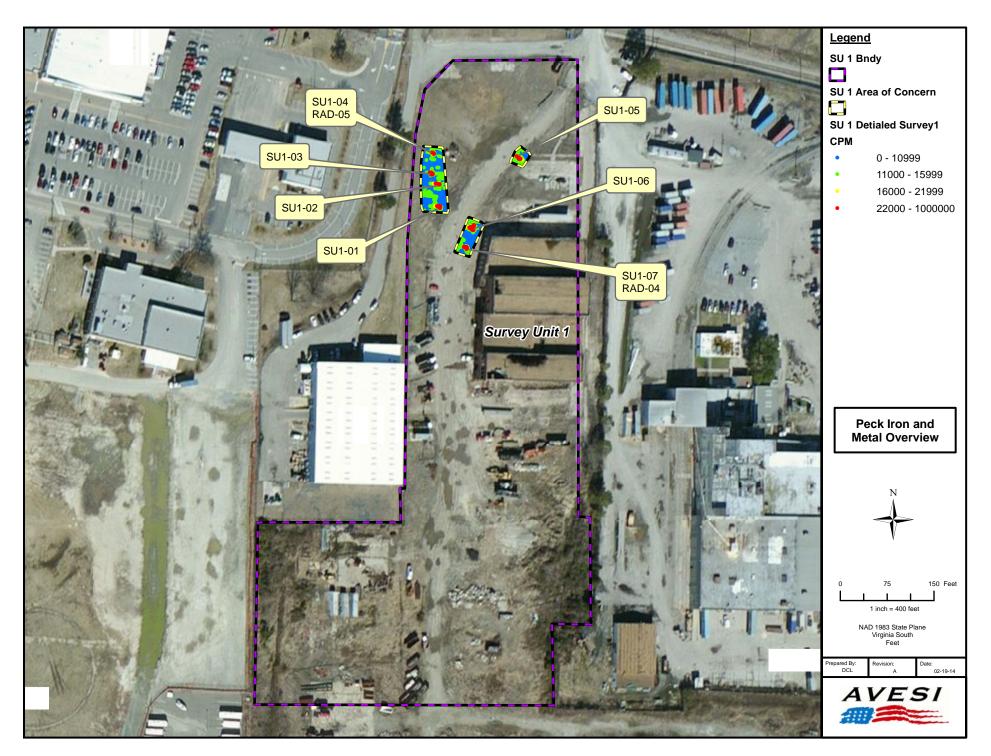


Figure 1-2: Peck Iron and Metal Survey Unit 1 Detailed Survey

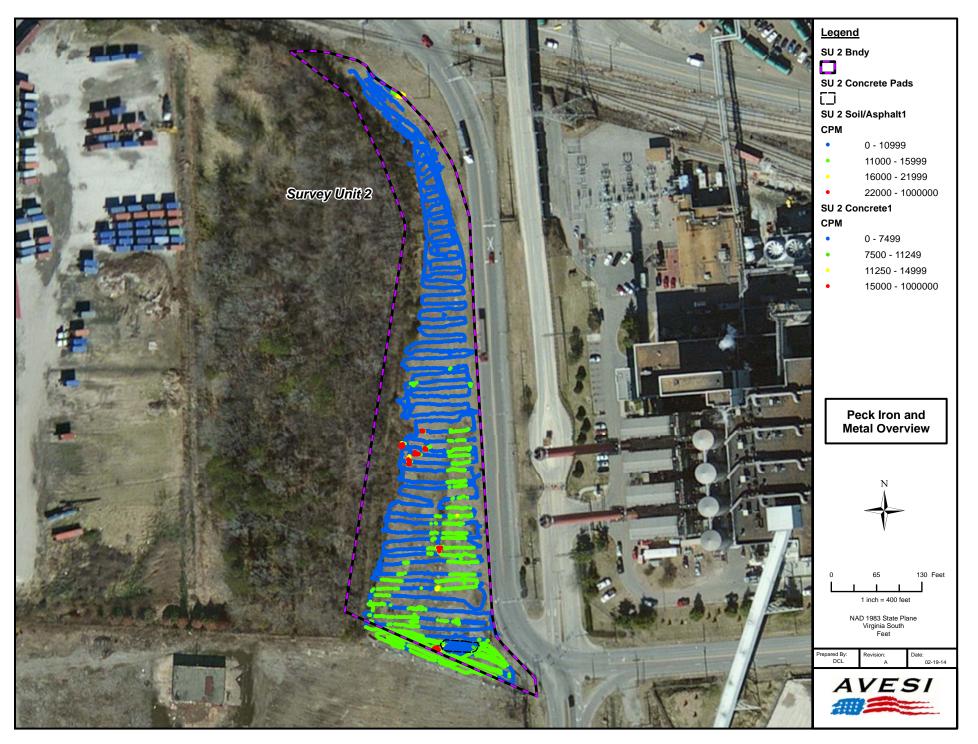


Figure 2-1: Peck Iron and Metal Survey Unit 2 Initial Survey

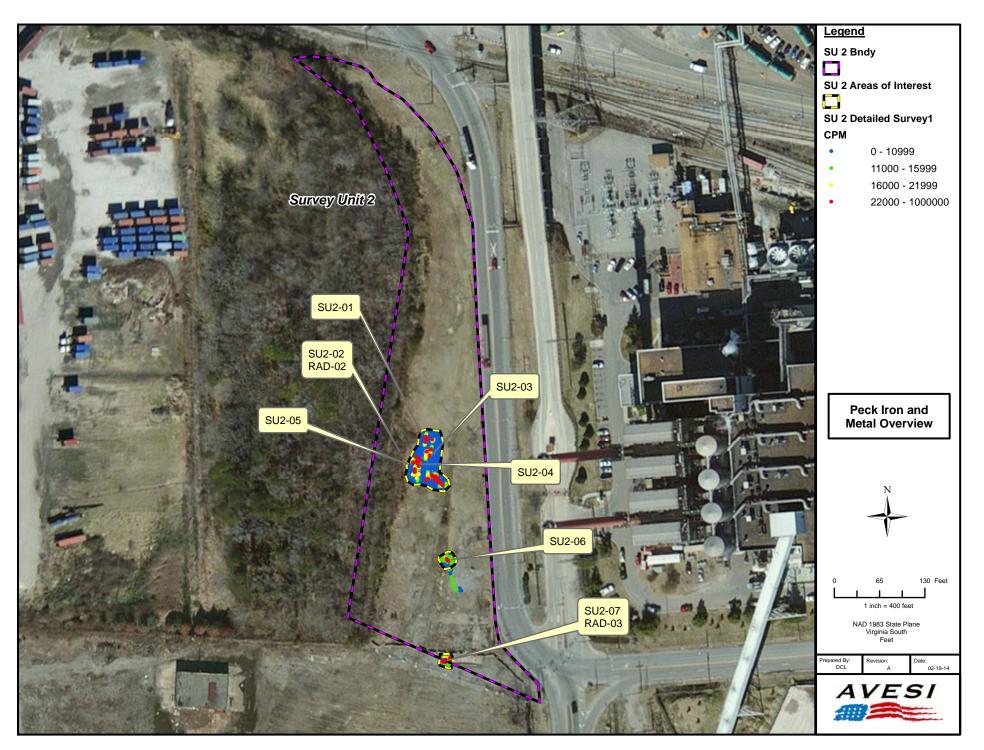


Figure 2-2: Peck Iron and Metal Survey Unit 2 Detailed Survey

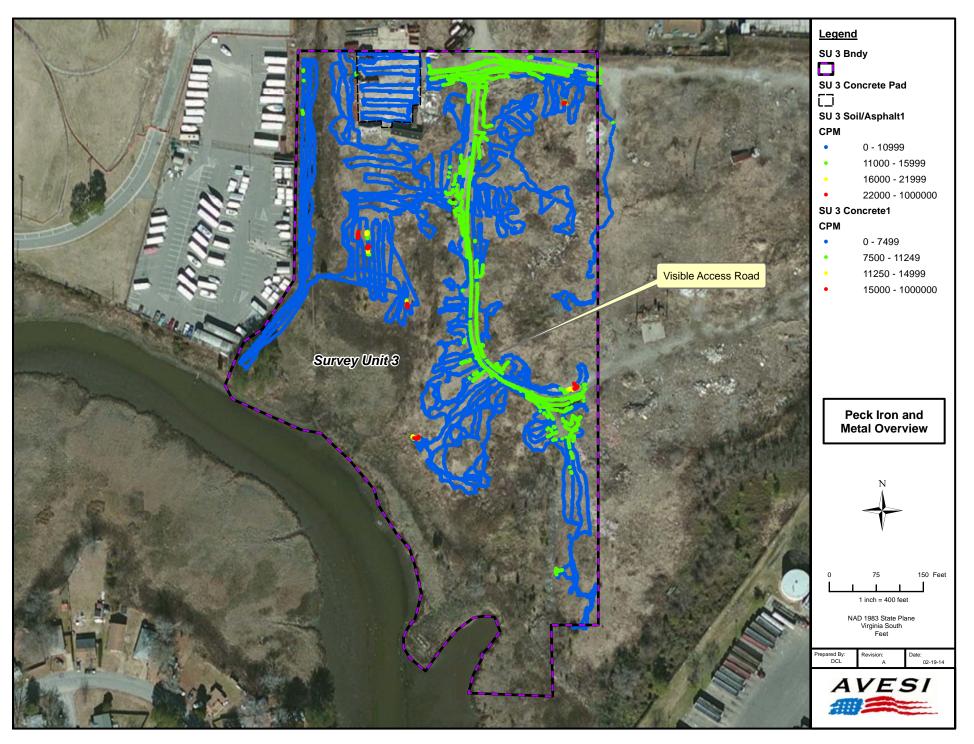


Figure 3-1: Peck Iron and Metal Survey Unit 3 Initial Survey

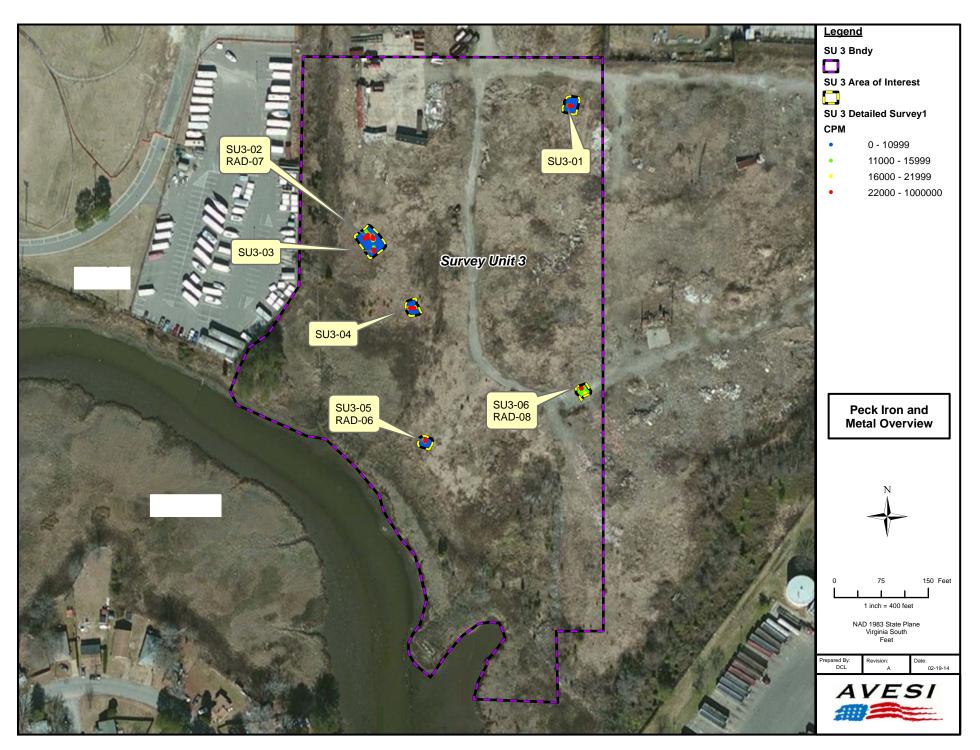


Figure 3-2: Peck Iron and Metal Survey Unit 3 Detailed Survey

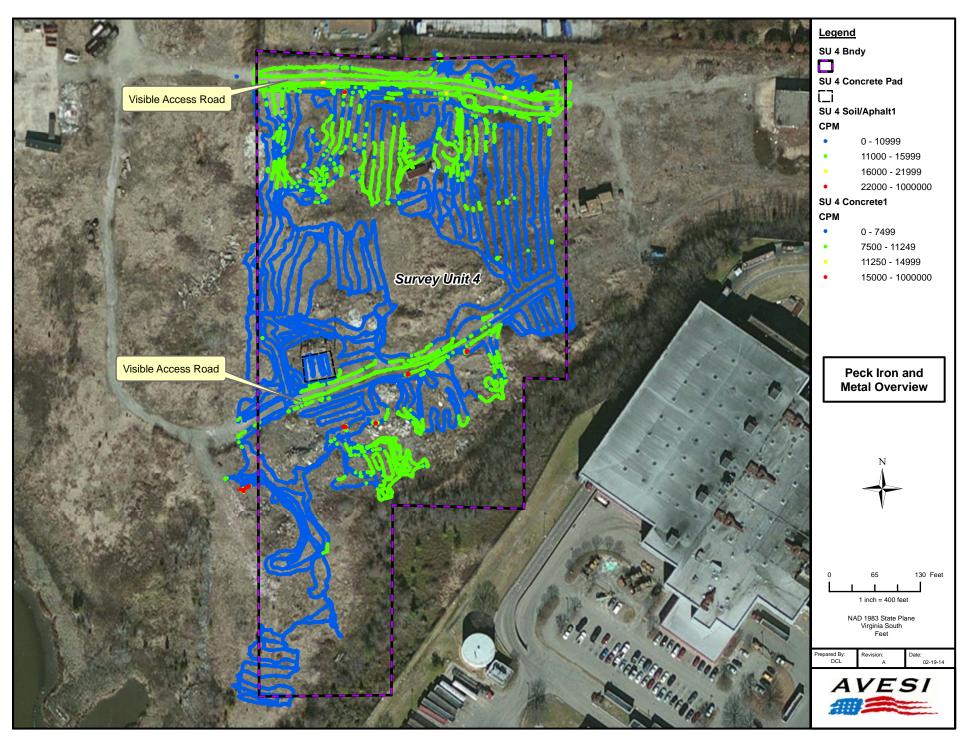


Figure 4-1: Peck Iron and Metal Survey Unit 4 Initial Survey

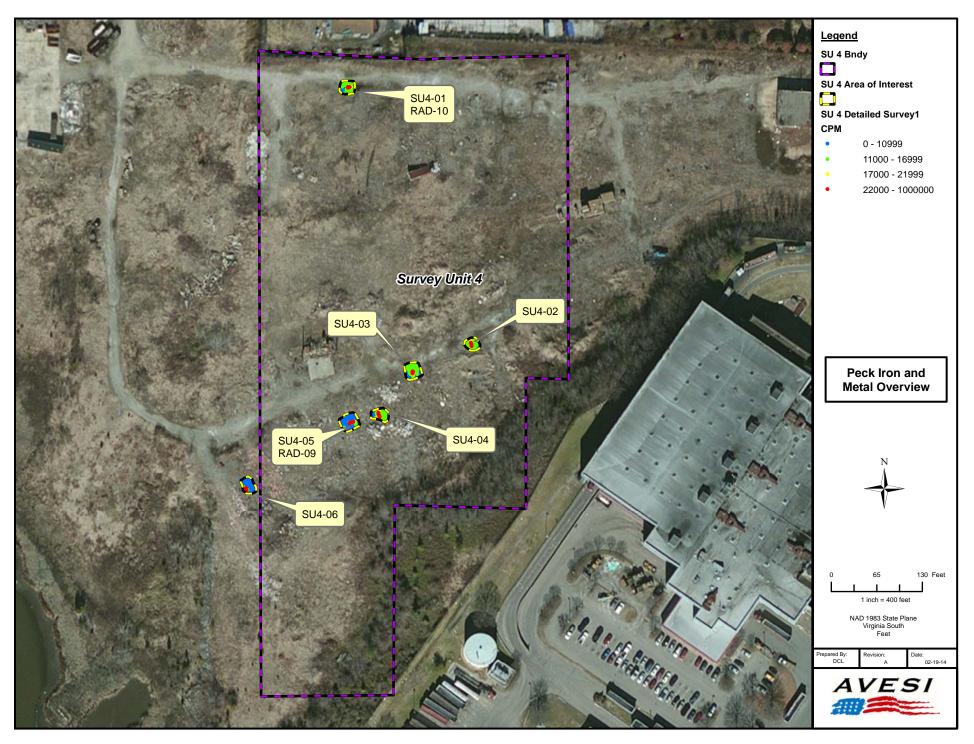


Figure 4-2: Peck Iron and Metal Survey Unit 4 Detailed Survey

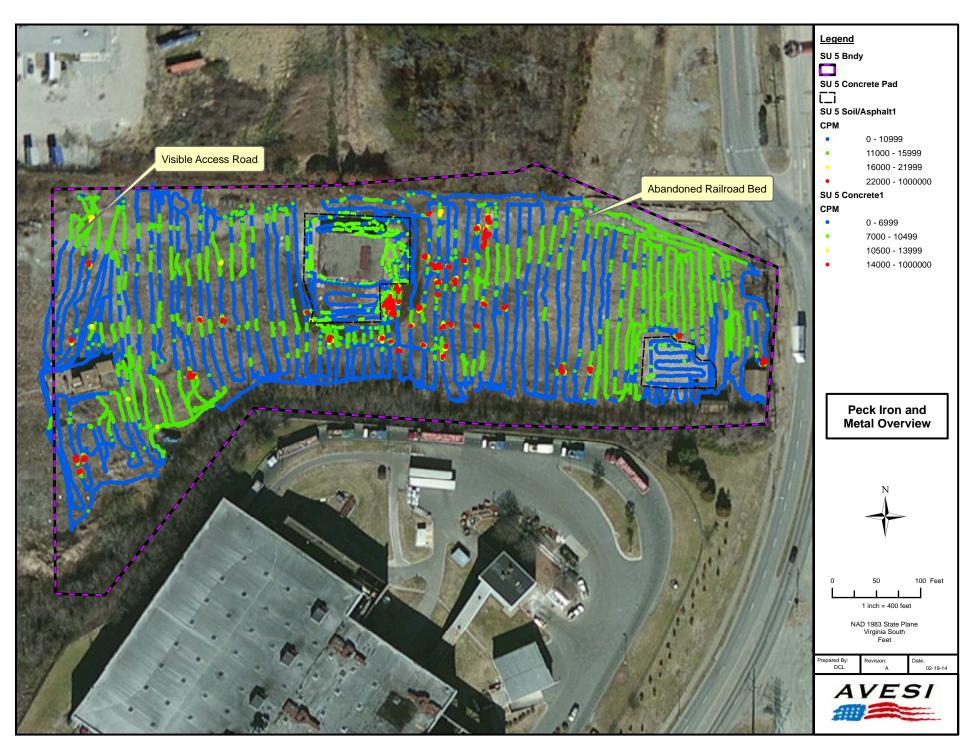


Figure 5-1: Peck Iron and Metal Survey Unit 5 Initial Survey

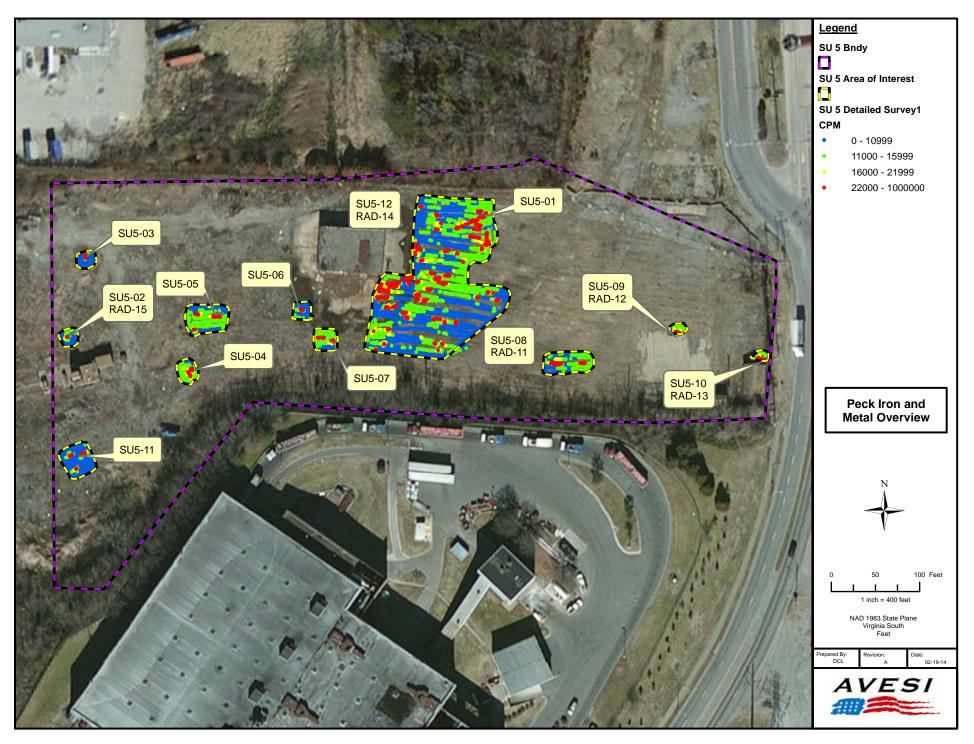
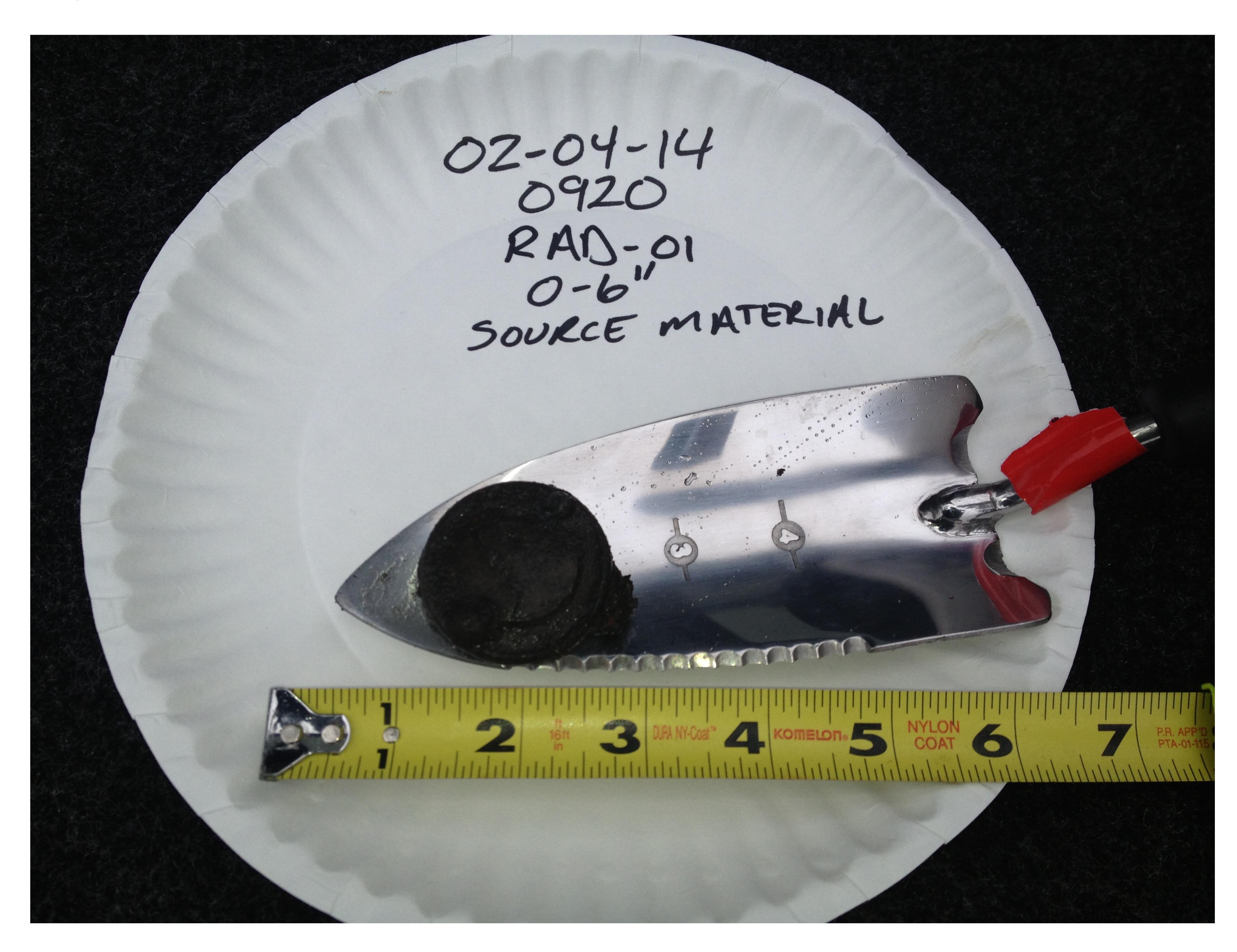


Figure 5-2: Peck Iron and Metal Survey Unit 5 Detailed Survey

ATTACHMENT B: PHOTOS





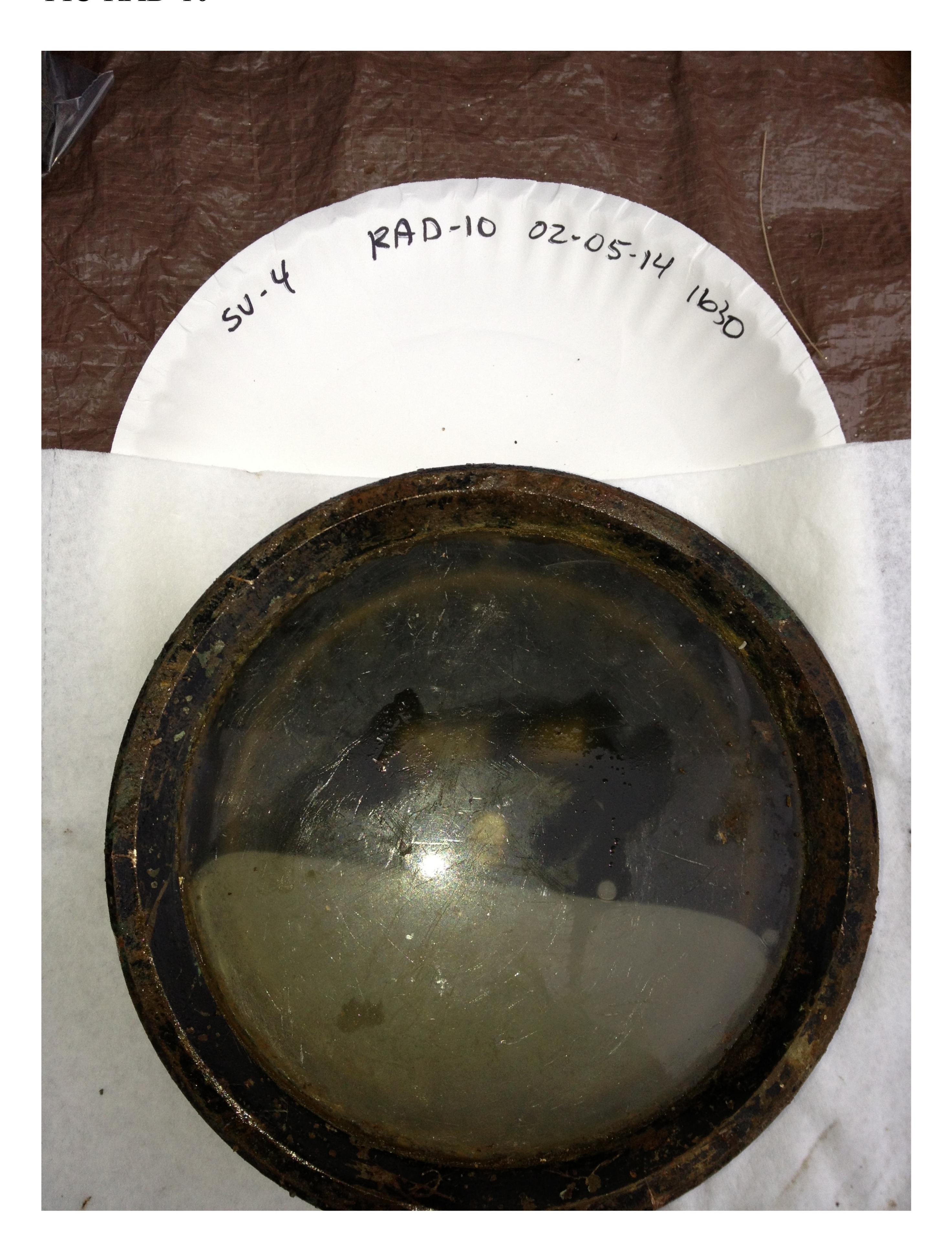










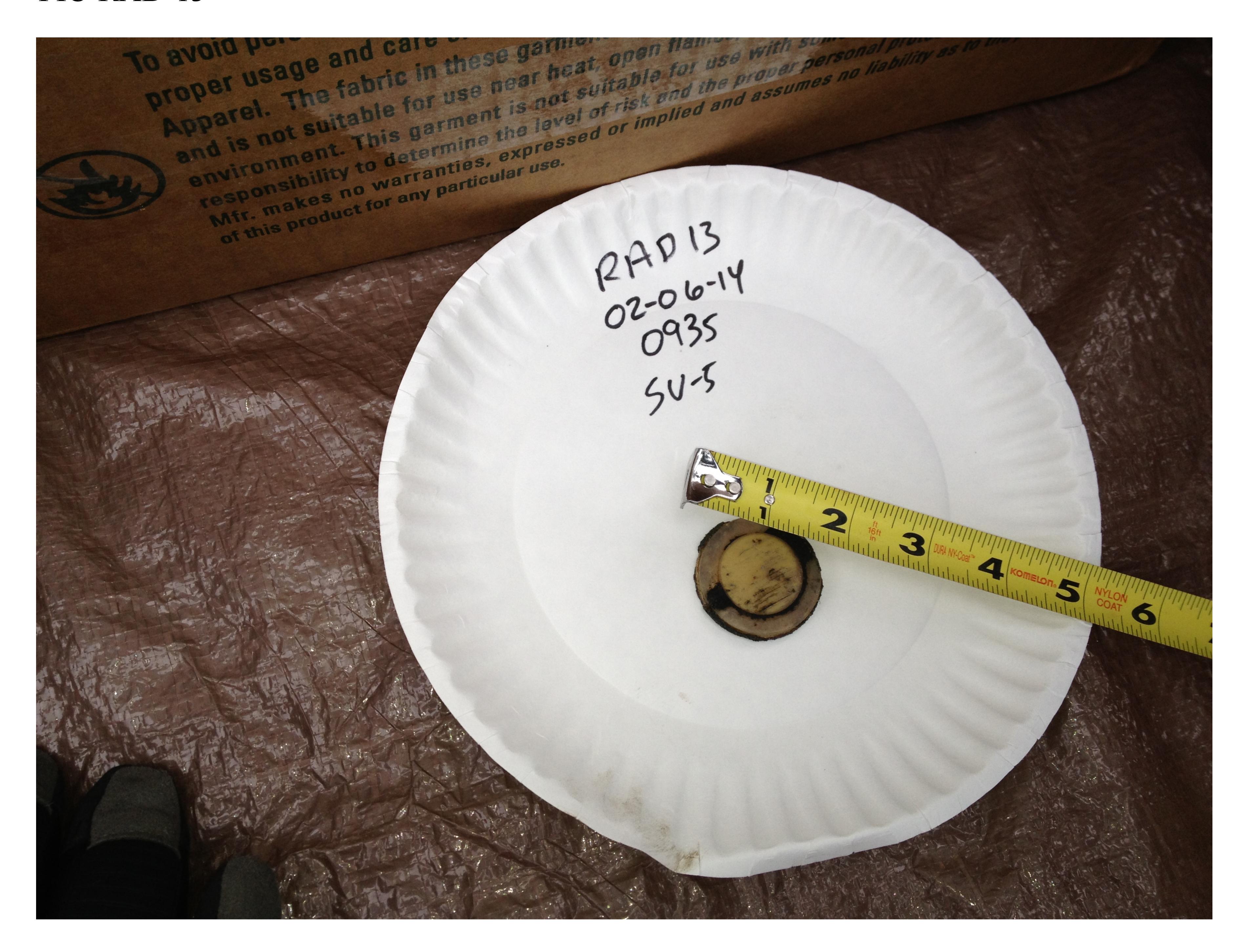






PIC-RAD-12-1





PIC-RAD-13-1





PIC-RAD-14-1



PIC-RAD-15



PIC-RAD-15-1



ATTACHMENT C: INSTRUMENTATION

Initial Instrument Check In							
	Meter Number:	<u>282985</u>	Detector Number:	303725			
	Meter Model:	<u>2221</u>	Detector Model:	44-10			
	Cal. Due:	<u>2/8/2013</u>	Cal. Due:	<u>2/8/2013</u>			
ALPHA	Source Type:		Threshold:	N/A			
ALPHA	Source #:	. 11	High Voltage:	N //			
ALPHA	Source Activity:	NIA					
ALPHA	Source count time:		Background count time:	N /A (min)			
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	#DIV/0!			
ALPHA			Average Source (GCPM):	#DIV/0!			
ALPHA			Average Net Source (NCPM):	#DIV/0!			
ALPHA	1	1	Source Range (GCPM):	#DIV/0! to #DIV/0!			
ALPHA			Background Range (CPM):	#DIV/0! to #DIV/0!			
ALPHA	AAA	NA	Determined Efficiency:	#DIV/0!			
ALPHA	N	14 / /					
ALPHA			20% of Bkg.	#DIV/0!			
ALPHA			1 Standard Deviation of Bkg.	#DIV/0!			
ALPHA			3 Standard Deviations of Bkg.	#DIV/0!			
ALPHA							

Beta / Gamma (circle one)

BETA	Source Type:	CS-137	Threshold:	10 mV		
BETA	Source #:	235	High Voltage:	1100 V		
BETA	Source Activity:	1 uCi				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	9,647		
BETA	50,404	9,252	Average Source (GCPM):	49,660		
BETA	49,529	9,275	Average Net Source (NCPM):	40,014		
BETA	49,541	9,668	Source Range (GCPM):	39,728	to	59,592
BETA	49,631	9,587	Background Range (CPM):	7,717	to	11,576
BETA	49,666	9,680	Determined Efficiency:	N/A		
BETA	49,712	9,608				
BETA	49,466	10,034	20% of Bkg.	1929		
BETA	49,272	9,855	1 Standard Deviation of Bkg.	243		
BETA	50,087	9,669	3 Standard Deviations of Bkg.	729		
BETA	49,295	9,838				

Performed By: Date: 1-27-14

Reviewed By: New (RPM / Asset RPM)

Date: 2 /9/14



INSTRUMENTATION QC CHECK LOG

METER: 2221/44-10 # 303725

DATE (MO/YR):

Jan/Feb 2014

		- TEIX. 222 1744-10 # 303723		DATE (MOTTIC). Callife CB 2014					
Sou	rce		Acceptan	ce Criteria			Model	Number	Cal. Due
Туре	CS-137	Bkgrd. QC (cpm) range		(cpm) range	Meter	2221	282985	2/8/2013
Number	235	7,717 to	11,576		o 59,592	Detector	44-10	303725	2/8/2013
Date	Time	Pre-use Bkg cpm	Post Bkg cpm ¹	Pre-Use Source cpm	Post Source cpm ¹	Bat Check	HV Check	Pre-Use HPT Initials	Post HPT Initials ¹
28-Jan	0738	10031	N/A	48520	N/A	5.6	1113	DK	N/A
30-Jan	0800	10208	N/A	48668	N/A	5.6	1107	DK	N/A
31-Jan	0727	8079	N/A	47979	N/A	5.5	1104	DK	N/A
1-Feb	0812	9590	N/A	48259	N/A	5.5	1107	DK	N/A
2-Feb	0740	10017	N/A	50232	N/A	5.4	1103	DK	N/A
3-Feb	0803	9210	N/A	49001	N/A	5.4	1104	DK	N/A
				N	A				

Todamina count inicitation of committation of volinication carrol of control	1	Gamma scan instruments u	sed for confirmation	or verification surveys	require a post check-in
--	---	--------------------------	----------------------	-------------------------	-------------------------

Mark Tope

Date:

Certificate of Calibration

Meter Calibration

Serial Number: 282985

Model: 2221

Manufacturer: Ludlum

Calibration Date: 02/13/2014

76 F

Customer: AVESEI

Service Ticket Number: 0000000949

Calibration Interval: 1 Year

Calibration Next Due: 02/13/2015

Environmental Measurements

Temperature:

Humidity:

21 % Altitude: 660

Barametric Pressure:

29.26 " Ha

Analog Readout

Digital F	Readout
-----------	---------

Log	Scal	e R	ead	out
-----	------	-----	-----	-----

Ref. Count	Multiplier	Pre-Cal	Post-Cal
400	1,000.0	400	400
100	1,000.0	100	100
400	100.0	400	400
100	100.0	100	100
400	10.0	400	400
100	10.0	100	100
400	1.0	400	400
100	1.0	100	100

Ref. Count	Pre-Cal	Post-Cal
400,000	399,954	399,878
40,000	39,996	39,997
4,000	3,999	4,000
400	400	400
40	40	40

Ref. Count	Pre-Cal	Post-Cal
500,000	500,000	500,000
50,000	50,000	50,000
5,000	5,000	5,000
500	500	500
50	50	50

Reference Instruments

Multimeter S/N: 93470436 Pulser S/N: 201462

Comments: None

Calibrated By:

But I Fromt

Reviewed By: Will of In

Review Date : 2-13-14

Bob French

(314) 770-3000

Calibration Summary/Additional Instrument Checks

Ticket Number: 0000000949

Customer: AVESEI

Serial Number: 282985

Calibration Date: 02/13/2014

Frequency: 1 Year

Calibration Due Date: 02/13/2015

Additional Instrument Checks

✓ Mechanically OK

✓ F/S Response OK

✓ Audio OK

✓ Meter Zero OK

✓ Reset OK

✓ Geotropism OK

✓ Window OK

Cable:

3 foot

Technician: E

Bob French

Comments:

None

Certificate of Calibration

Detector Calibration

Serial Number: 303725

Model: 44-10

Manufacturer: Ludlum

Calibration Date: 02/13/2014

Customer: AVESEI

Service Ticket Number: 0000000950

Calibration Interval: 1 Year

Calibration Next Due: 02/13/2015

Gamma Source Information

Serial Number: SAIC-0003

Isotope: Cs-137

Assay Date: 04/06/2004 2pi Activity: N/A

dpm 4pi Activity: 12,497,836 dpm

Background Counts (cpm)

Gamma As Left 4,240 Source Counts (cpm)

Gamma As Left 90,779

Calibration Instrument Used

Serial Number: 282985

Model: 2221

Manufacturer: Ludlum

Instrument Settings

High Voltage: Gamma Threshold 1,200 Volts

10.0 mV

Comments: No efficiency calculated, use for qualitative data only

Calibrated By:

But I Frank Reviewed By: Nich Vite

Review Date: 2-/3-/4

Bob French

Calibration Due Date: 02/13/2015

(314) 770-3000

Calibration Certificate PLATEAU CALIBRATION

Calibration	Background Counts	Source Counts
Model #:	303725	Source I.D.: $\frac{Sqic - \infty 03}{MA}$

Calibration	Background Counts	Source Counts
Points		
(Volts)		
300		
350		
400		
450		
500		
550		
600		
650		
700		
750		
800		
850		
900		
950	3748	89782
1000	7856	9042
1050	4032	91237
1100	4186	90542
1150	4/73	90586
1200	4240	90779
1250	4230	9/275
1300	4211	91883
1350	4649	101433
1400		
1450		
1500		

Determined HV Settings:	1200	Determined Threshol	ld Setting:	10 mV
Reviewed By: West	Vota	Date:	2-13-1	4



	Initial Instrument Check In											
	Meter Number: Meter Model:		1427 221	Detector Number: Detector Model:	PR150784 44-10							
	Cal. Due:	Charles and the Control of the Contr	/2015	Cal. Due:	1/6/2015							
ALPHA ALPHA	Source Type: Source #:		T	Threshold: High Voltage:	NIA							
ALPHA ALPHA	Source Activity: Source count time:	N	A	Background count time:	NIA	(min)						
ALPHA ALPHA	Source GCPM	BK	G CPM	Average Bkg. (CPM): Average Source (GCPM):	#DIV/0! #DIV/0!							
ALPHA ALPHA		44444		Average Net Source (NCPM): Source Range (GCPM):	#DIV/0! #DIV/0!	to #DIV/0!						
ALPHA ALPHA	IA		A	Background Range (CPM): Determined Efficiency:	#DIV/0! #DIV/0!	to #DIV/0!						
ALPHA ALPHA ALPHA ALPHA	N I	N		20% of Bkg. 1 Standard Deviation of Bkg. 3 Standard Deviations of Bkg.	#DIV/0! #DIV/0! #DIV/0!							
ALPHA				9								

Beta / Gamma (circle one)

					the sales of the sales	
BETA	Source Type:	CS-137	Threshold:	10 mV		
BETA	Source #:	235	High Voltage:	1200 V		
BETA	Source Activity:	1 uCi				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	9,599		
BETA	46,150	9,368	Average Source (GCPM):	47,306		
BETA	47,421	8,984	Average Net Source (NCPM):	37,707		
BETA	47,526	9,630	Source Range (GCPM):	37,845	to	56,768
BETA	47,211	9,525	Background Range (CPM):	7,679	to	11,519
BETA	47,390	9,296	Determined Efficiency:	N/A		
BETA	47,445	9,278				
BETA	47,620	10,457	20% of Bkg.	1920		
BETA	47,404	9,771	1 Standard Deviation of Bkg.	410		
BETA	47,503	9,832	3 Standard Deviations of Bkg.	1231		
BETA	47,393	9,848				

Performed By Sold Date: 1-27-14

Reviewed By: Naus RPM) Date: 2/9/14



INSTRUMENTATION QC CHECK LOG

METER: 2221/44-10 # PR150784

DATE (MO/YR):

Jan/Feb 2014

11401110141	LITIALIO	A GO CHECK LC	NIE.	IER. 2221/44-101	7 1 1(150704	DAI	E (IVIO/TK).	- Jaini C	#D ZU14
Sou	rce	The second secon		ce Criteria			Model	Number	Cal. Due
Туре	CS-137	Bkgrd. QC	(cpm) range	Source QC	(cpm) range	Meter	2221	271427	1/6/2015
Number	235		o 11,519		o 56,768	Detector	44-10	PR150784	1/6/2015
Date	Time	Pre-use Bkg cpm	Post Bkg cpm ¹	Pre-Use Source cpm	Post Source cpm ¹	Bat Check	HV Check	Pre-Use HPT Initials	Post HPT Initials ¹
28-Jan	0734	9602	N/A	49982	N/A	5.2	1207	DK	N/A
30-Jan	0804	10010	N/A	46858	N/A	6.1	1203	DK	N/A
31-Jan	0729	8847	N/A	48073	N/A	6	1201	DK	N/A
1-Feb	0810	9482	N/A	46858	N/A	5.9	1203	DK	N/A
2-Feb	0742	9745	N/A	48286	N/A	5.8	1201	DK	N/A
3-Feb	0800	8705	N/A	44790	N/A	5.7	1202	DK	N/A
4-Feb	1031	9224	N/A	50337	N/A	5.7	1205	DK	N/A
5-Feb	0836	9663	N/A	49976	N/A	5.7	1205	DK	N/A
6-Feb	0800	9734	N/A	50319	N/A	5.7	1206	DK	N/A
				N A					

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By: (

Date: 2/9/14

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc. 8809 Washington St NE, Suite 150 Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	S	erial Number:	2714	427
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	S	erial Number:	PR15	0784
✓ Mechan ✓ F/S Res ✓ Geotrop	ponse Check	✓ THR/WIN Operat✓ Reset Check✓ Audio Check	ion			500 V ☑ 1000 ch ☑ 72-inch		0 V
Meter Z Source Dis Source Geo	Zeroed stance: ☐ Conta ometry: ✓ Side	Battery Check (Moderate of the control of the cont	ther: ther:	Threshold: Window:	10 mV	Barometric Pressu Temperatur Relative Humidit	re: 73	inches Hg °F %
Range/Mul	ltiplier Re	ference Setting	"As Found Read	ing" M	leter Reading	Integra		og Scale Coun
x 100	0	400	400		400	4007		400
x 100	00	100	100		100			100
x 100		40	400		400	4006	59	400
x 100		10	100		100	7,000	ee i	100
x 10		4	400		400	400	7	400
x 10		1	100		100	400		100
			400		400	401	ſ	400
x 1 x 1		400 100	100		100	401)	100
High Vol	ltage	Source Counts	Ва	ickground		Volta	age Plateau	1
800		13458						
900		35493				80000	*.	
950		45495				70000	**	
1000		54990				50000	1	
1050		62013				40000		
1100		65797				30000		
1150		68770				10000		
1200		70221		10983		0 +		
1250		71869				300 020	1050 11	50 750
Comment	s: HV Plateau S	caler Count Time = 1-	min. Recommend	ded HV = 120	0			

Reference I	instruments and/or sources:				
Ludlum puls	ser serial number: ☐ 97743 🗹 201932	F	uke multimeter	serial number: 87490	112
Alpha Soi	urce: Th-230 @ 12,800 dpm (1/4/12) sn: 4098	3-03 ✓	Gamma Source	e Cs-137 @ 5.2 uCi (1/4	/12) sn: 4097 - 03
☐ Beta Sour	rce: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-	03	Other Source:		
Calibrated By:		Calibration Date	: 1-6-14	Calibration Due:	1-6-15
Reviewed By:	(A. /le	Date: 1/6	114		

SAIC ST. LOUIS

HP-30 Rev. 1
Attachment 2

	Initial Instrument Check In											
	Meter Number: Meter Model: Cal. Due:	157329 2929 10/22/2014	Detector Number: Detector Model: Cal. Due:	207851 43-10-1 10/22/201	4							
ALPHA	Source Type:	Th-230	Threshold:	180 mV								
ALPHA	Source #:	4006-02	High Voltage:	850 V								
ALPHA	Source Activity:	26,100										
ALPHA	Source count time:	1	Background count time:	10		(min)						
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	2.6	and the same of th							
ALPHA	9,490	1	Average Source (GCPM):	9,392								
ALPHA	9,340	3	Average Net Source (NCPM):	9,389								
ALPHA	9,392	2	Source Range (GCPM):	7,511	to	11,267						
ALPHA	9,362	3	Background Range (CPM):	-0.3	to	5.5						
ALPHA	9,363	1	Determined Efficiency:	36.0%								
ALPHA	9,383	3										
ALPHA	9,352	3	20% of Bkg.	0.5								
ALPHA	9,486	3	1 Standard Deviation of Bkg.	1.0								
ALPHA	9,468	3	3 Standard Deviations of Bkg.	2.9								
ALPHA	9,281	4										

Beta / Gamma (circle one)

BETA	Source Type:	SrY-90	Threshold:	4 mV		
BETA	Source #:	5442-05	High Voltage:	850 V		
BETA	Source Activity:	3,534				
BETA	Source count time:	1 min.	Background count time:	10		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	548		
BETA	1,359	537	Average Source (GCPM):	1,347		
BETA	1,321	560	Average Net Source (NCPM):	798		
BETA	1,367	532	Source Range (GCPM):	1,077	to	1,616
BETA	1,379	562	Background Range (CPM):	499	to	597
BETA	1,367	544	Determined Efficiency:	22.6%		
BETA	1,307	579				
BETA	1,258	532	20% of Bkg.	110		
BETA	1,368	531	1 Standard Deviation of Bkg.	16		
BETA	1,379	546	3 Standard Deviations of Bkg.	49		
BETA	1,361	561				

Performed By Date: 1-27-14

Reviewed By: Date: 2/9/14



INSTRUMENTATION QC CHECK LOG

METER: 2929/43-10-1

DATE (MO/YR):

Jan/Feb 2014

	MIAHOR				LIV. LULUITO		DATE (IVI			aii/i CD 2014
Met	ter		Acceptano	e Criteria					ha α	
Number	Cal. Due	Bkgrd. QC	(cpm) range	Source QC (Source Type	Source Number	Ins	t. Efficiency	Inst. Avg. Bkgrd.
157329	10/22/2014	Alpha	Beta	Alpha	Beta	Th-230	4006-02		36.0%	2.6
Dete	ctor	0	499	7,511	1,077				ta β	
Number	Cal. Due	to	to	to	to	Source Type	Source Number	Ins	t. Efficiency	Inst. Avg. Bkgrd.
207851	10/22/2014	5.5	597	11,267	1,616	SrY-90	5442-05		22.6%	548
Date	Time	Bkgrd. (QC (cpm)	Source Q	C (ncpm)	Bat Check	QC ¹	HPT		Comment
		Alpha	Beta	Alpha	Beta	Sat/Unsat	Sat/Unsat	Initials		
28-Jan	0740	2	556	9148	1362	Χ	Х	DK		
6-Feb	1124	3	576	9461	1399	X	X	DK		
4										
			n commence				OF CHARLES IN CO.			
							 			
										The second secon
				- 107 - 12 F A1						
							A. Property of the second			
							NAME OF THE PERSON			
					6.0					
							 			
									<u> </u>	

¹ An unsatisfactory QC check requires the recording the result in the comment column and repeating the evaluation. Tag the instrument out of service and notify the HP Supervisor upon failing the QC check two times in succession

Reviewed By: Marie Type

Date: 2/9/14

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc. 8809 Washington St NE, Suite 150 Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

Meter/Detector	r: Manufa		Ludlum	Model Nur		& 43-10-1	Serial Numb		9 & PR	
✓ Mechanical ☐ F/S Respons ☐ Geotropism	e Check	☐ Reset			Cable	Length: 🗸	%): ✓ 500 V 39-inch ☐ 7	72-inch C	Other:	
☐ Meter Zeroe					Alpha Thr		mV Barome		24.81	inches H
Source Distance			w 🗹 Other		Beta Thre Beta Wind			Temperature: ve Humidity:	75 20	°F %
Source Geometr Instrument for					Beta wind	10W: 50	mv Keiati	ve Humidity:	20	70
instrument for	-		<u> </u>		Integrated 1	-Min. Count	Integrated	l-Min. Count		
	Range/M	Iultiplier	Reference	Setting	"As F	ound" β	"Re α	ading" β		
	x 10	000	400 K	cpm	400296	400313	400296	400313		
	x 1	00	40 Kc	•	40032	40031	40032	40031		
	x	10	4 Kc	pm	4002	4004	4002	4004		
	X	1	400 c	pm	400	401	400	401		
	High Voltage	Pot. Setting	$^{Alpha}_{\alpha}$	Source B	Beta α	Source B	Back	kground β		
	750	3.02	4507	264	7	2779	1	52		
	800	3.24	4819	292	3	3577	2	60		
	850	3.44	4836	509	6	4057	0	77		
	900	3.64	4860	726	2	4951	2	80		
Comments: 1	HV Plateau	Scaler Cou	int Time = 1-n	nin. Recomr	nended HV =	850, Pot. set	ting = 3.44			
Reference I	nstrumen	ts and/or So	ources:							
Ludlum puls	ser serial ni	umber:	97743 🗸	201932]	Fluke multim	eter serial num	ber 8749	012	
✓ Alpha So ✓ Beta Sou			00 dpm (1/4/12) 0 dpm (1/4/12)			Gamma So	ource Cs-137 (rce:	@ 5.2 uCi (1/4	l/12) sn:	4097-03
Calibrated E	зу:				Calibratio	n Date 16.2	2-13 (Calibration Du	e /0-3	2-14
Reviewed B	y: (le	7.)_		Date:	10/24/13				

	111111	ai ilisti ullielit	CHECK III	
	Meter Number: Meter Model: Cal. Due:	190171 2221 1/6/2015	Detector Number: Detector Model: Cal. Due:	PR084357 44-9 1/6/2015
ALPHA ALPHA ALPHA	Source Type: Source #: Source Activity:	N/A	Threshold: High Voltage:	N/A
ALPHA	Source count time:		Background count time:	N /A (min)
ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM): Average Source (GCPM): Average Net Source (NCPM): Source Range (GCPM): Background Range (CPM): Determined Efficiency:	#DIV/0! #DIV/0! #DIV/0! to #DIV/0! #DIV/0! to #DIV/0! #DIV/0!
ALPHA ALPHA ALPHA ALPHA			20% of Bkg. 1 Standard Deviation of Bkg. 3 Standard Deviations of Bkg.	#DIV/0! #DIV/0! #DIV/0!

Initial Instrument Check In

Beta / Gamma (circle one)

DETA		0.1/.00	T	10 11		10-10-10-10-10-10-10-10-10-10-10-10-10-1
BETA	Source Type:	SrY-90	Threshold:	40 mV		
BETA	Source #:	5442-05	High Voltage:	900 V		
BETA	Source Activity:	3,534				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	47		
BETA	1,058	45	Average Source (GCPM):	1,028		
BETA	1,080	57	Average Net Source (NCPM):	981		
BETA	1,066	39	Source Range (GCPM):	823	to	1,234
BETA	1,028	45	Background Range (CPM):	38	to	57
BETA	1,025	45	Determined Efficiency:	N/A		
BETA	1,042	52				
BETA	984	51	20% of Bkg.	9		
BETA	1,019	54	1 Standard Deviation of Bkg.	6		
BETA	1,015	43	3 Standard Deviations of Bkg.	17		
BETA	967	43				

Performed By: Date: 1-27-14

Reviewed By: Navi PPM)

Date: 2/9/14





INSTRUMENTATION QC CHECK LOG

METER: 2221/44-9 # PR084357

DATE (MO/YR):

Jan/Feb 2014

					# FR004337	DATE (MOTTE).		Jan/1 eb 2014	
Source Acceptant				ce Criteria			Model	Number	Cal. Due
Туре	SrY-90	Bkgrd. QC	Bkgrd. QC (cpm) range Source QC (cpm) range 38 to 57 823 to 1,23			Meter	2221	190171	1/6/2015
Number	5442-05	38 t	0 57	823 to 1,234		Detector	44-9	PR084357	1/6/2015
Date	Time	Pre-use Bkg cpm	Post Bkg cpm ¹	Pre-Use Source cpm	Post Source cpm ¹	Bat Check	HV Check	Pre-Use HPT Initials	Post HPT Initials ¹
28-Jan	0740	43	N/A	1038	N/A	6.2	908	DK	N/A
30-Jan	0808	43	N/A	1046	N/A	6.2	906	DK	N/A
31-Jan	0736	45	N/A	1048	N/A	6.2	903	DK	N/A
1-Feb	0816	45	N/A	975	N/A	6.2	905	DK	N/A
2-Feb	0745	44	N/A	1052	N/A	5.7	903	DK	N/A
3-Feb	0812	40	N/A	988	N/A	5.7	903	DK	N/A
4-Feb	0835	42	N/A	1003	N/A	5.7	904	DK	N/A
5-Feb	0830	37	N/A	1063	N/A	5.8	906	DK	N/A
6-Feb	0804	42	N/A	970	N/A	5.8	909	DK	N/A

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By: Havid Type

Date: 2/9/14

ERG

Certificate of Calibration

Calibration and Efficiency Determination

Environmental Restoration Group, Inc. 8809 Washington St NE, Suite 150 Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number	er:	2221r	Serial 1	Number:	19017	1
Detector:	Manufacturer:	Ludlum	Model Number	er:	44-9	Serial 1	Number:	PR0843	57
✓ Mechan ✓ F/S Res ✓ Geotrop	ponse Check	✓ THR/WIN Opera✓ Reset Check✓ Audio Check	tion				✓ 1000 V ✓ 72-inch ☐ Othe		-
✓ Meter Z		☑ Battery Check (M	lin 4.4 VDC)			Baro	metric Pressure:	24.85	inches Hg
Source Dis	tance: Conta	act	ther:	Thr	eshold: 40 m	īV	Temperature:	73	°F
Source Geo	ometry: Side	✓ Below □ O	ther:	W	indow:	Re	elative Humidity:	20	%
Instrument	found within to	lerance: 🗸 Yes	No						
Rang	e/Multiplier	Reference Setting	"As Found R	eading"	Meter R	eading	Integrated 1-Min. Count	Log Sc	cale Count
	x 1000	400	400	kepm	400	kcpm	401293	400	kcpm
	x 1000	100	100	kcpm	100	kcpm		100	kcpm
	x 100	400	400	kcpm	400	kcpm	40157	400	kcpm
	x 100	100	100	kcpm	100	kcpm		100	kcpm
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HP-31 Revision 0 ATTACHMENT 8

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Page I of I

ERG

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Electroplated Beta Standard
S.O.#_6233
P.O.#_1093
Description of Standard:
Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90
Electroplated on polished Ni disc, 0.79 mm thick.
Total diameter of 4.77 cm and an active diameter of 4.45 cm.
The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.
Measurement Method:
The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source $S/N = 4002-02$.
Measurement Result:
The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:
3,050 + 122
The total disintegration rate (dpm) assuming $_$ 40 $_{\odot}$ 8 backscatter of beta particles from the surface of the disc, was:
$-4,370$ $+$ 174 $($ 0.00197 μ Ci $)$
The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.
Calibrated by: ART REUST Reviewed by: Thus Sende
Calibration Technician: Atlant Q.A. Representative:
Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services 7021 Pan American Freeway NE Albuquerque, New Mexico 87109-4238 (505) 345-3461 Fax (505) 761-5416 Toll Free (866) RAD-LABS (723-5227) www.eberlineservices.com



CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard									
Description of Standard:			S.O. P.O.	# 3905 # 0423					
Model No. DNS-11	Serial No	4006-02	Isotope	Th-230					
Electroplated on polished									
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Measurement Method:									
chamber. Absolute counting o active surface was verified b	The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source $S/N = 2393/91$								
Measurement Result:									
The observed alpha particles the calibration date was:	emitted from the	surface of	the disc per mi	inute (cpm) on					
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Calibration Technician:									
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Appendix F.4.2

Radionuclide Identification and Characterization Survey, June 11, 2014





Peck Iron and Metal Radionuclide Identification and Characterization Survey

Prepared for HydroGeologic (HGL) – HGL Project Manager Brett Brodersen

Prepared By: **American Veteran Environmental Service, Inc. (AVESI)** 2534 Shawnee Springfield, IL 62702 (618) 210-0631



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ATTACHMENTS

ATTACHMENT A: SU-1 Gamma Spectrums and Photos

ATTACHMENT B: SU-2 Gamma Spectrums and Photos

ATTACHMENT C: SU-3 Gamma Spectrums and Photos

ATTACHMENT D: SU-4 Gamma Spectrums and Photos

ATTACHMENT E: SU-5 Gamma Spectrums and Photos

ATTACHMENT F: Discretionary Sample Gamma Spectrums

ATTACHMENT G: Instrumentation Documents

FIGURES

FIGURE A: All Proposed Gamma Spectroscopy Sample Locations

FIGURE 1-1: Peck Iron and Metal SU 1 Gamma Spectroscopy Sample Locations

FIGURE 1-2: Peck Iron and Metal SU 2 Gamma Spectroscopy Sample Locations

FIGURE 1-3: Peck Iron and Metal SU 3 Gamma Spectroscopy Sample Locations

FIGURE 1-4: Peck Iron and Metal SU 4 Gamma Spectroscopy Sample Locations

FIGURE 1-5: Peck Iron and Metal SU 5 Gamma Spectroscopy Sample Locations

TABLES

TABLE 4-1: All Survey Units Sampling Summary.



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LIST OF ACRONYMS

AVESI American Veteran Environmental Services INC.

Nal(TI) Total Absorption Detector
Pb Chemical Symbol for Lead

Bi Chemical Symbol for Bismuth

Cs-137 Cesium

keV Kiloelectron Volt

MeV Megaelectron Volt

GM Geiger-Muller

mRem/hr Millirem per Hour NaI Sodium Iodide

NIST Institute of Standards and Technology
ANSI American National Standards Institute

SU Survey Unit

RA Radiation Protection Program

Ra-226 Radium

μRem/hr Micro Rem per Hour

RI Radionuclide Identification
Rn Chemical Symbol for Radon

Po-210 Polonium

RPP Radiation Protection Plan

HP Health Physics

RMSA Radioactive Materials Storage Area

NaI Sodium Iodide

NRC Nuclear Regulatory Commission

NUREG Nuclear Regulatory



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1.0 SURVEY OBJECTIVES

1.1. Radionuclide Identification by Portable Gamma Spectroscopy

The intent of this survey was to identify existing radioactivity by radionuclide at locations recorded during the Gamma Radiation Scan Survey using a handheld radionuclide identifier such as the FLIR Systems, identiFINDER. The identiFINDER is a handheld instrument that identifies man-made and natural radionuclides and combines high sensitivity with a wide dose rate range.

Each area or object scanned by the identiFINDER will record the activity of the parent radionuclide and its decay radionuclides. Each activity recording is compared to a radionuclide library and matches the energy peaks of the recorded radionuclides to a known spectrum. Similar to the spectrum below:

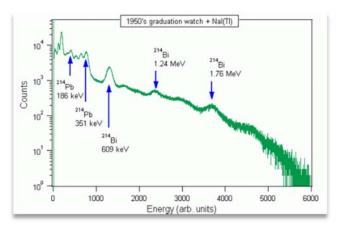


Table 1-1: Gamma Spectrum Example

The instrument has a dual purpose design to facilitate locating missing or offending sources and then identifying the source via its gamma spectrometry and nuclide identification capability. The identifINDER is a complete digital gamma spectroscopy and dose rate system. It integrates multi-channel analyzer, amplifier, high voltage power supply, and memory with an integral scintillation and GM detector.

1.2. Radionuclide Identification and Location Objectives

AVESI completed the Radionuclide Identification/characterization study and proposed to survey a minimum of 25 predetermined locations at the Peck Iron and Metal site with the identiFINDER to record gamma spectroscopy data and dose rates. Each location required:

- Physically locating and retrieving source objects or soil sample
- Gamma spectroscopy process:
 - o 10 minute relative background
 - o 10 minute known (Check Source)
 - o 10 minute unknown (Obtained Object or Area)
- Source object returned to location



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Personnel frisk.

The identiFINDER stores the gamma spectroscopy data for each location within the handset until post processing of the data is completed. Data was transferred to an external hard drive two times per day. Dose rates were recorded on contact at the highest activity location of each object or soil sample and entered into a Microsoft Excel spreadsheet.

AVESI completed the Radionuclide Identification/Characterization Survey by providing a final report detailing the results of the survey at each location including:

- Gamma spectrum for each location
- Dose rates up to 100 milliRem/hour (mRem/hr).
- Radionuclide(s) identification
- Depth of source object below ground surface
- Gamma activity readings
- Object Identification if possible

The pre-determined sample locations were locations that were identified as having elevated activity in excess of 2 x background during the gamma radiation scan survey. All proposed gamma spectroscopy sample locations are depicted on **Figure A: All Proposed Gamma Spectroscopy Sample Locations**. Each Survey Unit contains the following elevated areas of activity (sample locations may represent one or many anomalies):

- In Survey Unit 1, Seven (7) of the 7 anomalies were inspected and sampled. (Figure 1-1: Peck Iron and Metal SU 1 Gamma Spectroscopy Sample Locations)
- In Survey Unit 2, Eight (8) of the 8 anomalies were inspected and sampled. (Figure 1-2: Peck Iron and Metal SU 2 Gamma Spectroscopy Sample Locations)
- In Survey Unit 3, Six (6) of the 6 anomalies were inspected and sampled. (Figure 1-3: Peck Iron and Metal SU 3 Gamma Spectroscopy Sample Locations)
- In Survey Unit 4, Six (6) of the 6 anomalies were inspected and sampled. (Figure 1-4: Peck Iron and Metal SU 4 Gamma Spectroscopy Sample Locations)
- In Survey Unit 5, eleven (11) of the 31 anomalies were inspected and sampled. (Figure 1-5: Peck Iron and Metal SU 5 Gamma Spectroscopy Sample Locations)

There were a total of 39 potential sample locations and 2 discretionary sample locations. AVESI committed to a minimum of 25 gamma spectroscopy analyses to be performed. However, background efficiency adjustments created additional time for AVESI to complete all 39 locations as well as the 2 discretionary locations. All sampling activity to date are summarized in **Table A: All Survey Units Sampling Summary.**



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2.0 SURVEY METHODS

2.1. Background

Each individual sample location may have differing backgrounds due to many factors. For this reason a relative background reading was collected prior to reading each areas object or sample. In the event a natural background reading cannot be acquired by the identiFINDER, the identiFINDER will be moved to a location where a relative natural background can be achieved and soil samples and objects will be brought to the identiFINDER.

2.2. Source Check

A periodic source check with a known source, such as a Cesium 137 (Cs-137) button source, shall be performed to ensure accurate response and proper function of the identiFINDER.

2.3. Sample Survey

At each location AVESI performed the following tasks in this order:

- 1. Retrieve object or soil sample
- 2. Record the depth of the object or soil sample
- 3. Perform gamma spectroscopy (Identify Radionuclides)
- 4. Collect a dose rate reading of the object or soil sample (Estimate Absorbed Dose)
- 5. Perform a gamma survey of the location where the object or soil sample was obtained (Identifies Gamma Activity)
- 6. Return the object or soil sample to its original location

Each sample location yielded a radioactive object or soil sample that was subjected to gamma spectroscopy analysis which determines radionuclides present within each sample. After the object or soil sample has been obtained the depth of the object or sample was recorded. A gamma radiation survey of the sample location was completed to determine the existence of additional objects or the possibility of residual soil contamination. Each object or sample was gamma spectroscopy analyzed, on contact, at the highest established dose rate. All objects or soil samples were placed in a zip lock container or equivalent to reduce the potential for spreading contamination and reduce the risk of cross contamination of the samples.

Once the gamma spectroscopy analysis, dose rate readings and gamma radiation surveys were complete, all objects and soil samples were returned to the sample location and buried at the same depth it was removed.

2.4. Quality Assurance

Radiological instrumentation and associated detectors were calibrated (annually) using National Institute of Standards and Technology (NIST) traceable sources and calibration equipment. Check Source Certificates, Instrument Calibration Certificates, Instrument Initial Check In



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paperwork, and Daily Response Check Log are in **Attachment G: Instrumentation Documents.**

Instrumentation was calibrated in accordance with guidance contained in American National Standards Institute (ANSI) N323 (ANSI, 1978) and manufacturers' instructions.



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3.0 SURVEY SUMMARY

The gamma spectroscopy survey was initiated at location SU-5-01-RI. The identiFINDER was not able to achieve a stable background and consequently, was relocated to a known stable natural background area (work Trailer). Therefore, all objects and samples were brought to the work trailer for gamma spectroscopy analysis. A plastic bin was dedicated to each survey unit where each object or soil sample was individually containerized prior to placing it in the bin.

3.1. *Survey Unit 1 (SU-1)*

A total of seven (7) objects were collected from 7 sample locations and gamma spectroscopy surveyed in SU-1. All objects were small pieces of tubing or plastic coating located within the top 6 inches of soil or crushed debris. All objects were similar in shape and varied in size. Three of the objects were brown in color and 4 were light tan. The gamma spectroscopy survey resulted in the identification of the radionuclide *Radium 226 (Ra-226)* for all objects surveyed. For the full spectrum analysis and object photos refer to **Attachment A: SU-1 Gamma Spectrums and Photos.**

A gamma radiation activity survey was completed at locations where object(s) were obtained. Gamma radioactivity remaining after objects have been removed indicates the possibility of other remaining objects or soil contamination. In SU-1, none of the sample locations had gamma radioactivity remaining once the objects were removed.

Table 3-1: SU-1 Spectrum Results and Dose Rates

Gamma Spectrum Sample Number (RI)	Spectrum Number	Object Description	Gamma Spec Dose Rate (µRem/hr)	Identified Radionuclide	Activity Remaining Post Sampling (Y/N)
SU-1-01-RI	322	small brown tubing	450	Radium 226	N
SU-1-02-RI	324	small brown tubing	450	Radium 226	N
SU-1-03-RI	326	small brown tubing	800	Radium 226	N
SU-1-04-RI	328	small tan tubing	1,600	Radium 226	N
SU-1-05-RI	330	small tan tubing	800	Radium 226	N
SU-1-06-RI	332	small tan tubing	1,500	Radium 226	N
SU-1-07-RI	334	small tan tubing	1,000	Radium 226	N

^{*} Spectrum 320 is a background survey

^{**} Spectrum 336 is the Cs-137 source response check

^{***} Shaded rows indicate soil samples from previous event



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3.2. *Survey Unit 2 (SU-2)*

A total of five (5) objects and four (4) soil samples were collected from 8 sample locations and gamma spectroscopy surveyed in SU-2. All objects were located in the top six inches of soil or crushed debris. These objects include soil, plastic, plastic deck marker, metal and decaying pieces of metal. The gamma spectroscopy survey resulted in the identification of the radionuclide (*Ra-226*) for all objects surveyed. For the full spectrum analysis and object photos refer to **Attachment B: SU-2 Gamma Spectrums and Photos**.

A gamma radiation activity survey was completed at locations where object(s) were obtained. Gamma radioactivity remaining after objects have been removed indicates the possibility of other remaining objects or soil contamination. In SU-2, all of the sample locations had gamma radioactivity remaining once the objects were removed with the exception of SU-2-08-RI. In addition, SU-2-03-RI(1) plastic material was removed from the sample location and activity still remained at the sample origin therefore, a soil sample (SU-2-03-RI(2)) was obtained for gamma spectroscopy analysis.

Table 3-2: SU-2 Spectrum Results and Dose Rates

Gamma Spectrum Sample Number (RI)	Spectrum Number	Object Description	Gamma Spec Dose Rate (μRem/hr)	Identified Radionuclide	Activity Remaining Post Sampling (Y/N)
SU-2-01-RI	302	soil	210	Radium 226	Υ
SU-2-02-RI	304	piece of metal	500	Radium 226	Υ
SU-2-03-RI(1)	306	plastic material	250	Radium 226	Υ
SU-2-03-RI(2)	308	soil	80	Radium 226	Υ
SU-2-04-RI	310	piece of metal	14,000	Radium 226	Υ
SU-2-05-RI	312	soil	35	Radium 226	Υ
SU-2-06-RI	314	soil	25	Radium 226	Υ
SU-2-07-RI	316	piece of metal	130	Radium 226	Υ
SU-2-08-RI	318	deck marker	6,200	Radium 226	N

^{*} Spectrum 298 is a background survey

^{**} Spectrum 300 is the Cs-137 source response check

^{***} Shaded rows indicate soil samples from previous event



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3.3. *Survey Unit 3 (SU-3)*

A total of six (5) objects and (2) soil sample were collected from 6 sample locations and gamma spectroscopy surveyed in SU-3. All objects were located in the top six inches of soil or crushed debris. These objects include soil, unknown device, eroded metal, melted metal, soil (clay), and a piece of a rock. The gamma spectroscopy survey resulted in the identification of the radionuclide *Ra-226* for all objects surveyed. For the full spectrum analysis and object photos refer to **Attachment C: SU-3 Gamma Spectrums and Photos**.

A gamma radiation activity survey was completed at locations where object(s) were obtained. Gamma radioactivity remaining after objects have been removed indicates the possibility of other remaining objects or soil contamination. In SU-3, five locations had gamma radioactivity remaining once the objects were removed. Soil sample SU-3-01-RI(1) was collected from around the unknown device in object SU-3-01-RI(2).

Table 3-3: SU-3 Spectrum Results and Dose Rates

Gamma Spectrum Sample Number (RI)	Spectrum Number	Object Description	Gamma Spec Dose Rate (µRem/hr)	Identified Radionuclide	Activity Remaining Post Sampling (Y/N)
SU-3-01-RI(1)	281	soil	8	Non Detect	N
SU-3-01-RI(2)	283	unknown device	3,800	Radium 226	Υ
SU-3-02-RI	285	corroded metal	1,700	Radium 226	Υ
SU-3-03-RI	287	unknown device	3,600	Radium 226	Υ
SU-3-04-RI	289	chunk	9,000	Radium 226	Υ
SU-3-05-RI	291	clay like soil	430	Radium 226	Υ
SU-3-06-RI	293	chunk of rock	1,000	Radium 226	N

^{**} Spectrum 295 is the Cs-137 source response check

^{***} Shaded rows indicate soil samples from previous event



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3.4. Survey Unit 4 (SU-4)

A total of six (6) objects were collected from 6 sample locations and gamma spectroscopy surveyed in SU-4. All objects were located in the top six inches of soil or crushed debris. These objects include a liquid filled gauge, four (4) small button type objects and one piece of corroded metal. The gamma spectroscopy survey resulted in the identification of the radionuclide *Ra-226* for all objects surveyed. For the full spectrum analysis and object photos refer to **Attachment D: SU-4 Gamma Spectrums and Photos**.

A gamma radiation activity survey was completed at locations where object(s) were obtained. Gamma radioactivity remaining after objects have been removed indicates the possibility of other remaining objects or soil contamination. In SU-4, none of the sample locations had gamma radioactivity remaining once the objects were removed.

Table 3-4: Spectrum Results and Dose Rates

Tuble 2 11 Spectrum results and 2000 rates						
Gamma Spectrum Sample Number (RI)	Spectrum Number	Object Description	Gamma Spec Dose Rate (mRem/hr)	Identified Radionuclide	Activity Remaining Post Sampling (Y/N)	
SU-4-01-RI	267	large gauge	100	Radium 226	N	
SU-4-02-RI	269	small button	1,700	Radium 226	N	
SU-4-03-RI	271	small button	1,350	Radium 226	N	
SU-4-04-RI	273	small button	1,150	Radium 226	N	
SU-4-05-RI	275	small button	3,600	Radium 226	N	
SU-4-06-RI	277	corroded metal	260	Radium 226	N	

^{*} Spectrum 265 is a background survey

^{**} Spectrum 279 is the Cs-137 source response check

^{***} Shaded rows indicate soil samples from previous event



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3.5. Survey Unit 5 (SU-5)

A total of eleven (11) objects were collected from 12 sample locations and gamma spectroscopy surveyed in SU-5. All objects were located in the top six inches of soil or crushed debris with the exception of SU-5-12-RI and SU-5-06-RI. Sample SU-5-12-RI was obtained below a drain or sewer pipe and SU-5-06-RI was under water and not accessible. Objects in this survey unit include deck markers, small button type objects, a glass bulb or light fixture, soil, plastic, wood, and metal. The gamma spectroscopy survey resulted in the identification of the radionuclide *Ra-226* for all objects surveyed. For the full spectrum analysis and object photos refer to **Attachment E: SU-5 Gamma Spectrums and Photos**.

A gamma radiation activity survey was completed at locations where object(s) were obtained. Gamma radioactivity remaining after objects have been removed indicates the possibility of other remaining objects or soil contamination. In SU-5, three of the sample locations had gamma radioactivity remaining once the objects were removed.

Table 3-5: SU-5 Spectrum Results and Dose Rates

Gamma Spectrum	Spectrum	Ohio at Doossiption	Gamma Spec Dose	Identified	Activity Remaining Post Sampling
Number (RI)	Number	Object Description	Rate (mRem/hr)	Radionuclide	(Y/N)
SU-5-01-RI	238	glass bulb	3,000	Radium 226	Y
SU-5-02-RI	242	deck marker badge	220	Radium 226	N
SU-5-03-RI	244	small button	1,100	Radium 226	N
SU-5-04-RI	246	soil	130	Radium 226	Υ
SU-5-05-RI	248	deck marker	6,700	Radium 226	N
SU-5-06-RI	N/A	N/A	N/A	N/A	N/A
SU-5-07-RI	250	small button	1,850	Radium 226	N
		small piece of			N
SU-5-08-RI	252	plastic	50,000	Radium 226	
SU-5-09-RI	254	small button	2,400	Radium 226	N
SU-5-10-RI	256	deck marker	6,500	Radium 226	N
SU-5-11-RI	258	small button	2,500	Radium 226	N
SU-5-12-RI	260	wood and metal	800	Radium 226	Υ

^{*} Spectrum 236 is a background survey

^{**} Spectrum 240 and 262 are the Cs-137 source response checks

^{***} Shaded rows indicate soil samples from previous event



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3.6. Discretionary Sample Locations

Two (2) discretionary sample locations were gamma spectroscopy surveyed. Both samples were located in close proximity to Elizabeth River. These gamma spectroscopy samples were completed via in-situ. Both locations were negative for gamma emitting radionuclides. For the full spectrum analysis refer to **Attachment E: Discretionary Sample Location Gamma Spectrums**.

Table 3-6: Discretionary Spectrum Results and Dose Rates

	Spectru				Activity Remaining
Gamma Spectrum	m		Gamma Spec Dose	Identified	Post Sampling
Number (RI)	Number	Object Description	Rate (mRem/hr)	Radionuclide	(Y/N)
Desc-01-RI	341	soil (in situ)	8	Non Detect	N/A
Desc-02-RI	344	soil (in situ)	8	Non Detect	N/A



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4.0 SURVEY RESULTS

Gamma spectroscopy sample results in this section are summarized and discussed in two sections, the "Gamma Spectroscopy Results and Dose Rates" section summarizes the results of each survey unit and identifies radionuclide(s) and reports a range for exposure dose rates in μ Rem/hr. The "Gamma Radioactivity Survey Results" section summarizes the radioactivity at each location in the survey unit ultimately recording areas of possible residual soil contamination or the presence of additional radioactive objects.

4.1. Survey Unit 1

4.1.1. In SU-1 a total of seven locations were identified for gamma spectroscopy analysis. All seven locations contained objects that were removed from the sample locations. The sample locations were then surveyed for gamma radioactivity and the objects were subjected to gamma spectroscopy analysis and dose rate surveys.

4.1.1.1. Gamma Spectroscopy Results and Dose Rates

Of the seven objects that were gamma spectroscopy surveyed, all seven objects had radioactivity consistent with Ra-226. The dose rates of these objects ranged from $450 \mu \text{Rem/hr}$ to $1,600 \mu \text{Rem/hr}$.

4.1.1.2. Gamma Radioactivity Survey Results

All seven sample locations were gamma radiation surveyed after objects with radioactivity were removed. All seven locations had no radioactivity remaining suggesting that there were *no additional radioactive objects or residual soil containing radioactivity* at these locations.

4.2. Survey Unit 2

4.2.1.In SU-2 a total of eight locations were identified for gamma spectroscopy analysis. Only five locations contained objects that were removed from the sample locations. Soil samples were obtained at three locations where objects were not present. All sample locations were then surveyed for gamma radioactivity and the objects and soil samples were subjected to gamma spectroscopy analysis and dose rate surveys.

4.2.1.1. Gamma Spectroscopy Results and Dose Rates

Of the five objects and three soil samples that were gamma spectroscopy surveyed, all objects and soil samples had radioactivity consistent with Ra-226. The dose rates of these objects ranged from 25 μ Rem/hr to 14,000 μ Rem/hr.

4.2.1.2. Gamma Radioactivity Survey Results

All eight sample locations were gamma radiation surveyed after objects with radioactivity were removed. One location had no radioactivity remaining



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suggesting that were *no additional radioactive objects or residual soil containing radioactivity were present* at this location. Seven locations had activity remaining suggesting that there are *additional radioactive objects or residual soil containing radioactivity* at these locations.

4.3. Survey Unit 3

4.3.1.In SU-3 a total of six locations were identified for gamma spectroscopy analysis. Five locations contained objects that were removed from the sample locations. A soil sample was obtained at one location where an object was not present. One additional soil sample (SU-3-01-RI(1)) was collected from around an unknown device (SU-3-01-RI(2)). All sample locations were then surveyed for gamma radioactivity and the objects and soil samples were subjected to gamma spectroscopy analysis and dose rate surveys.

4.3.1.1. Gamma Spectroscopy Results and Dose Rates

Of the five objects and two soil samples that were gamma spectroscopy surveyed, five objects and one soil sample had radioactivity consistent with Ra-226. The dose rates of these objects and soil samples ranged from $430 \mu Rem/hr$ to $9,000 \mu Rem/hr$.

One soil sample, SU-3-01-RI(1), collected around the unknown device, contained no radioactivity and a dose rate consistent with background of 8 μ Rem/hr.

4.3.1.2. Gamma Radioactivity Survey Results

All six sample locations were gamma radiation surveyed after objects and soils samples with radioactivity were removed. One location had no radioactivity remaining suggesting that there is no additional radioactive objects or residual soil containing radioactivity at this location. Six locations had radioactivity remaining suggesting that there were additional radioactive objects or residual soil containing radioactivity at these locations.

4.4. Survey Unit 4

4.4.1.In SU-4 a total of six locations were identified for gamma spectroscopy analysis. All six locations contained objects that were removed from the sample locations. All sample locations were then surveyed for gamma radioactivity and the objects were subjected to gamma spectroscopy analysis and dose rate surveys.

4.4.1.1. Gamma Spectroscopy Results and Dose Rates

Of the six objects that were gamma spectroscopy surveyed, all six objects had radioactivity consistent with Ra-226. The dose rates of these objects and soil samples ranged from $100 \ \mu \text{Rem/hr}$ to $3{,}600 \ \mu \text{Rem/hr}$.



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4.4.1.2. Gamma Radioactivity Survey Results

All six sample locations were gamma radiation surveyed after objects with radioactivity were removed. All six locations had no radioactivity remaining suggesting that no additional radioactive objects or residual soil containing radioactivity remains.

4.5. Survey Unit 5

4.5.1.In SU-5 a total of twelve locations were identified for gamma spectroscopy analysis. Ten locations contained objects that were removed from the sample locations. A soil sample were obtained at one location where an object was not present. One location (SU-5-06-RI) was under water and not accessible and therefore not sampled. All sample locations were then surveyed for gamma radioactivity and the objects were subjected to gamma spectroscopy analysis and dose rate surveys.

4.5.1.1. Gamma Spectroscopy Results and Dose Rates

Of the 11 objects and soil samples that were gamma spectroscopy surveyed, all eleven objects had radioactivity consistent with Ra-226. The dose rates of these objects and soil samples ranged from $130~\mu\text{Rem/hr}$ to $50,000~\mu\text{Rem/hr}$.

4.5.1.2. Gamma Radioactivity Survey Results

All eleven sample locations were gamma radiation surveyed after objects with radioactivity were removed. Eight locations had no radioactivity remaining suggesting that *no additional objects or residual soil containing radioactivity remains*. Three locations had radioactivity remaining suggesting that there were additional radioactive objects or residual soil containing radioactivity.

4.6. Discretionary Sample Locations

4.6.1.Two discretionary sample locations were identified for gamma spectroscopy analysis. These two sample locations were near the Elizabeth River. No objects were removed and no soil was sampled. A gamma spectroscopy analysis was completed via in-situ.

4.6.1.1. Gamma Spectroscopy Results and Dose Rates

Two locations were analyzed by gamma spectroscopy via in situ survey. No soil was removed and no objects were obtained. The gamma spectroscopy instrument was not able to detect any radioactivity present at either discretionary location. The dose rates obtained at each location was 8 μ Rem/hr which is consistent with background.



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4.6.1.2. Gamma Radioactivity Survey Results

Due to these samples being analyzed via in situ, no gamma radioactivity survey data was obtained.



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5.0 CONCLUSION

5.1. Gamma Spectroscopy

The discretionary locations where the gamma spectroscopy was performed via in situ, near the Elizabeth River were excluded from this conclusion. The discretionary sample locations were generated randomly without any indication of radioactivity. All other locations were selected due to radioactivity present and the need for radionuclide identification.

AVESI committed to a minimum of 25 gamma spectroscopy analyses to be performed. There was a total of 39 potential sample locations and 2 discretionary sample locations. The decision to bring the objects and soil samples to the work trailer, as discussed in section 3.0, was a more efficient way to complete the gamma spectroscopy analyses. Therefore, of the 39 potential gamma spectroscopy sample locations, AVESI was able to complete 38. Two discretionary samples were also completed bringing the total gamma spectroscopy analysis to 40.

A total of 40 gamma spectroscopy analyses were performed at 39 predetermined locations across 5 survey units. One sample (SU-5-06-RI) was not accessible due to standing water. Two additional soil samples were obtained, one on SU-2 and one on SU-3. Object sample (SU-2-03-RI(1)) was removed and radioactivity remained at the sample location. Soil sample (SU-2-03-RI(2)) was obtained to confirm the soil contamination. Object (SU-3-01-RI(2)) was removed. The interior of the device contained a large amount of soil. The soil was collected as sample (SU3-01-RI(1)) and gamma spectroscopy was performed.

Of the 40 gamma spectroscopy analyses completed, 39 displayed radioactive energies consistent with Ra-226. One sample (SU3-01-RI(1)) contained no detectable radioactivity.

Of the 40 gamma spectroscopy analyses, 33 were objects and 7 were soil samples and of the 38 locations where objects or soil samples were removed 16 locations had radioactivity remaining in the sample location suggesting additional objects or soil contamination.

5.2. Dose Rates

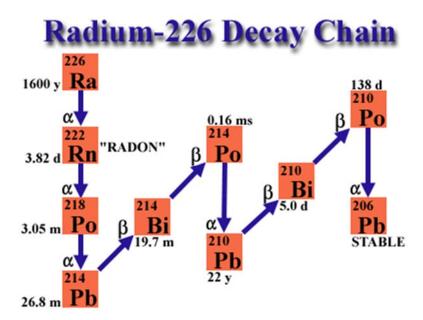
The dose rates for each object or soil sample were attained at the highest gamma activity point reading possible. Of the 38 locations, the highest dose rate was obtained on an object in SU-5 at 50,000 μ Rem/hr. The lowest dose rate, other than non-detect samples, was attained in SU-2 at 25 μ Rem/hr.

5.3. Radium 226

In the past Radium has been used to produce neutron sources, luminous paints, luminous dials and medical radioisotopes, etc... Ra-226 has a half-life of approximately 1600 years and gamma X-ray energy of 186 keV. Ra-226 undergoes decay by alpha to Radon 222 (Rn-222) then Polonium 218 (Po-218) and so on. As seen below:



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The Gamma Spectroscopy analysis identified Radium 226 by its gamma energy of 186.1 keV and correlating daughter product energies as well. Gamma energy peaks that identify Radium 226 are:

- Ra 226 → 186.1 keV
- Pb 214 → 352 keV
- Bi 214 → 609 keV
- Bi 214 → 1120 keV
- Bi 214 → 1764 keV



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6.0 RECOMMENDATIONS

6.1.1. Radiation Protection Program

It is recommended that a Radiation Protection Program (RA) with a site Radiation Protection Plan (RPP) be developed and implemented to assist and protect the public and site personnel during future intrusive soil activities. The RPP at a minimum should include sections addressing radiological hazards, radiological controls, training, dosimetry, monitoring, and posting and labeling.

6.1.2.Dose Assessment

It is recommended that a dose assessment be conducted based on current survey data for the reasonable maximally exposed scenario group (critical group). For example, what is the dose to a transient who accesses uncontrolled areas of the property? This dose assessment can be refined using data identified during further surveys.

6.1.3. Health Physics Support

It is recommended that <u>all</u> future soil intrusion work is supported by the radiation protection plan and health physicists (HP).

6.1.4. Radioactive Materials Storage Area

It is recommended that a temporary Radioactive Materials Storage Area (RMSA) be established in the rear of the property.

6.1.5. Radioactive Materials Control

It is recommended that all known areas of elevated activity that are <u>not controlled</u> (SU-2) within the fenced area of Peck Iron and Metal be removed and stored within the fenced area.



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7.0 REFERENCES

ANSI (American National Standards Institute) 1997. *American National Standards Radiation Protection Instrumentation Test and Calibration*, ANSI N323A-1997.

NRC (United States Nuclear Regulatory Commission) 1974, *Termination of Operating Licenses for Nuclear Reactors*, NUREG-1.86, June.

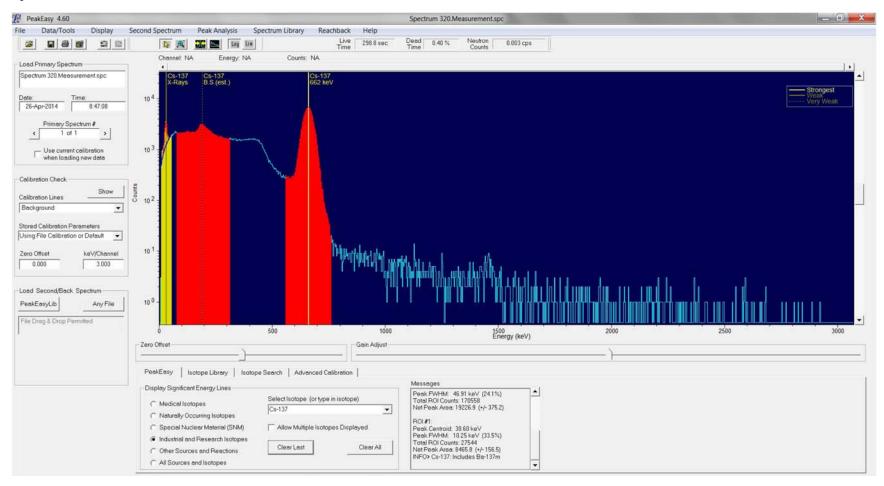


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ATTACHMENT A: SU-1 GAMMA SPECTRUMS AND PHOTOS

Survey Unit 1

Spectrum 320: Cs-137 Source Check



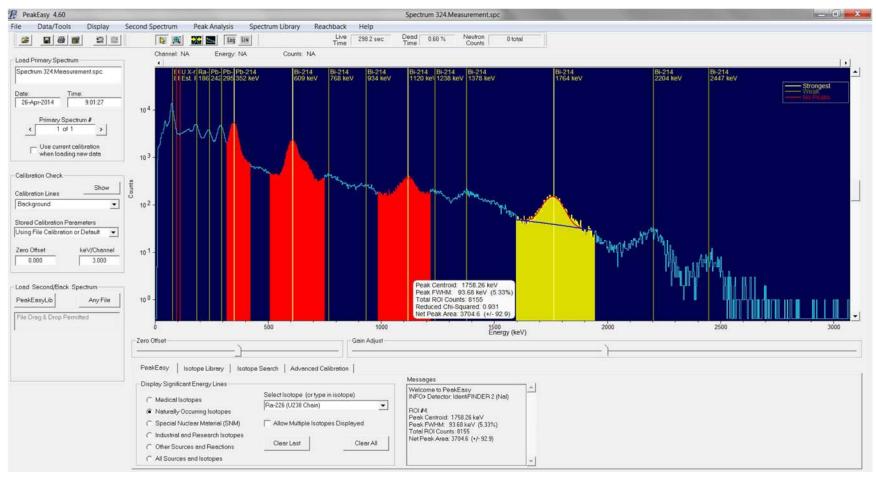
Spectrum 322: SU-01-01-RI





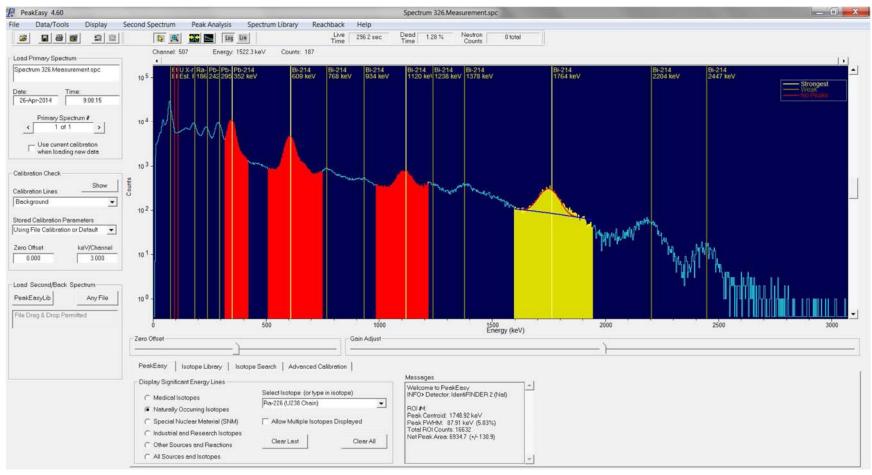
Peck Iron and Metal Radionuclide Identification Survey Gamma Spectroscopy SU-1

Spectrum 324: SU-01-02-RI





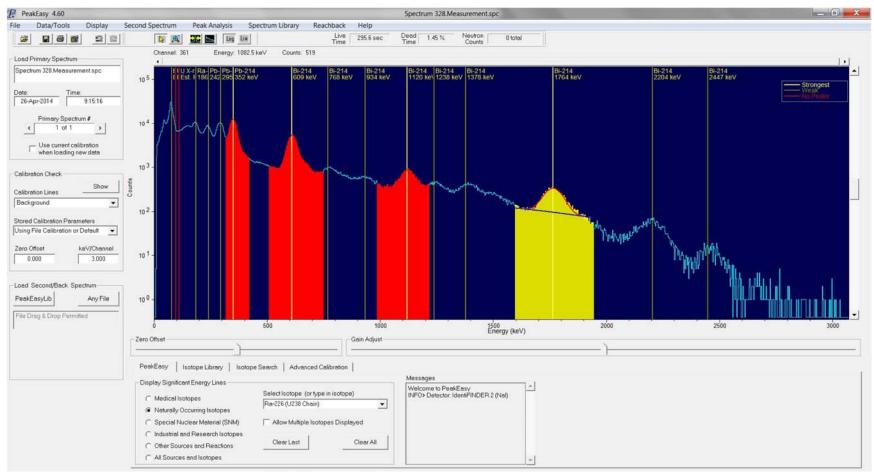
Spectrum 326: SU-01-03-RI





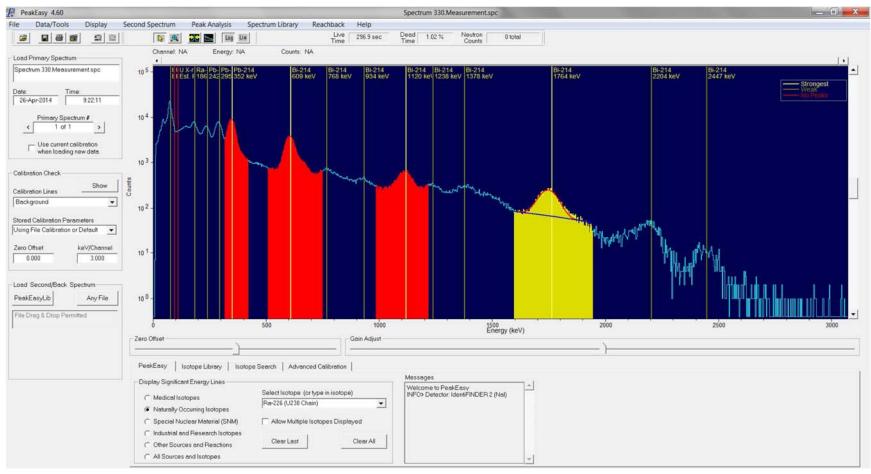
Peck Iron and Metal Radionuclide Identification Survey Gamma Spectroscopy SU-1

Spectrum 328: SU-01-04-RI



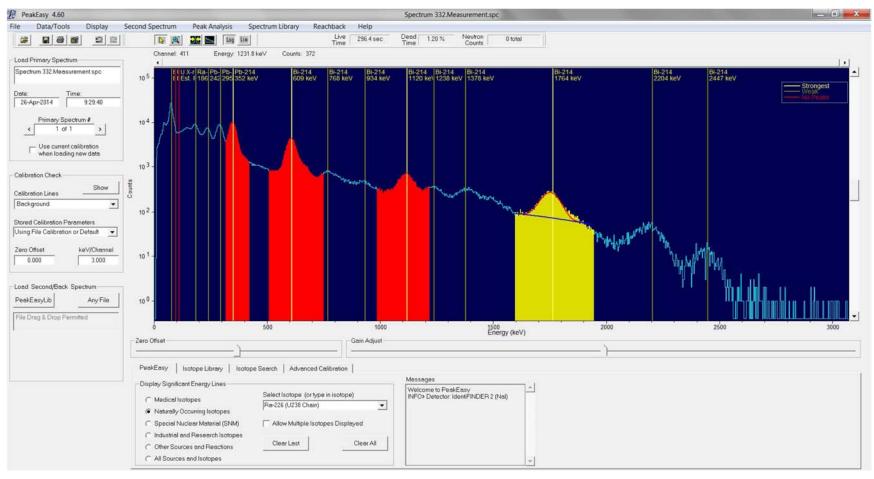


Spectrum 330: SU-01-05-RI



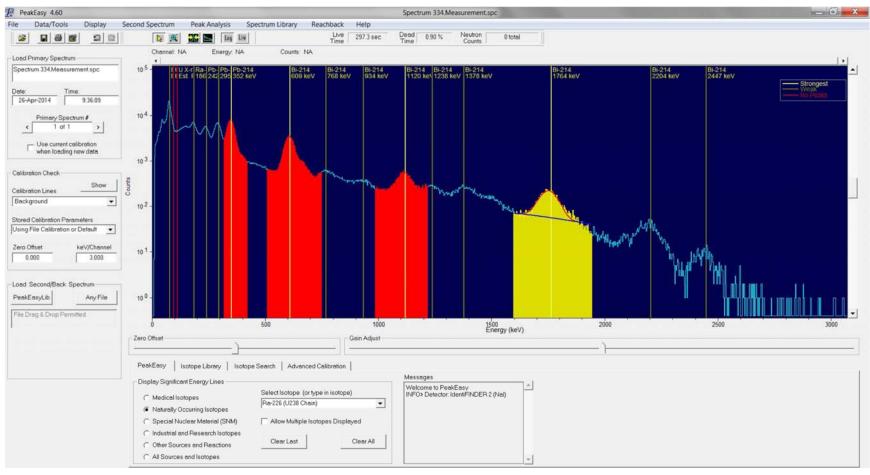


Spectrum 332: SU-01-06-RI





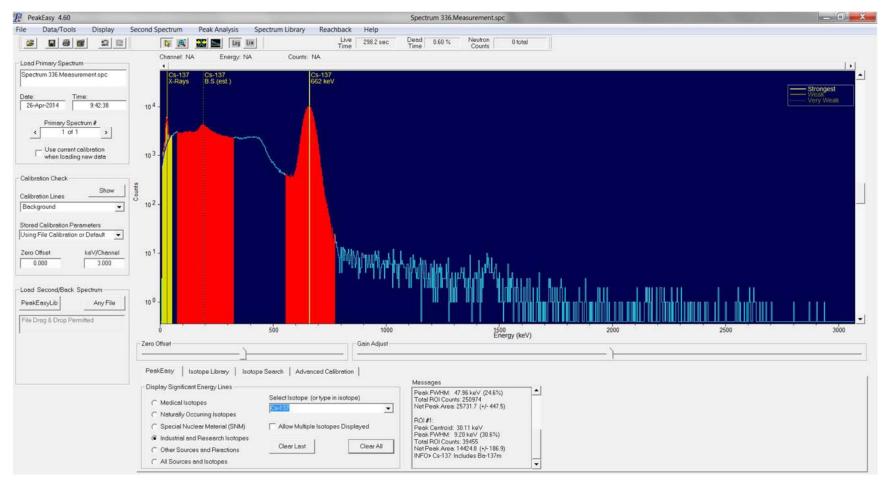
Spectrum 334: SU-01-07-RI





Peck Iron and Metal Radionuclide Identification Survey Gamma Spectroscopy SU-1

Spectrum 336: Cs-137 Source Check



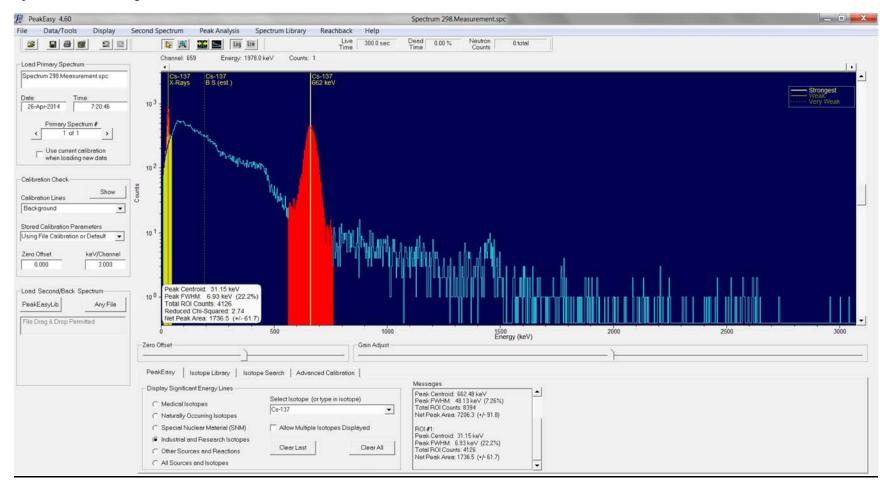


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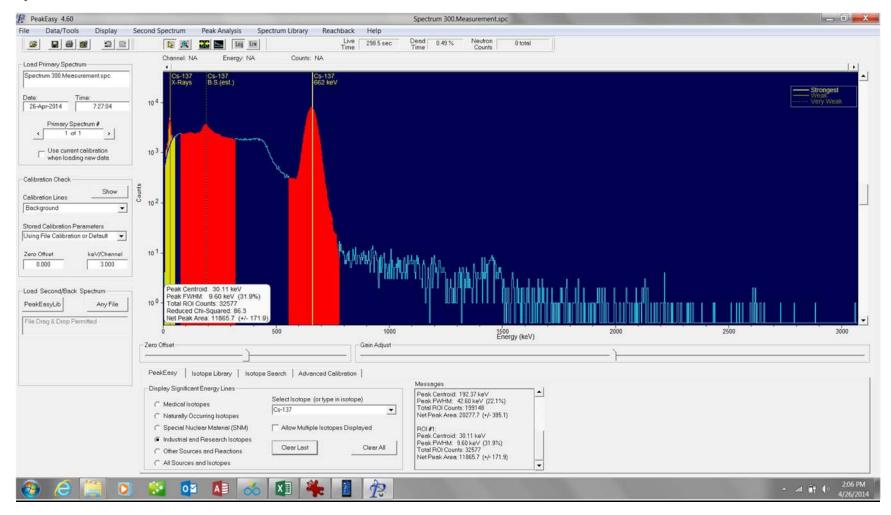
ATTACHMENT B: SU-2 GAMMA SPECTRUMS AND PHOTOS

Survey Unit 2

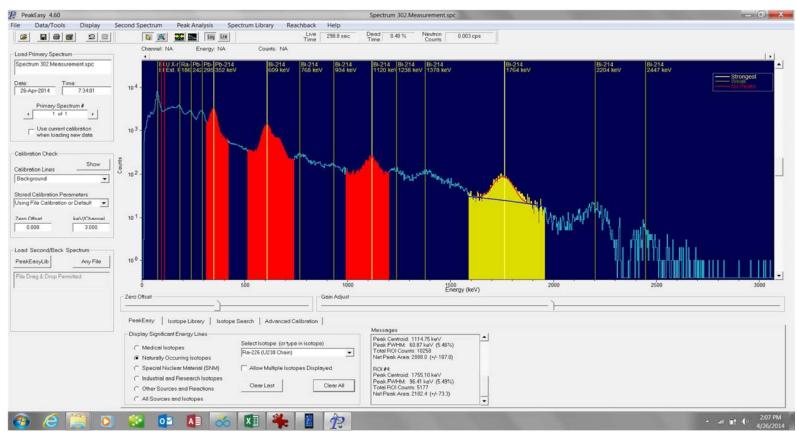
Spectrum 298: Background



Spectrum 300: Cs-137 Source Check

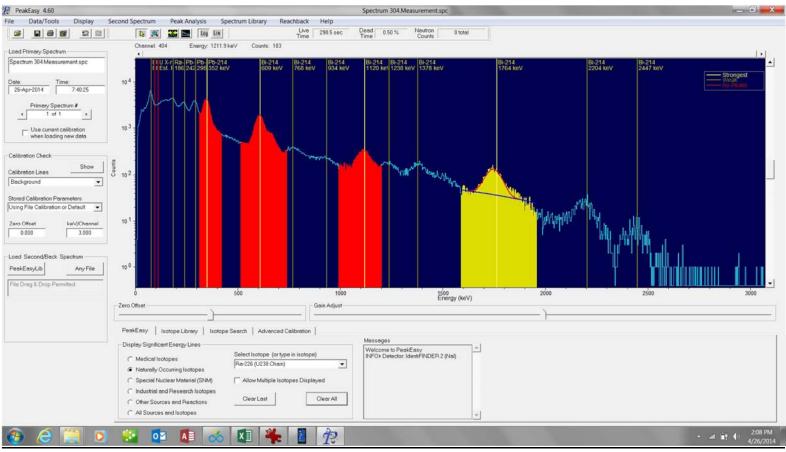


Spectrum 302: SU 02-01-RI (210 μRem/hr.)



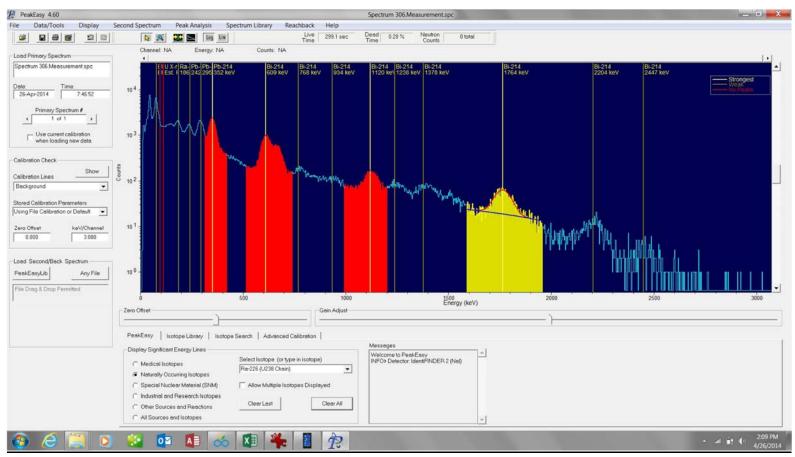


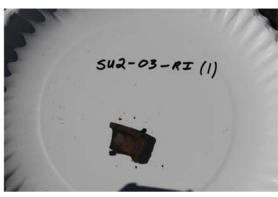
Spectrum 304: SU 02-02-RI (500 μRem/hr.)



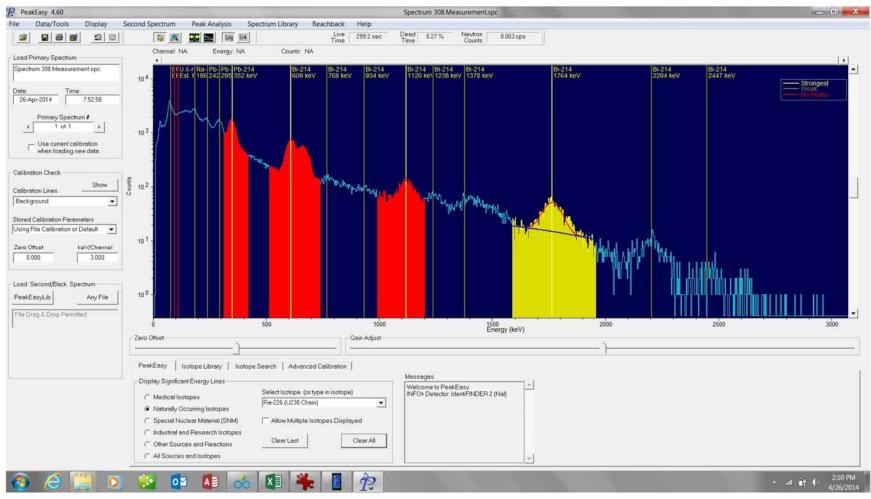


Spectrum 306: SU 02-03-RI(1) (250 μRem/hr.)

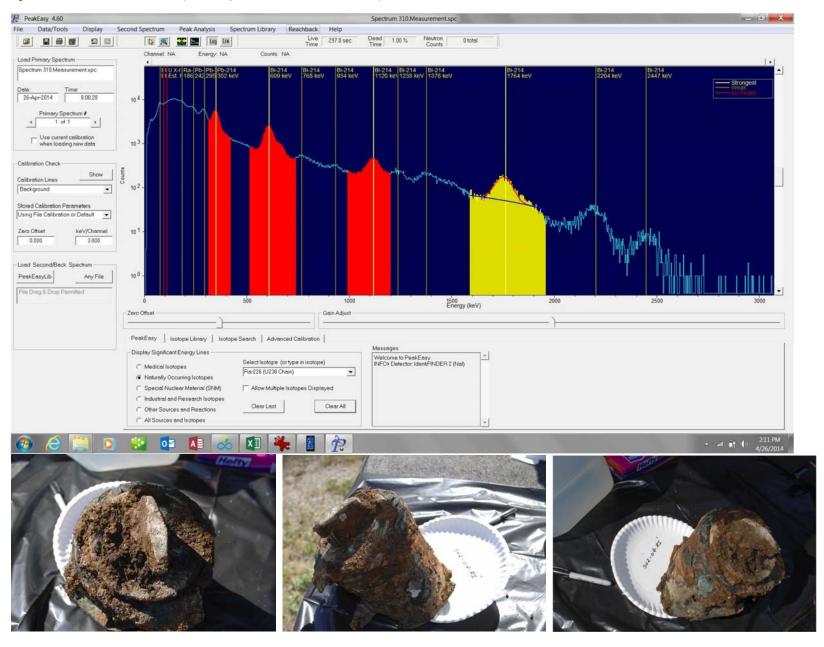




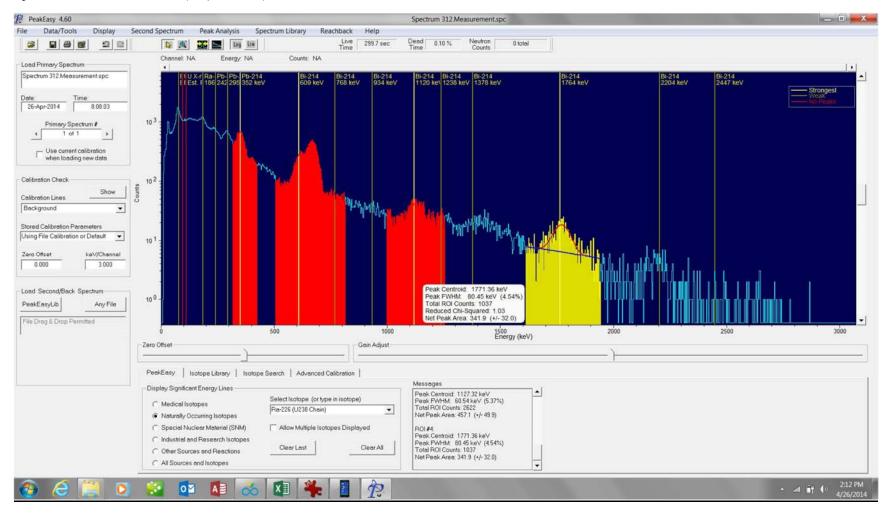
Spectrum 308: SU 02-03-RI(2) (80 μRem/hr.)





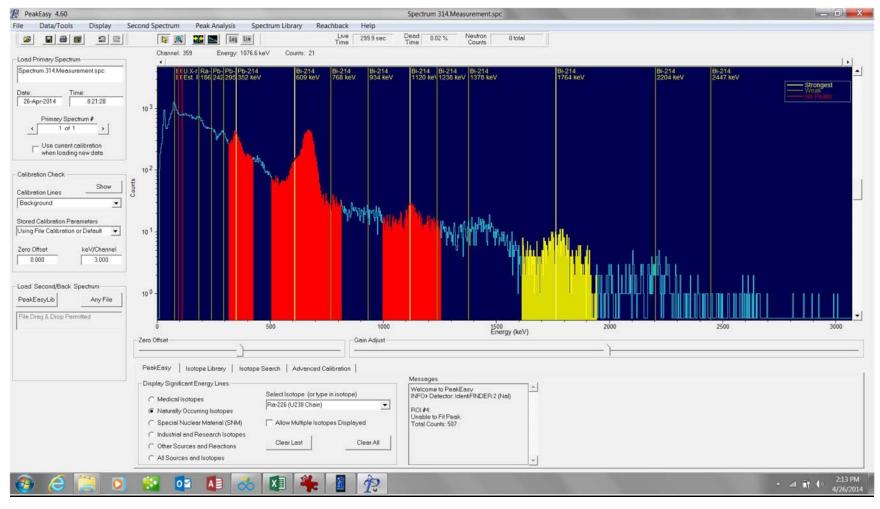


Spectrum 312: SU 02-05-RI (35 μRem/hr.)



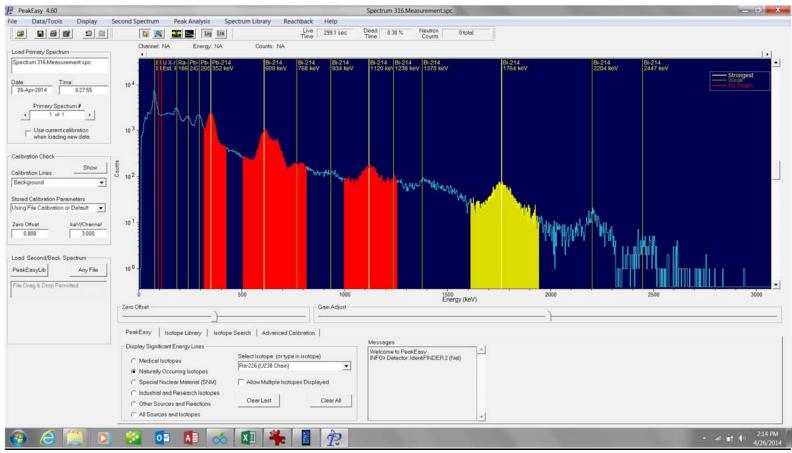
No Picture Available

Spectrum 314: SU 02-06-RI (25 μRem/hr.)



No Picture Available

Spectrum 316: SU 02-07-RI (130 μRem/hr.)





Spectrum 318: SU 02-08-RI (6,200 μRem/hr. or 6.2 mRem)



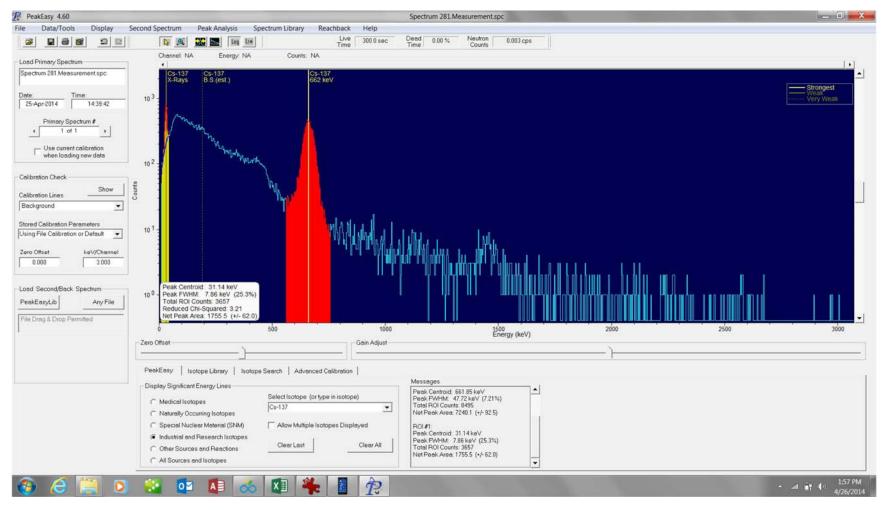


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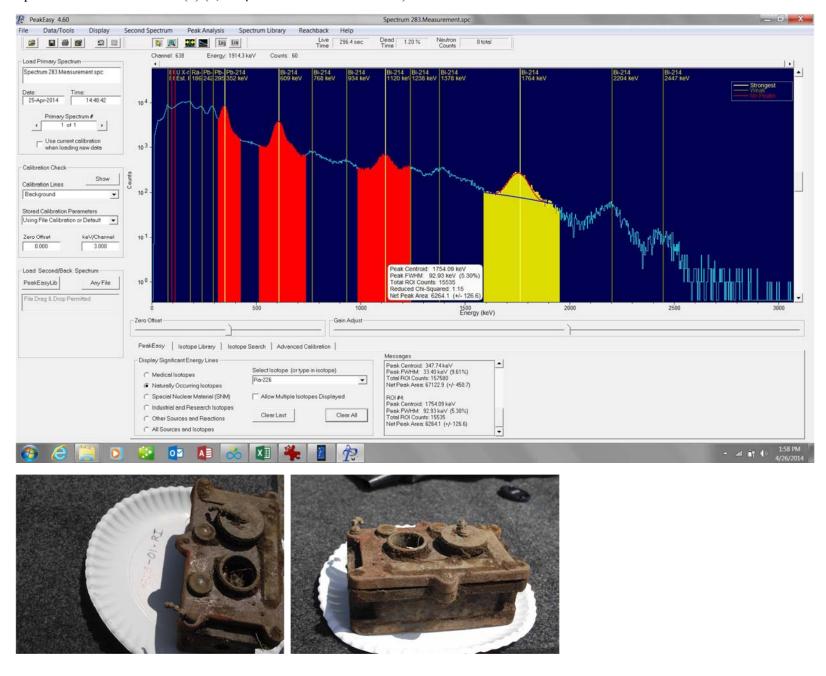
ATTACHMENT C: SU-3 GAMMA SPECTRUMS AND PHOTOS

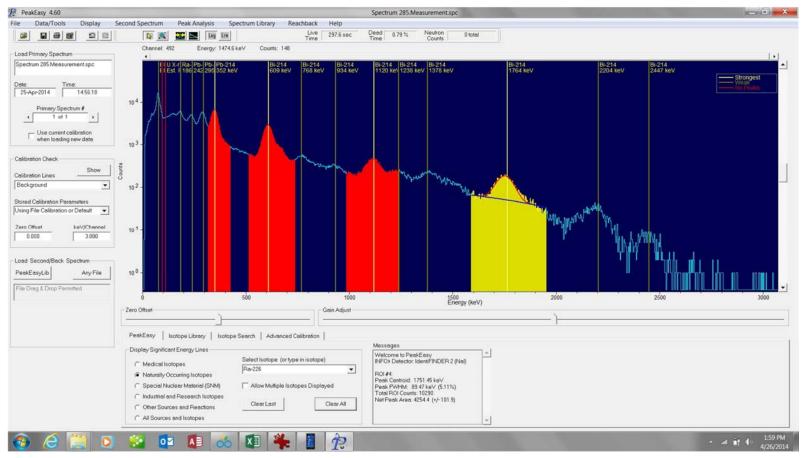
Survey Unit 3

Spectrum 281: SU-03-01-RI(1) (8 μRem/hr.)



No Photo Available





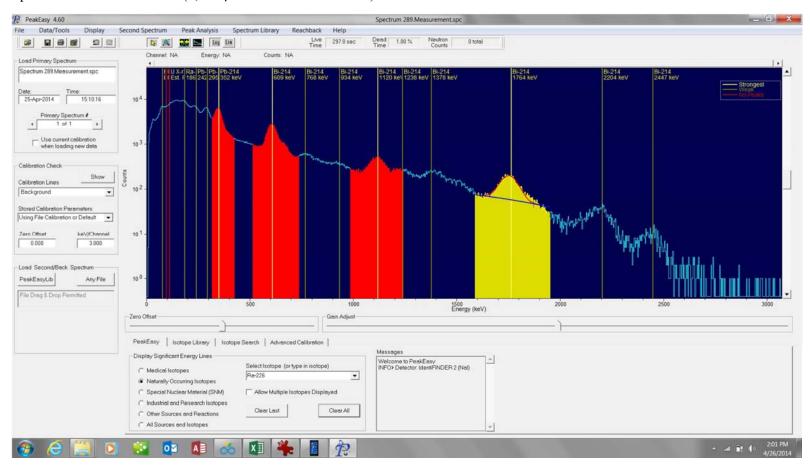


Spectrum 287: SU-03-03-RI (3,600 μRem/hr. or 3.6 mRem/hr.)



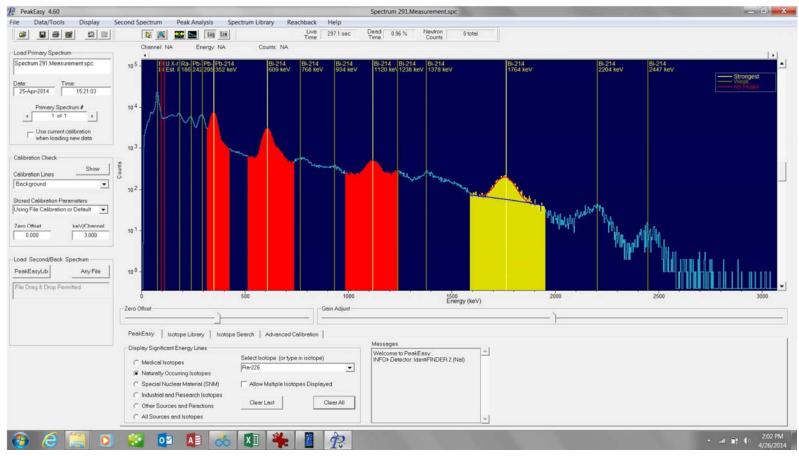


Spectrum 289: SU-03-04-RI (9,000 μRem/hr. or 9 mRem/hr.)



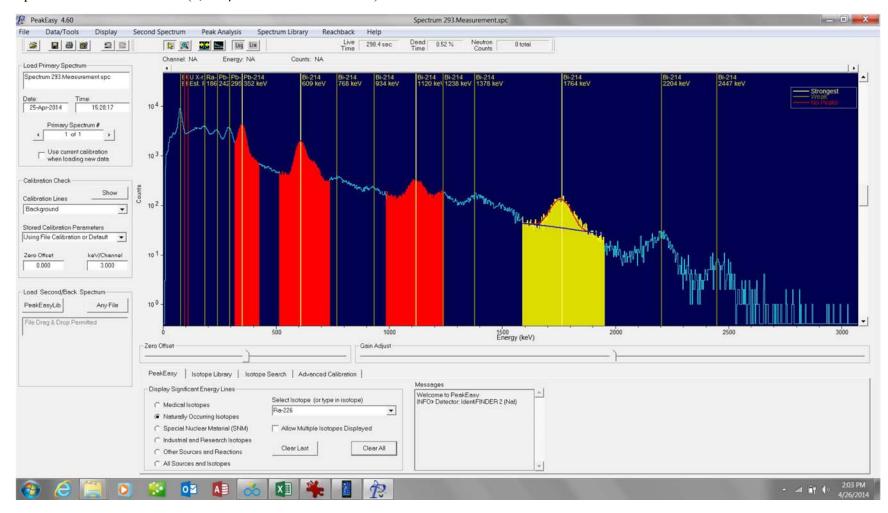
No Photo Available

Spectrum 291: SU-03-05-RI (430 μRem/hr.)



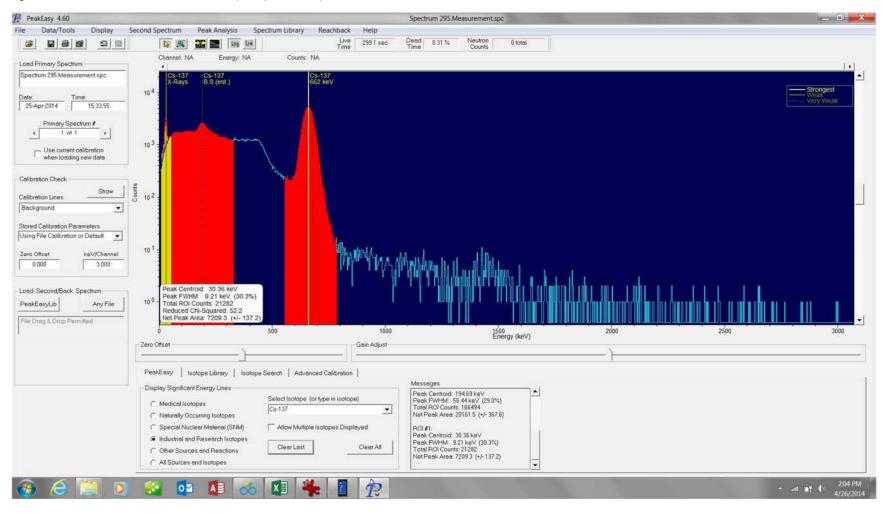


Spectrum 293: SU-03-06-RI (1,000 μRem/hr. or 1 mRem/hr.)



No Photo Available

Spectrum 295: Cs-137 Check Source (440 µRem/hr.)





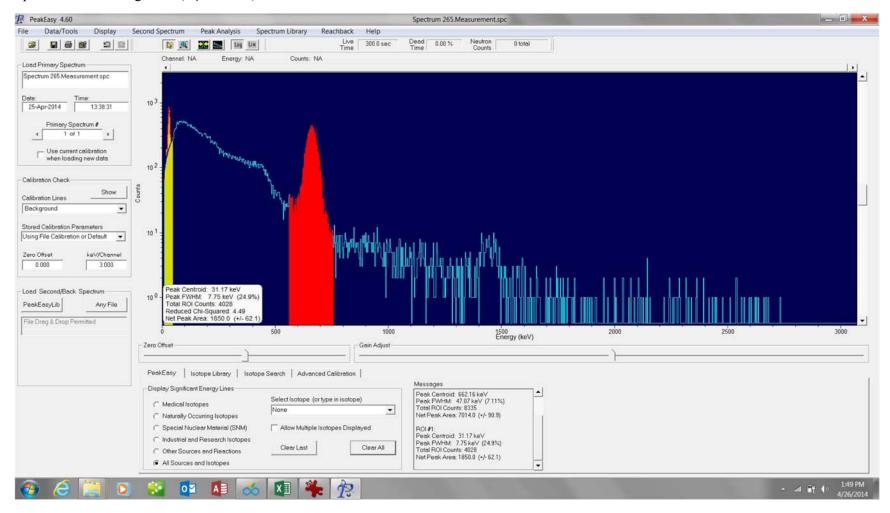
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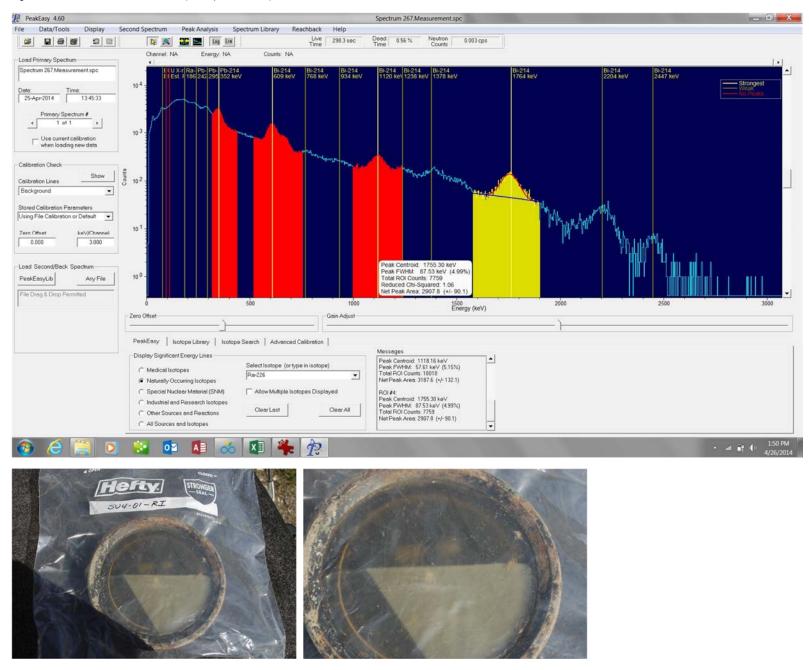
ATTACHMENT D: SU-4 GAMMA SPECTRUMS AND PHOTOS

Survey Unit 4

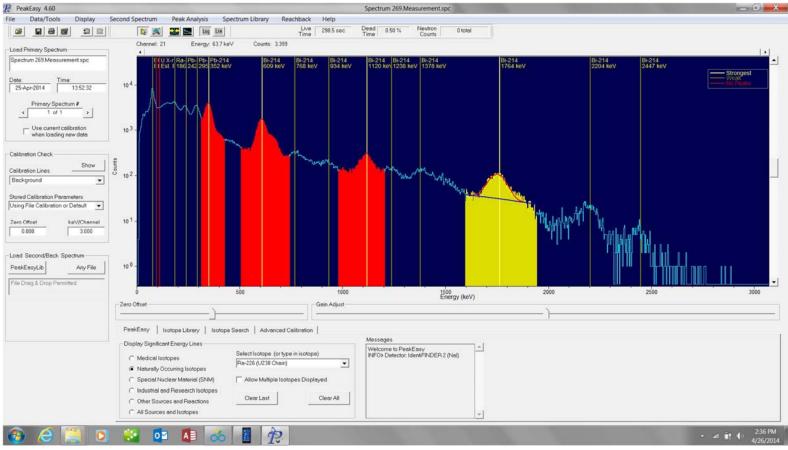
Spectrum 265: Background (8 µRem/hr.)



Spectrum 267: SU-04-01-RI (100 μRem/hr.)

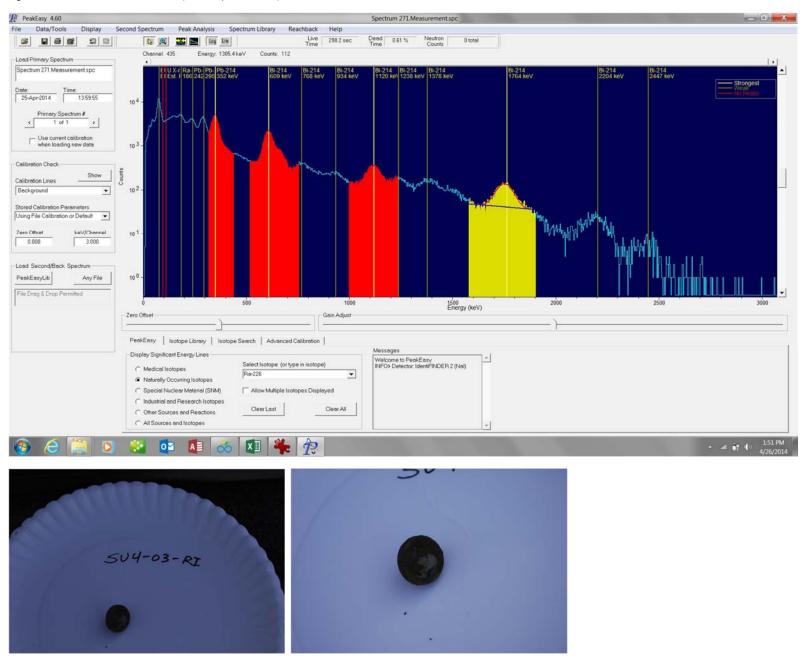


Spectrum 269: SU-04-02-RI (1,700 μRem/hr.)

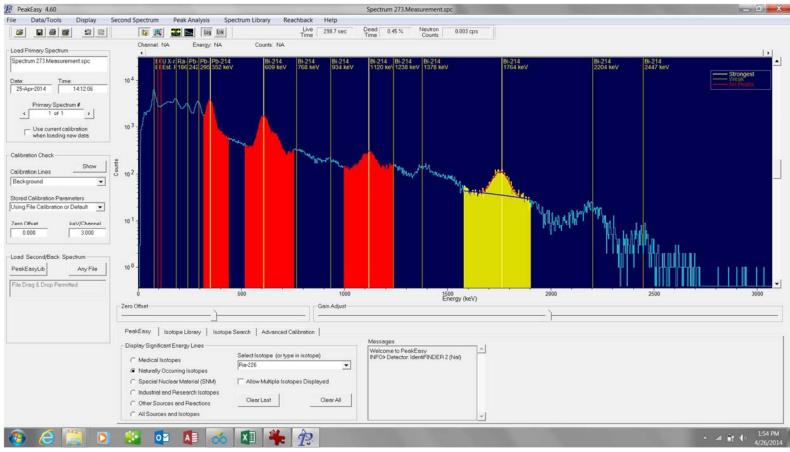




Spectrum 271: SU-04-03-RI (1,350 μRem/hr.)

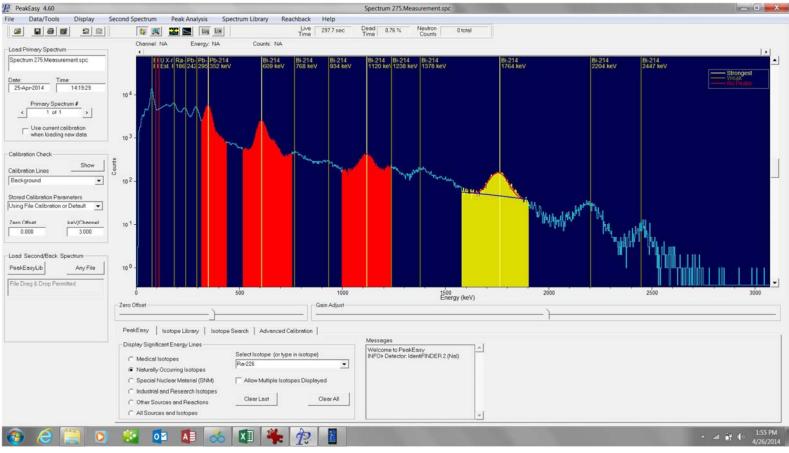


Spectrum 273: SU-04-04-RI (1,150 μRem/hr.)



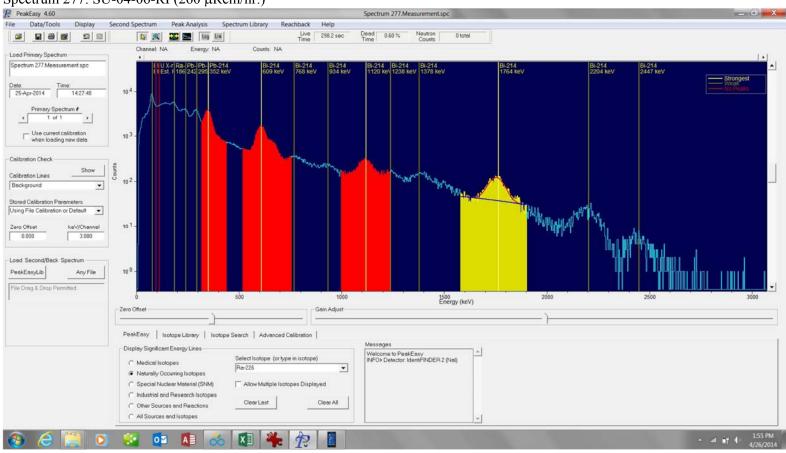


Spectrum 275: SU-04-05-RI (3,600 μRem/hr. or 3.6 mRem/hr.)



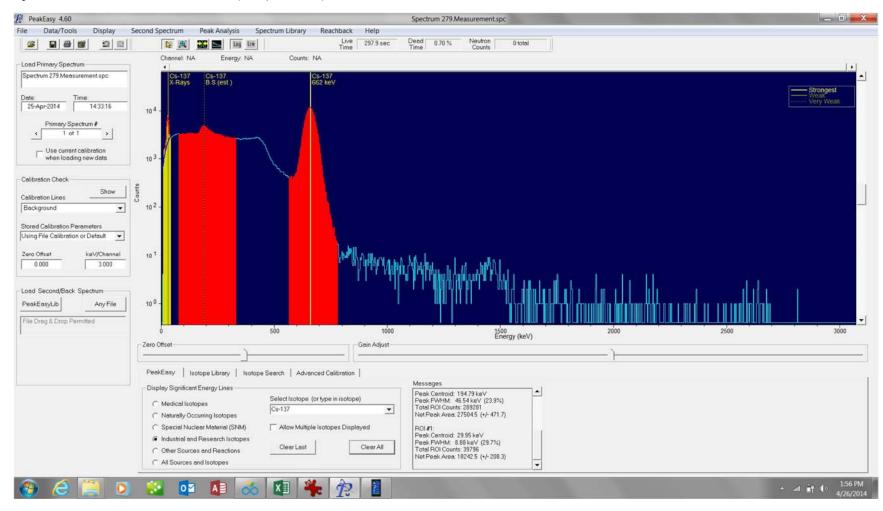


Spectrum 277: SU-04-06-RI (260 μRem/hr.)





Spectrum 279: Cs-137 Check Source (440 µRem/hr.)





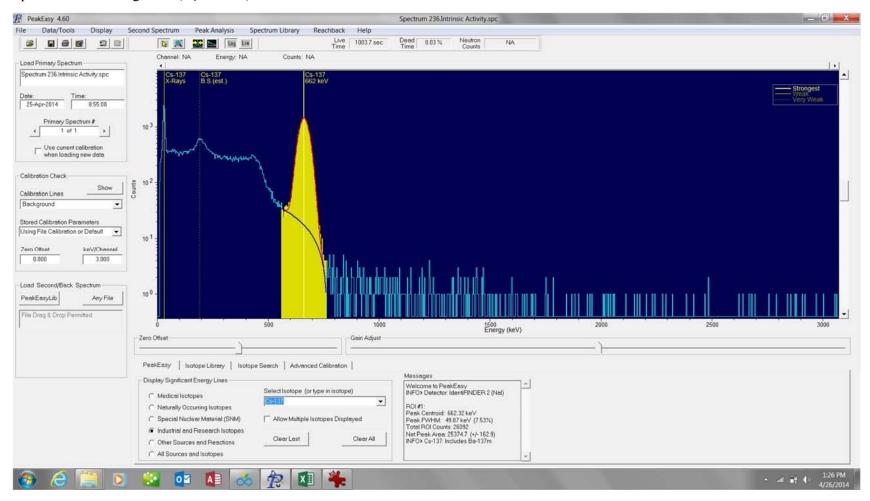
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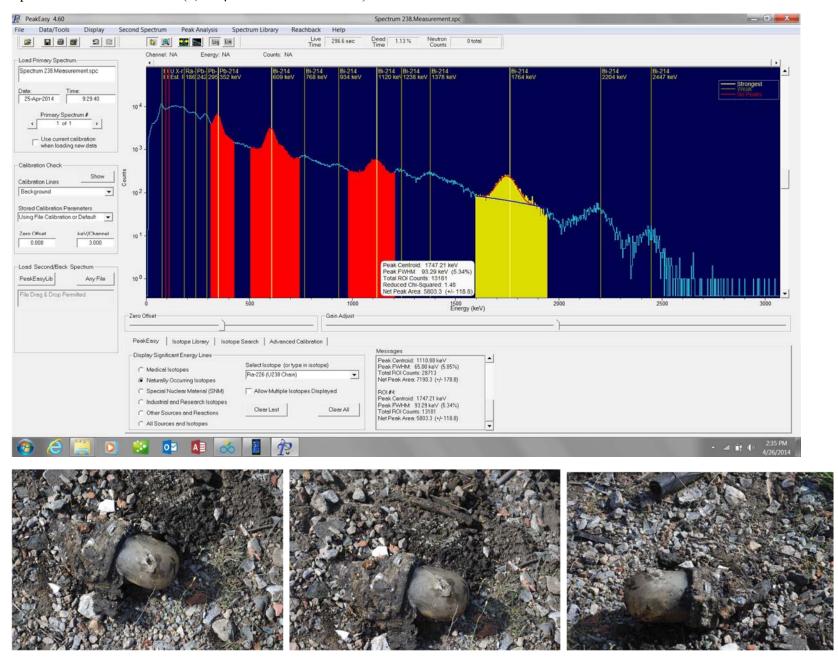
ATTACHMENT E: SU-5 GAMMA SPECTRUMS AND PHOTOS

Survey Unit 5

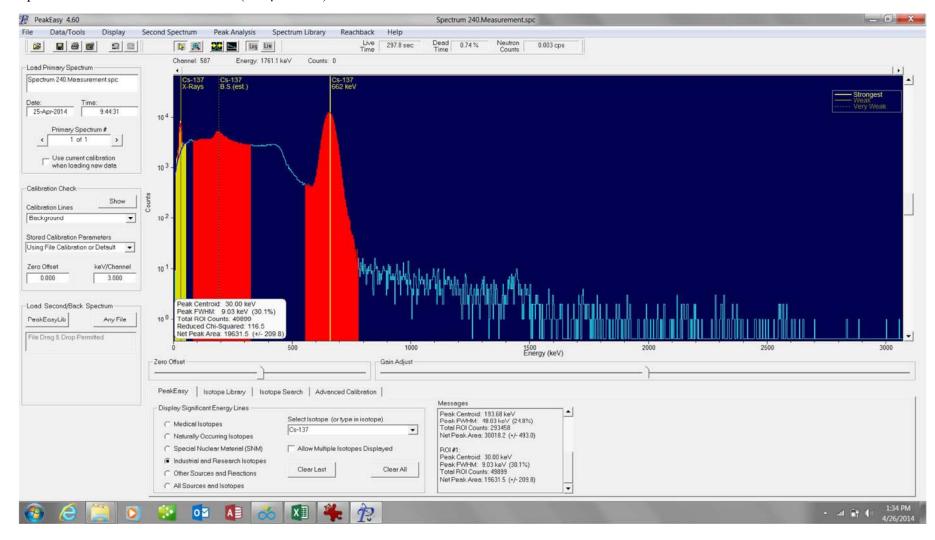
Spectrum 236: Background (8 µRem/hr)



Spectrum 238: SU-05-01-RI (3,000 μRem/hr or 3 mRem/hr)



Spectrum 240: Cs-137 Check Source (440 µRem/hr)

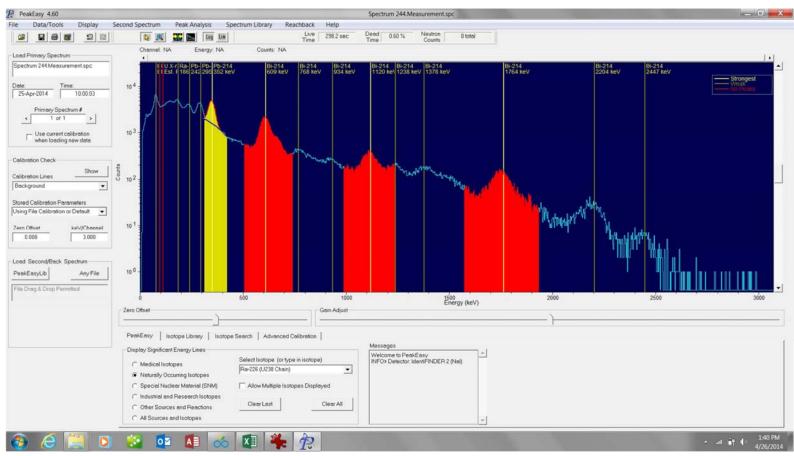


Spectrum 242: SU-05-02-RI (220 μRem/hr)





Spectrum 244: SU-05-03-RI (1,100 μRem/hr)



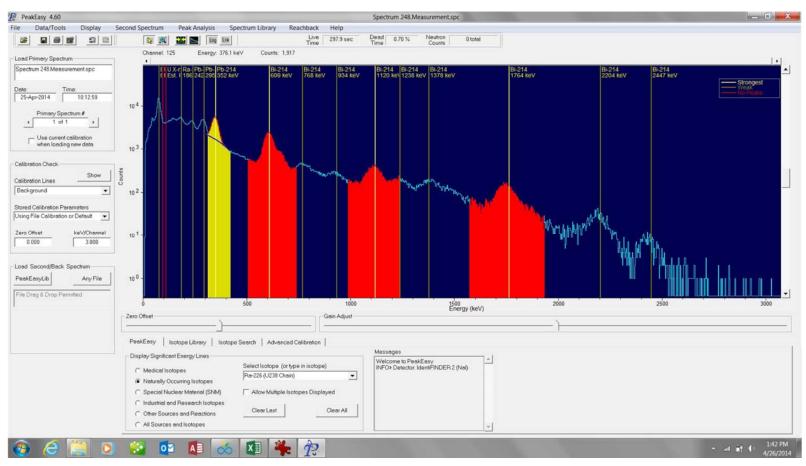


Spectrum 246: SU-05-04-RI (130 μRem/hr)



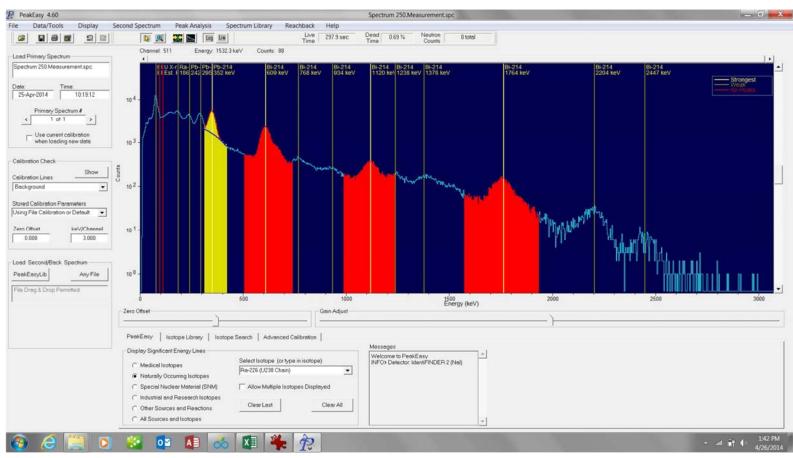


Spectrum 248: SU-05-05-RI (6,700 μRem/hr or 6.7 mRem/hr)



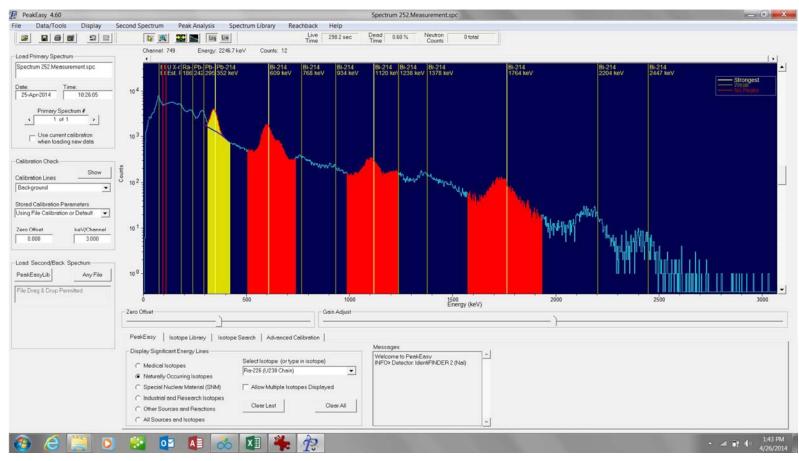


Spectrum 250: SU-05-07-RI (1,850 μRem/hr or 1.85 mRem/hr)



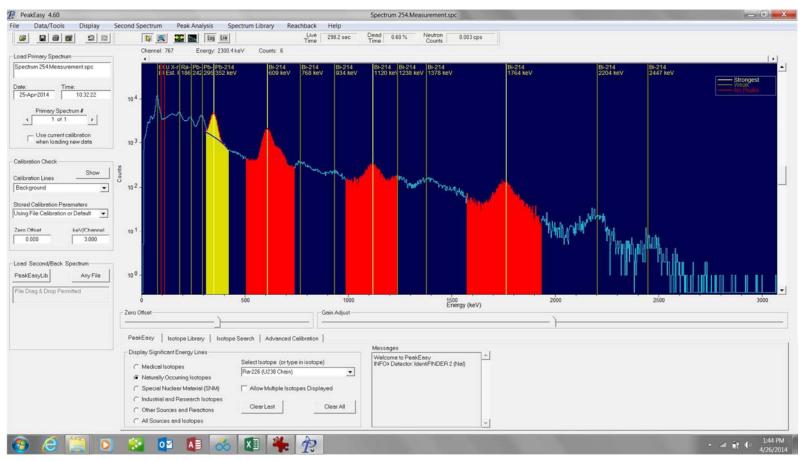


Spectrum 252: SU-05-08-RI (50,000 μRem/hr or 50 mRem/hr)



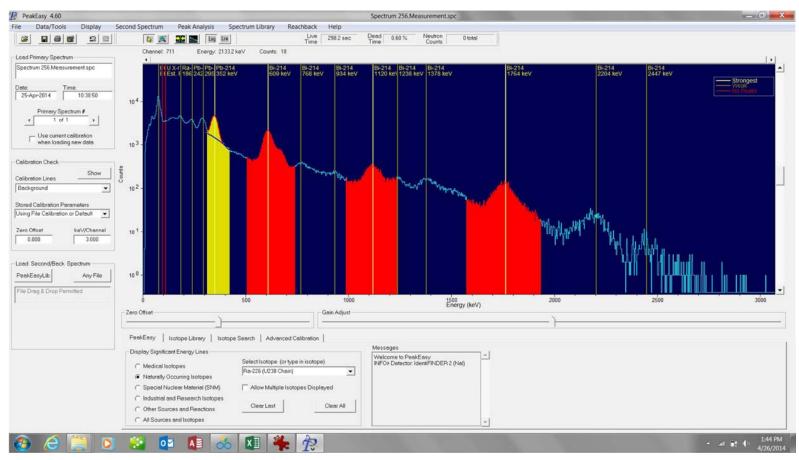


Spectrum 254: SU-05-09-RI (2,400 μRem/hr or 2.4 mRem/hr)



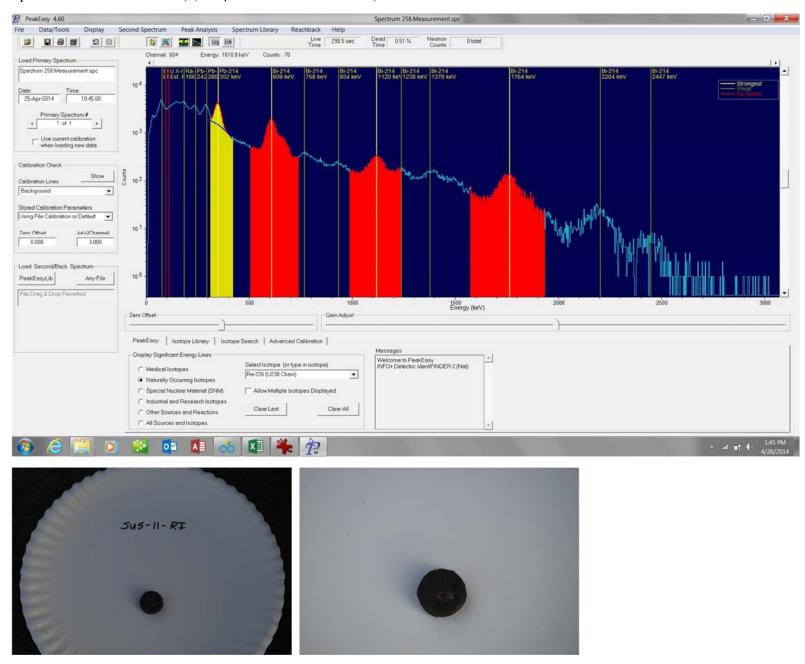


Spectrum 256: SU-05-10-RI (6,500 μRem/hr or 6.5 mRem/hr)

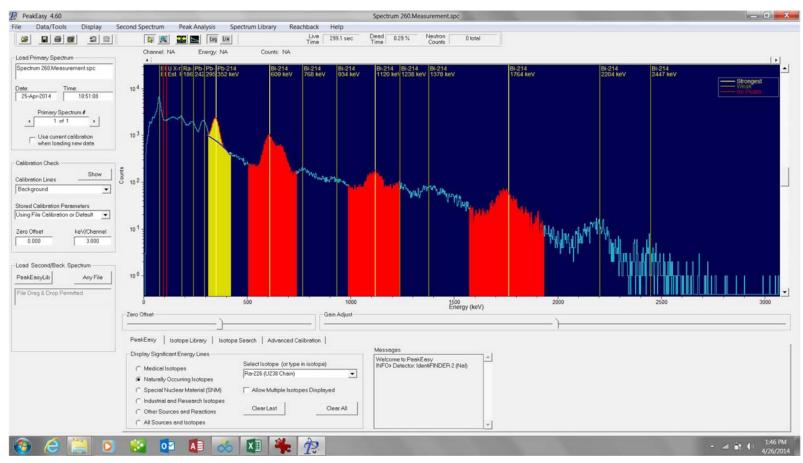




Spectrum 258: SU-05-11-RI (2,500 μRem/hr or 2.5 mRem/hr)

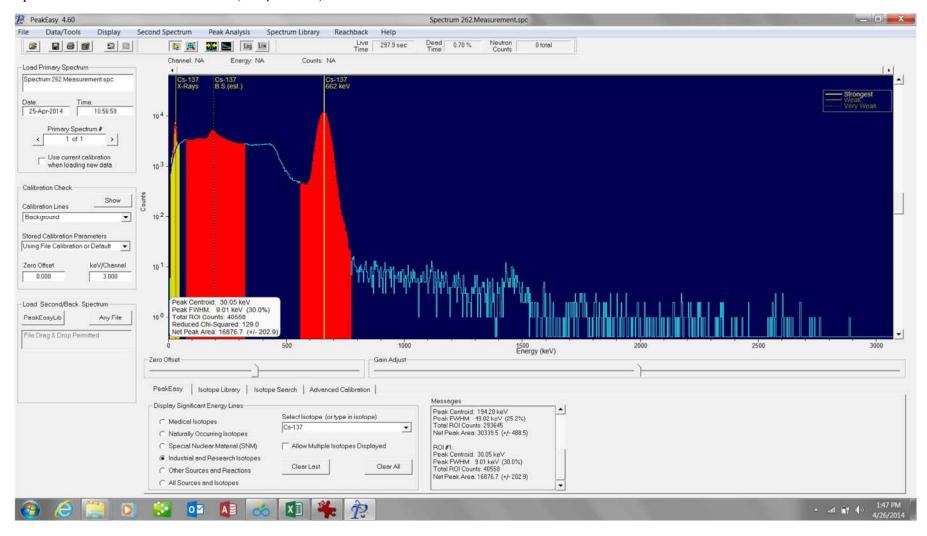


Spectrum 260: SU-05-12-RI (800 μRem/hr)





Spectrum 262: Cs-137 Source Check (440 µRem/hr)





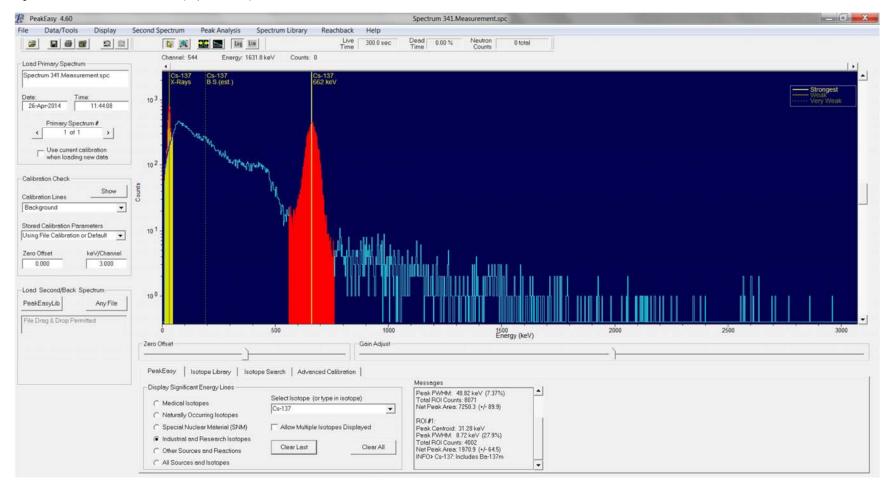
American Veteran Environmental Services, Inc.

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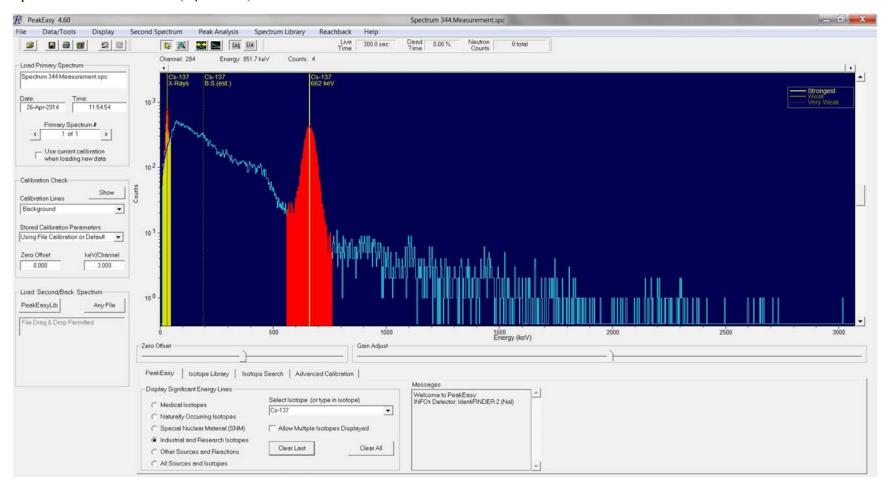
ATTACHMENT F: DISCRETIONARY SAMPLE SPECTRUMS

Discretionary Spectrums

Spectrum 341: DISC-01-RI (8 µRem/hr)



Spectrum 344: DISC-02-RI (8 µRem/hr)





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ATTACHMENT G: INSTRUMENTATION DOCUMENTS

ERG

Certificate of Calibration

Calibration and Efficiency Determination

Environmental Restoration Group, Inc. 8809 Washington St NE, Suite 150 Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

Meter: Manufa	acturer: Ludlum	Model Numb	er:	2221r	Serial Number:		117636		
Detector: Manufa	acturer: Ludlum	Model Numb	er:	44-9	Serial N	Serial Number:		PR125466	
✓ Mechanical Che	ck THR/WIN Open	ation	HV Che	ck (+/- 2.5%): 5	≥ 500 V	▼ 1000 V ▼	1500 V		
F/S Response Cl			Cable L	ength: 🗹 39-i	nch 7	2-inch Othe			
✓ Geotropism ✓ Meter Zeroed	Audio Check	dia 4.4 V/DC)			Dana	metric Pressure:	24.57	Inches He	
					Daro	Temperature:	75	inches Hg °F	
Source Distance: ✓ Contact ☐ 6 inches ☐ Ot Source Geometry: ☐ Side ✓ Below ☐ Ot			nor.			lative Humidity:	20	%	
	rithin tolerance: Ves					Integrated			
Range/Multip	plier Reference Setting	"As Found F	Reading"	Meter Reading		1-Min. Count Log Scale Count		ale Count	
x 1000	400	400	kepm	400	kcpm	400185	400	kepm	
x 1000	100	100	kcpm	100	kepm		100	kepm	
x 100	400	400	kepm	400	kepm	40054	400	kepm	
x 100	100	100	kcpm	100	kepm		100	kepm	
x 10	400	400	kepm	400	kcpm	4006	400	kcpm	
x 10	100	100	kcpm	100	kcpm		100	kepm	
x 1	400	400	cpm	400	cpm	400	400	cpm	
x 1	100	100	cpm	100	cpm		100	cpm	
	Gross Tc-99 counts (cpm):	2486		Gross Sr/Y-90 counts (cpm)					
	Background counts (cpm):	63		Background counts (cpm):					
	Net Tc-99 Counts (cpm):	2423	Net Sr/Y-90 counts (cpm)			1):			
Comments:									
Reference Instru	ments and/or Sources:								
Ludlum pulser ser	ial number: \square 97743	✓ 201932		Fluke multime	eter serial	number: 8749	012		
☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03				Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03					
☑ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03				Other Source:					
Calibrated By:	By: Calibration Date: 4.24-14 Calibration Due: 4.24-15							14-15-	
Reviewed By:	Reviewed By: Review Date: 4/24/14								

ERG

1200

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc. 8809 Washington St NE, Suite 150 Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

	Calif	ration and voltage Flat	cau	www.ERGoffice.com	
Meter: Manu	ufacturer: Ludlum	Model Number:	2221r	Serial Number:	108846
Detector: Manu	ufacturer: Ludlum	Model Number:	44-10	Serial Number: P	R114540
✓ Mechanical Ch	neck THR/WIN O	peration		▼ 500 V ▼ 1000 V ▼	
✓ F/S Response	Check Reset Check	Ca	ble Length: 39-	nch 72-inch Othe	er:
✓ Geotropism	✓ Audio Check				
✓ Meter Zeroed	✓ Battery Chec	k (Min 4.4 VDC)		Barometric Pressure: 2	
Source Distance:	☐ Contact ✓ 6 inches	Other: T	hreshold: 10 mV	Temperature:	78 °F
Source Geometry	:✓ Side ☐ Below	Other:	Window:	Relative Humidity:	20 %
Instrument four	nd within tolerance: 🗸	Yes No			
Range/Multiplier	Reference Setting	"As Found Reading"	" Meter Readii	Integrated 1-Min. Count	Log Scale Cour
x 1000	400	400	400	400175	400
x 1000	100	100	100		100
x 100	40	400	400	40030	400
x 100	10	100	100		100
x 10	4	400	400	4001	400
x 10	1	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100
High Voltage	Source Cou	nts Backg	ground	Voltage Pla	ateau
700	60915				
800	68735			140000	
900	72719			120000	*
950	73422	* 113	741	100000	NA A
1000	74428			60000	+-
1050	77520			40000	
1100	83660			20000	
1150	94899			0 + 1 1 1	1 1 1 1 1

Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 950

117339

Reference Instruments and/or Sources:			
Ludlum pulser serial number: ☐ 97743 💆 201932		Fluke multimeter se	erial number: 8749012
☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4	1098-03	✓ Gamma Source	Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Beta Source: Tof99 @ 17,700 dpm (1/4/12) sn: 40		Other Source:	, ,
Calibrated By:	Calibrat	ion Date: 4/15-/14	Calibration Due: 4/15/15
Leviewed By: Market July	Date:	4/16/14	

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.

ERG

Ludlum pulser serial number:

✓ Beta Source:

Calibrated By:

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration 8809 Washington St NE, S Albuquerque, NM 87113 (505) 298-4224 www.ERGoffice.com

Fluke multimeter serial number 8749012

Other Source:

4/16/14

Calibration Date 4/16/14

☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sr

Calibration Due 4/

Meter/Detector:	Manufa	cturer:	Ludlum	Model Nun	nber: 2929	& 43-10-1	Serial Numb	er: 15732	0 &
✓ Mechanical C F/S Response Geotropism		✓ THR Rese		on			6): 🔽 500 V 39-inch 🔲 7		
Meter Zeroed		A TOWN HOLDERS	ery Check (Min	n 4.4 VDC)	Alpha Th	reshold: 170	mV Barome	tric Pressure:	24.
Source Distance:	Contac	et 6 inc	thes 🗸 Other	: In Planchet				Femperature:	7
Source Geometry	: Side	☐ Belo	ow 🗸 Other	: In Planchet	Beta Win	dow: 46	mV Relati	ve Humidity:	2
Instrument four	nd within	tolerance:	✓ Yes □	No					
						-Min. Count	The state of the s	l-Min. Count ading"	
	Range/Mi	ultiplier	Reference	Setting	α	β	α	β	
	x 10	00	400 K	Cepm	399991	399997	399991	399997	
	x 10	00	40 K	cpm	39993	39993	39993	39993	
	x 1	0	4 Kc	pm	4000	4000	4000	4000	
	x 1		400 0	epm	400	400	400	400	
	High Voltage	Pot. Setting	Alpha α	Source B	Beta α	Source B	Back α	ground β	
	700	3.92	3718	296	5	1849	2	30	
	750	4.12	4366	307	5	2566	0	59	
	800	4.36	4496	363	6	3361	1	65	
	850	4.56	4670	582	3	4162	1	73	
Comments: H	V Plateau	Scaler Co	unt Time = 1-r	min. Recomm	nended HV =	800, Pot. Set	ting = 4.36		
Reference In	struments	s and/or S	ources:						

□ 97743 🗸 201932

-99 @ 17,700 dpm (1/4/12) sn: 4099-03

✓ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

Reviewed By: Muchun hheer

Date:

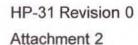
Designer and Manufacturer
of
Scientific and Industrial
CERTIFICAT

LUDLUM MEASUREMENTS, INC.

TE OF CALIBRATION 501 Oak Street 10744 Dutchtown Road

	Instruments	CERTIFICA	TE OF CALIBRATION	325-235-5494 Sweetwater, TX 79556, U.S.A.	865-392-4601 Knoxville, TN 37932,	U.S.A.
CUSTOMER	ERG			ORDER N		
Mfg.	Ludium Measurements, Inc.	Model	19	Serial No.	221561	
Mfg.		Model		Serial No.		
Cal. Date _	21-Oct-13	Cal Due Date	21-Oct-14	Cal. Interval 1 Year	Meterface 20	02-1070
Sheck mark	applies to applicable instr. and	or detector IAW mfg	, spec. T.	74 °F RH 44	% Alt 704.8	mm Hg
New Instr	rument Instrument Receive	d Within Tole	r. +-10% 🔲 10-20% 🔲 Ou	t of Tol. Requiring Repair	Other-See comm	ients
F/S Resp Audio ck. Calibrated	in accordance with LMI SOP 1	set ck. rm Setting ck. 4.8 rev 12/05/89.	☐ Window Operat ☐ Batt. ck. (Min. V ☐ Calibrated in acc	ordance with LMI SOP 14.9 re	Geotropism ov 02/07/97.	mV
nstrument Volt	Set V Input S	ens28 m ¹	V Det. Oper.	V atmV Dial	Ratio =	
HVR	eadout (2 points) Ref./Inst.	500	/_ 510 V	Ref./Inst. 1000	1002	V
COMMENT	S:					

	RANGE/MULTIPLI		FERENCE AL. POINT	INSTRUMENT "AS FOUND R		INSTRUM METER R		
	5000	4000 u	ıR/hr	3800		40	200	
	5000	1000 µ		950		10	\sim	
	500		/hr = 72,000 cpm	400		4	00	
	500	100 µ		100		10	20	
	250		/hr = 36,400 com	200		2	00	
	250	100 µ		100		10	×	
	50	2,200		40		- 2	+0	
	50	, , ,	cpm	10			10	
	25	7	cpm	20		-	20	
	25	70.0	cpm	5			5	
	*Uncertainty within ± 10% C	C.F. within ± 20%			50,25	Range(s) Cali	brated Electronically	
	REFERENCE	INSTRUMENT	INSTRUMENT	REFERENCE	INS	TRUMENT	INSTRUMENT	
	CAL. POINT	RECEIVED	METER READING*	CAL. POINT	REC	EIVED	METER READING	
adout				og icale				
er Internation calibration eferen 6064	onal Standards Organization mem n system conforms to the requirem ce Instruments and/o	bers, or have been derive ents of ANSI/NCSL Z540- r Sources: 059	alibrated by standards traceable to the difference of natural photo-1-1994 and ANSI N323-1978 9 280 720 734 G112 M565 S-39 Beta S/N	ysical constants or have been	derived by the ration State	type of calibration to of Texas Calibration 5105 57	echniques. tion License No. LO-1963 17CO 5719CO	
	500 S/N18949		Oscilloscope S/N		Multime	ter S/N	82250292	
Calibrate	d By: Done	ne miek	05	Date	91.00	7.74 13		
Reviewe	d By: Phal	H		Date	2100	413		
	ate shall not be reproduced except A 02/26/2013 Page	t in full, without the writter	approval of Ludium Measurements,		Inst. Passe	d D	and Continuity Test	





INSTRUMENTATION QC CHECK LOG

METER: 2221/44-10 # PR125466

DATE (MO/YR):

April-14

Sou	rce		Acceptan	ce Criteria			Model	Number	Cal. Due
Туре	SrY-90	Bkgrd. QC (d	cpm) range	Source QC	(cpm) range	Meter	2221	1176366	4/24/2015
Number	2148/90	Bkgrd. QC (d	66	3,014 t	0 4,522	Detector	44-10	PR125466	1/24/2015
Date	Time	Pre-use Bkg cpm	Post Bkg cpm ¹	Pre-Use Source cpm	Post Source cpm ¹	Bat Check	HV Check	Pre-Use HPT Initials	Post HPT Initials 1
24-Apr	730	58		3800		X	х	DK	
25-Apr	730	55		3711		X	x	DK	
26-Apr	730	54		3771		X	X	DK	

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By:

Date: 4/27/14

		157000		457004		
	Meter Number:	<u>157320</u>	Detector Number:	157321	_	
	Meter Model:	2929	Detector Model:	43-10-1		
	Cal. Due:	4/16/2015	Cal. Due:	4/16/201	5	
ALPHA [Source Type:	Th-230	Threshold:	180 mV		
ALPHA	Source #:	4006-02	High Voltage:	800		
ALPHA	Source Activity:	22,000				
ALPHA	Source count time:	1	Background count time:	10		(min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	2.9		
ALPHA	7,997	1	Average Source (GCPM):	7,787		
ALPHA	7,667	3	Average Net Source (NCPM):	7,784		
ALPHA	7,740	2	Source Range (GCPM):	6,227	to	9,341
ALPHA	7,856	1	Background Range (CPM):	-4.2	to	10.0
ALPHA	7,830	0	Determined Efficiency:	35.4%		
ALPHA	7,800	3				
ALPHA	7,760	7	20% of Bkg.	0.6		
ALPHA	7,830	7	1 Standard Deviation of Bkg.	2.4		
ALPHA	7,778	2	3 Standard Deviations of Bkg.	7.1		
ALPHA	7,610	3				

Beta / Gamma (circle one)

BETA	Source Type:	SrY-90	Threshold:	4 mV		
BETA	Source #:	2148/90	High Voltage:	800		
BETA	Source Activity:	10,733				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	420		
BETA	4,443	429	Average Source (GCPM):	4,313		
BETA	4,249	427	Average Net Source (NCPM):	3,893		
BETA	4,419	424	Source Range (GCPM):	3,451	to	5,176
BETA	4,314	435	Background Range (CPM):	387	to	454
BETA	4,230	409	Determined Efficiency:	36.3%		
BETA	4,365	434				
BETA	4,246	409	20% of Bkg.	84		
BETA	4,259	409	1 Standard Deviation of Bkg.	11		
BETA	4,208	406	3 Standard Deviations of Bkg.	34		
BETA	4,399	420				

Performed By.

Date: 4/27/14

Reviewed B

Meter Number: Meter Model: Cal. Due:		117636 2221 4/24/2015	Detector Number: Detector Model: Cal. Due:	PR125466 44-9 4/24/2015		
ALPHA ALPHA ALPHA	Source Type: Source #: Source Activity: Source count time:		Threshold: High Voltage: Background count time:			(min)
ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM): Average Source (GCPM): Average Net Source (NCPM): Source Range (GCPM): Background Range (CPM): Determined Efficiency: 20% of Bkg. 1 Standard Deviation of Bkg. 3 Standard Deviations of Bkg.	#DIV/0! #DIV/0! #DIV/0! #DIV/0! #DIV/0! #DIV/0! #DIV/0! #DIV/0!	to to	#DIV/0! #DIV/0!

Beta / Gamma (circle one)

BETA	Source Type:	SrY-90	Threshold:	40 mV		
BETA	Source #:	2148/90	High Voltage:	900 V		
BETA	Source Activity:	10,733				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	55		
BETA	3,772	64	Average Source (GCPM):	3,768		
BETA	3,736	60	Average Net Source (NCPM):	3,713		
BETA	3,873	49	Source Range (GCPM):	3,014	to	4,522
BETA	3,753	39	Background Range (CPM):	44	to	66
BETA	3,776	57	Determined Efficiency:	N/A		
BETA	3,784	70	2			
BETA	3,708	59	20% of Bkg.	11		
BETA	3,839	44	1 Standard Deviation of Bkg.	10		
BETA	3,704	47	3 Standard Deviations of Bkg.	30		
BETA	3,735	62				

Performed By

Date: 4/24/14



INSTRUMENTATION QC CHECK LOG

METER: 2221/44-9 # PR125466

DATE (MO/YR): April-14

Sou	rce		Acceptan	ce Criteria			Model	Number	Cal. Due
Туре	SrY-90	Bkard, QC (c	cpm) range	Source QC	(cpm) range	Meter	2221	117636	4/24/2015
Number	2148/90	Bkgrd. QC (c	66	3,014 to		Detector	44-9	PR125466	4/24/2015
Date	Time	Pre-use Bkg cpm	Post Bkg cpm ¹	Pre-Use Source cpm	Post Source cpm ¹	Bat Check	HV Check	Pre-Use HPT Initials	Post HPT Initials ¹
24-Apr	730	58		3800		Х	х	DK	
25-Apr	730	55		3711		Х	X	DK	
26-Apr	730	54		3771		X	Х	DK	
-									

1 Gamma scan instruments used for confirmation or verification surveys require a post check-in

Reviewed By:

Date: 4/27/14

	43-1	0-1 Initi	al Instrument Check In			
	Meter Number: Meter Model: Cal. Due:	157320 2929 4/16/2015	Detector Number: Detector Model: Cal. Due:	<u>157321</u> <u>43-10-1</u> <u>4/16/201</u>	5	
ALPHA	Source Type:	Th-230	Threshold:	180 mV		
ALPHA ALPHA	Source #: Source Activity:	4006-02 22,000	High Voltage:	800		
ALPHA	Source count time:	1	Background count time:	10		(min)
ALPHA	Source GCPM	BKG CPM	Average Bkg. (CPM):	2.9		
ALPHA	7,997	1	Average Source (GCPM):	7,787		
ALPHA	7,667	3	Average Net Source (NCPM):	7,784		
ALPHA	7,740	2	Source Range (GCPM):	6,227	to	9,341
ALPHA	7,856	1	Background Range (CPM):	-4.2	to	10.0
ALPHA	7,830	0	Determined Efficiency:	35.4%		
ALPHA	7,800	3				
ALPHA	7,760	7	20% of Bkg.	0.6		
ALPHA	7,830	7	1 Standard Deviation of Bkg.	2.4		
ALPHA	7,778	2	3 Standard Deviations of Bkg.	7.1		
ALPHA	7,610	3				

Beta / Gamma (circle one)

BETA [Source Type:	SrY-90	Threshold:	4 mV		
BETA	Source #:	2148/90	High Voltage:	800		
BETA	Source Activity:	10,733				
BETA	Source count time:	1 min.	Background count time:	1 minute		(min)
BETA	Source GCPM	BKG CPM	Average Bkg. (CPM):	420		
BETA	4,443	429	Average Source (GCPM):	4,313		
BETA	4,249	427	Average Net Source (NCPM):	3,893		
BETA	4,419	424	Source Range (GCPM):	3,451	to	5,176
BETA	4,314	435	Background Range (CPM):	387	to	454
BETA	4,230	409	Determined Efficiency:	36.3%		
BETA	4,365	434				
BETA	4,246	409	20% of Bkg.	84		
BETA	4,259	409	Standard Deviation of Bkg.	11		
BETA	4,208	406	3 Standard Deviations of Bkg.	34		
BETA	4,399	420				

Performed By:

Date: 4/24/14 Reviewed By:



INSTRUMENTATION QC CHECK LOG

METER: 2929/43-10-1

DATE (MO/YR):

April-14

									The state of the s	
Me			Acceptance	e Criteria				Aip	паα	
Number	Cal. Due		(cpm) range		(ncpm) range	Source Type	Source Number	Ins	t. Efficiency	Inst. Avg. Bkgrd.
157320	4/16/2015	Alpha	Beta	Alpha	Beta	Th-230	4006-02		35.4%	2.9
Dete	ctor	-4	387	6,227	3,451			Be	ta β	
Number	Cal. Due	to	to	to	to	Source Type	Source Number	Ins	t. Efficiency	Inst. Avg. Bkgrd.
157321	4/16/2015	10.0	454	9,341	5,176	SrY-90	2148/90		36.3%	420
Date	Time	Bkgrd. C	QC (cpm)	Source (QC (ncpm)	Bat Check	QC ¹	HPT		Comment
52-5135		Alpha	Beta	Alpha	Beta	Sat/Unsat	Sat/Unsat	Initials		
4/26/2014	1000	6	437	7757	4285	X	X	DK		
				1111						
	-						-			
							1			

¹ An unsatisfactory QC check requires the recording the result in the comment column and repeating the evaluation. Tag the instrument out of service and notify the HP Supervisor upon failing the QC check two times in succession

Reviewed By:

Date: 4/27/14



American Veteran Environmental Services, Inc.

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FIGURES



Figure A: All Proposed Gamma Specroscopy Sample Locations

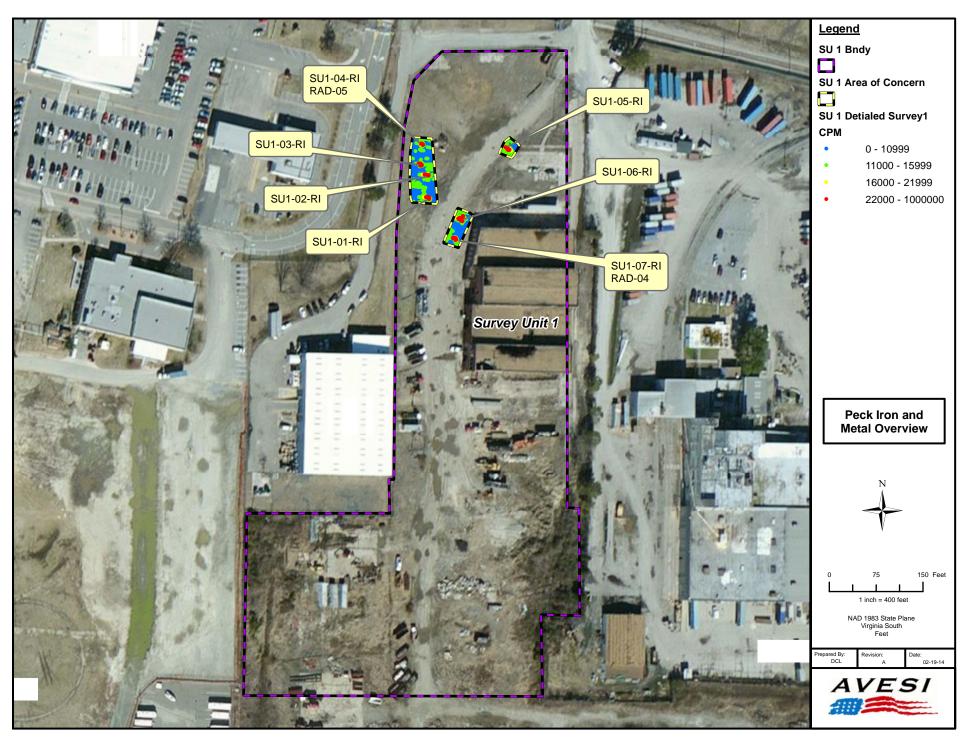


Figure 1-1: Peck Iron and Metal SU 1 Gamma Spectroscopy Sample Locations

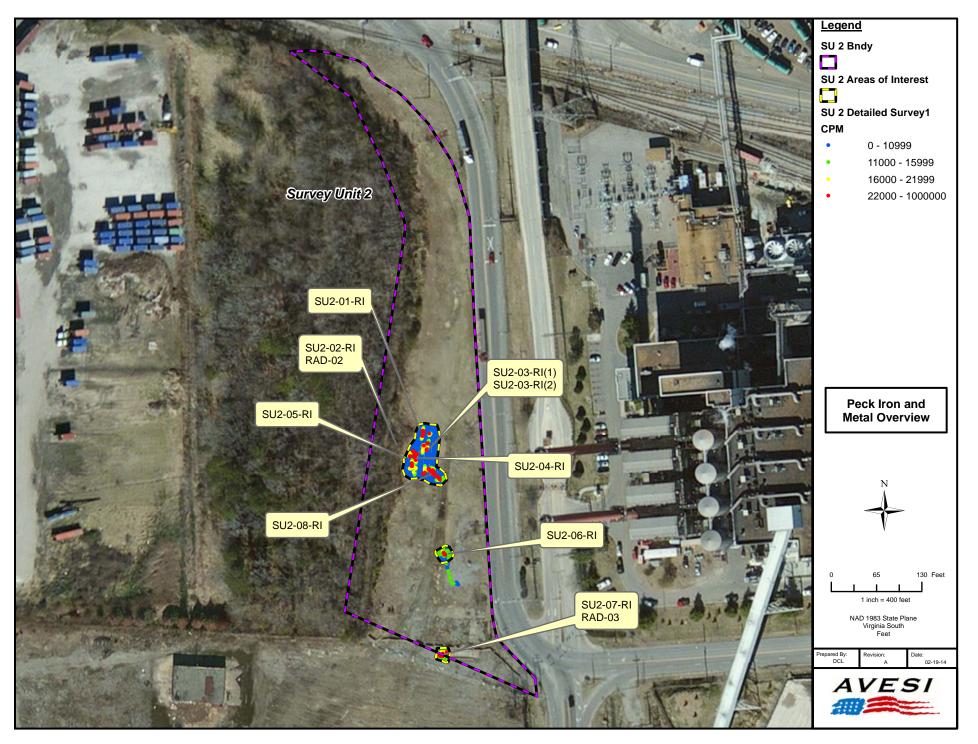


Figure 1-2: Peck Iron and Metal SU 2 Gamma Spectroscopy Sample Locations

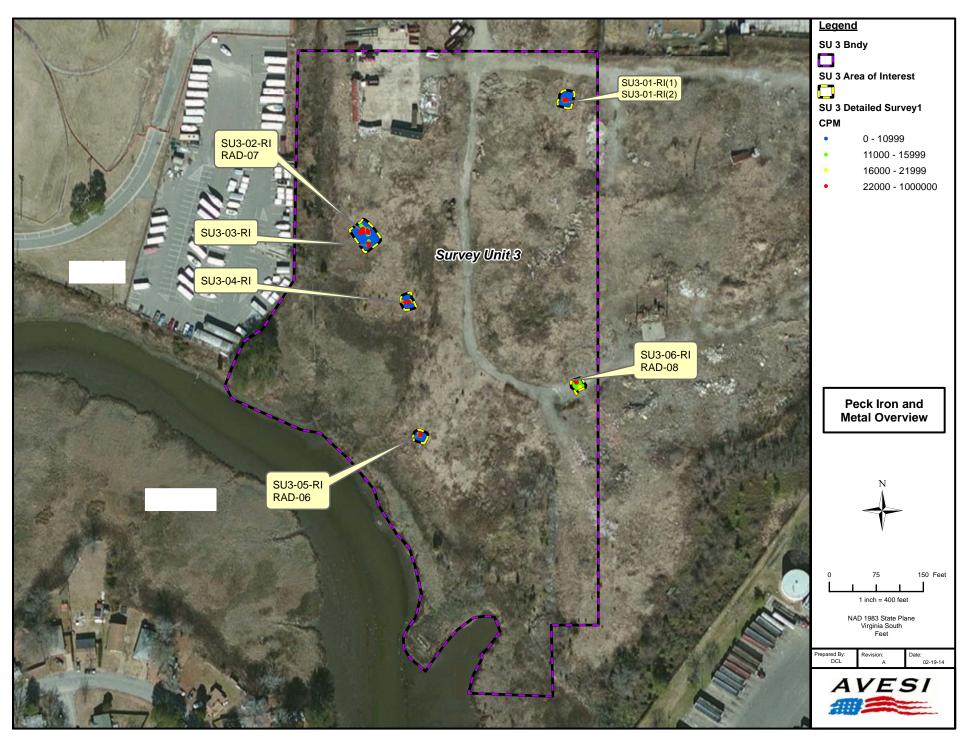


Figure 1-3 : Peck Iron and Metal SU 3 Gamma Spectroscopy Sample Locations

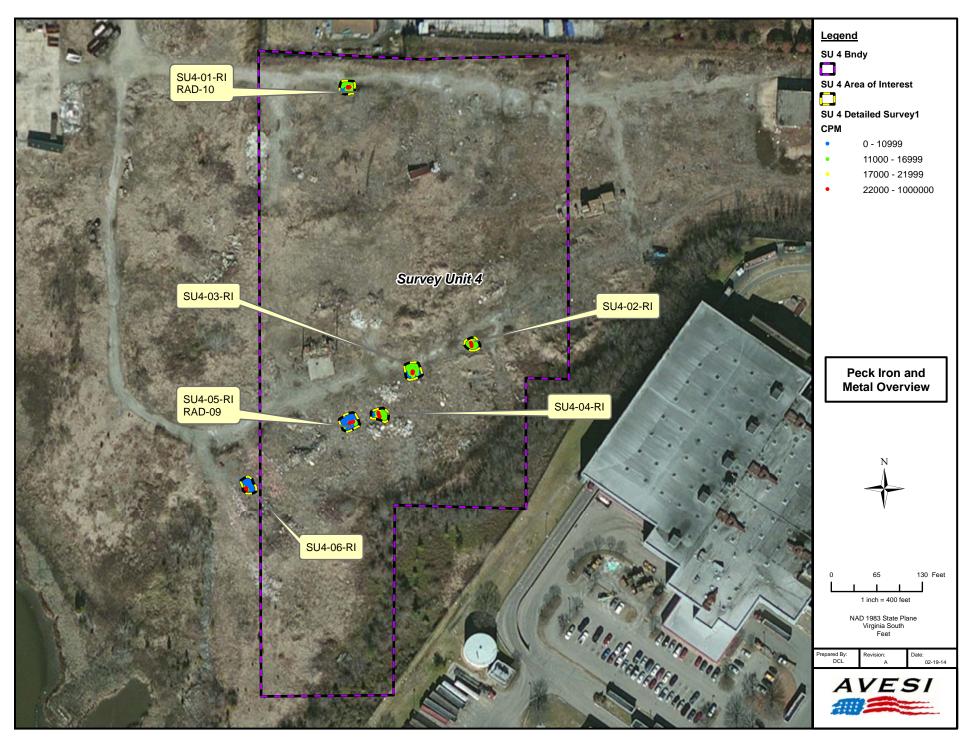


Figure 1-4: Peck Iron and Metal SU 4 Gamma Spectroscopy Sample Locations

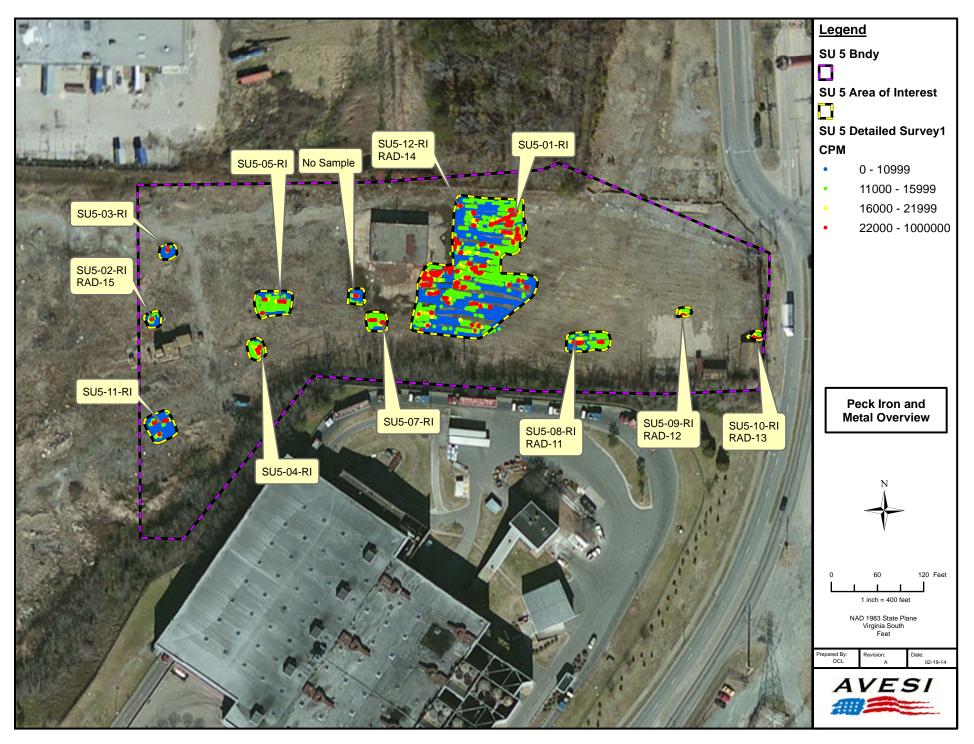


Figure 1-5: Peck Iron and Metal SU 5 Gamma Spectroscopy Sample Locations

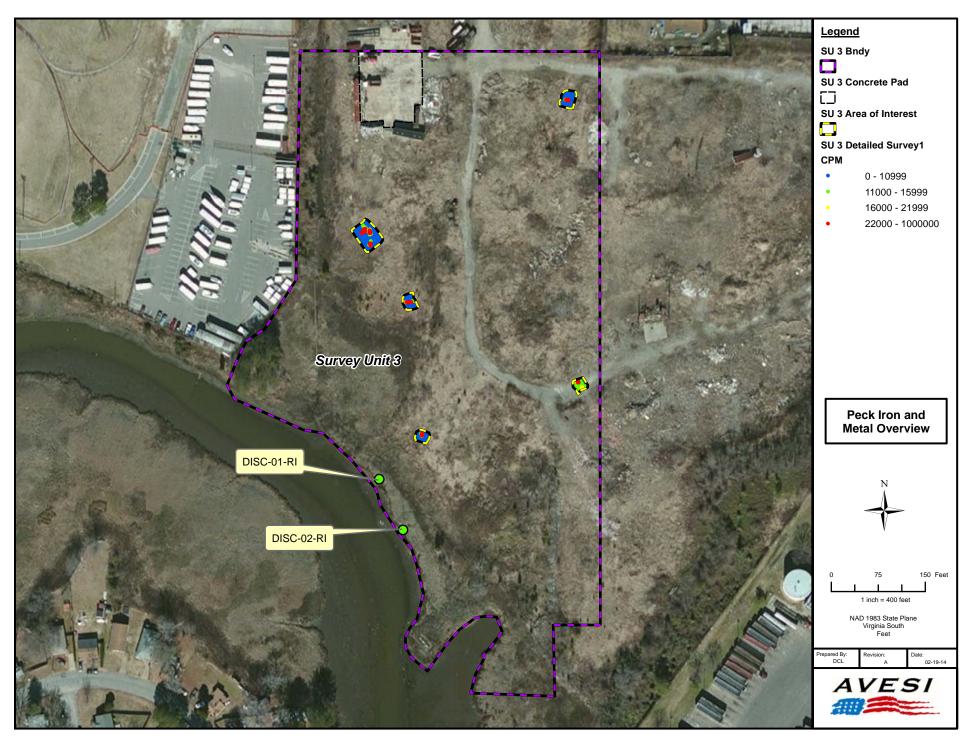


Figure 1-6: Peck Iron and Metal Discretionary Gamma Spectoscopy Sample Locations



American Veteran Environmental Services, Inc.

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TABLES

Table A: All Survey Units Sampling Summary

							Dose Rate on	Dose Rate @		Gamma				
			Gamma				Contact	3 Feet		Spectrum			Gamma Spec	
Rad Survey	Soil	Gamma Spec	Spectrum			44-10 CPM on	(Micro Rem)	(Micro Rem)	Size	Sample	Spectrum		Dose Rate	Identified
Flagged ID	Sample ID	Sample ID	ID	Northing	Easting	Counting	BKG=13	BKG=13	(sqft)	Number (RI)	Number	Object Description	(μRem/hr)	Radionuclide
SU1-01		SU1-01-RI	322		12124307	150K	140	15	>1	SU-1-01-RI	322	Small brown tubing	450	Radium 226
SU1-02		SU1-02-RI	324		12124304	210K	190	14	>1	SU-1-02-RI	324	Small brown tubing	450	Radium 226
SU1-03		SU1-03-RI	326		12124295	280K	28	16	>1	SU-1-03-RI	326	Small brown tubing	800	Radium 226
		SU1-04-RI	328		12124298	550K	310	18	>2	SU-1-04-RI	328	Small tan tubing	1,600	Radium 226
SU1-05		SU1-05-RI	330		12124436	380K	420	18	>2	SU-1-05-RI	330	Small tan tubing	800	Radium 226
SU1-06		SU1-06-RI	332		12124360	290K	380	24	>2	SU-1-06-RI	332	Small tan tubing	1,500	Radium 226
SU1-07	RAD-04	SU1-07-RI	334		12124348	160K	180	24	>1	SU-1-07-RI	334	Small tan tubing	1,000	Radium 226
SU2-01		SU2-01-RI	302		12125595	210K	110	19	>1	SU-2-01-RI	302	Soil	210	Radium 226
		SU2-02-RI	304		12125600	28K	39	10	>1	SU-2-02-RI	304	Metallic Chunks	500	Radium 226
SU2-03		SU2-03-RI(1)	304		12125581	310K	210	26	>1	SU-2-03-RI(1)	306	Piece of plastic like material	250	Radium 226
SU2-03		SU2-03-RI(2)	308		12125581	N/A	N/A	N/A	N/A	SU-2-03-RI(2)	308	Soil from around material	80	Radium 226
SU2-04		SU2-04-RI	301		12125572	85K	90	13	>1	SU-2-04-RI	310	Big chunk of metal	14,000	Radium 226
SU2-05		SU2-05-RI	312		12125561	100K	110	23	>1	SU-2-05-RI	312	Soil	35	Radium 226
SU2-06		SU2-06-RI	314		12125616	42K	45	14	>1	SU-2-06-RI	314	Soil	25	Radium 226
		SU2-07-RI	316		12125614	700K	900	60	>2	SU-2-07-RI	316	Metallic Chunks	130	Radium 226
SU2-08		SU2-08-RI	318		12125614	150K	60	19	>1	SU-2-08-RI	318	Deck Marker	6,200	Radium 226
SU3-01		SU3-01-RI(1)	281		12124432	125K	120	14	>1	SU-3-01-RI(1)	281	Soil	8	Non Detect
SU3-01		SU3-01-RI(2)	283		12124432	N/A	N/A	N/A	N/A	SU-3-01-RI(2)	283	Device	3,800	Radium 226
		SU3-02	285		12124100	290K	190	23	>2	SU-3-02-RI	285	Chunk of black material	1,700	Radium 226
SU3-03		SU3-03	287		12124115	185k	120	18	>1	SU-3-03-RI	287	Metal Device	3,600	Radium 226
SU3-04		SU3-04	289		12124180	200K	200	24	>1	SU-3-04-RI	289	Big Chunk	9,000	Radium 226
		SU3-05	291		12124198	60K	60	14	>1	SU-3-05-RI	291	Clay Like Soil	430	Radium 226
		SU3-06	293		12124449	100K	50	14	>1	SU-3-06-RI	293	Chunk of rock	1,000	Radium 226
SU4-01		SU4-01-RI	267	3461065		40K	40	14	>1	SU-4-01-RI	267	Large Gauge	100	Radium 226
SU4-02		SU4-02-RI	269		12124793	225K	110	14	>1	SU-4-02-RI	269	Small Button	1,700	Radium 226
SU4-03		SU4-03-RI	271		12124704	90K	50	14	>1	SU-4-03-RI	271	Small Button	1,350	Radium 226
SU4-04		SU4-04-RI	273		12124660	190K	100	15	>1	SU-4-04-RI	273	Small Button	1,150	Radium 226
SU4-05		SU4-05-RI	275		12124617	450K	210	20	>2	SU-4-05-RI	275	Small Button	3,600	Radium 226
SU4-06		SU4-06-RI	277		12124470	125K	130	14	>1	SU-4-06-RI	277	Chunk of corroded metal?	260	Radium 226
SU5-01		SU5-01-RI	238		12125417	<1000K	2900	170	6	SU-5-01-RI	238	Glass Bulb	3,000	Radium 226
SU5-02	RAD-15	SU5-02-RI	242		12124947	50K	40	14	>1	SU-5-02-RI	242	Deck Marker Badge	220	Radium 226
SU5-03		SU5-03-RI	244		12124966	225K	120	14	>1	SU-5-03-RI	244	Small Button	1,100	Radium 226
SU5-04		SU5-04-RI	246		12125082	250K	200	30	>1	SU-5-04-RI	246	Soil	130	Radium 226
SU5-05		SU5-05-RI	248		12125117	250K	200	20	>1	SU-5-05-RI	248	Deck Marker	6,700	Radium 226
SU5-06		N/A	N/A		12125212	60K	50	14	>1	SU-5-06-RI	N/A	N/A	N/A	N/A
SU5-07		SU5-07-RI	250		12125239	150K	300	18	>1	SU-5-07-RI	250	Small Button	1850	Radium 226
SU5-08		SU5-08-RI	252		12125501	<1000K	1000	150	6	SU-5-08-RI	252	Small piece of Plastic	50,000	Radium 226
SU5-09		SU5-09-RI	254		12125634	80K	40	14	>1	SU-5-09-RI	254	Small Button	2,400	Radium 226
		SU5-10-RI	256		12125729	240K	280	15	>2	SU-5-10-RI	256	Deck Marker	6,500	Radium 226
SU5-11		SU5-11-RI	258		12124961	160K	60	16	>1	SU-5-11-RI	258	Small Button	2,500	Radium 226
SU5-12	RAD-14	SU5-12-RI	260		12126368	150K	220	14	>1	SU-5-12-RI	260	Wood and Metal	800	Radium 226
	N/A	DISC-01-RI	341	12124116	3460423	11k	8	8	N/A	SU-5-01-RI	341	In-situ, Soil	8	Non-Detect
N/A	N/A	DISC-02-RI	344	12124152	3460340	11k	8	8	N/A	SU-5-02-RI	344	In-situ, Soil	8	Non-Detect

Appendix F.4.3

AVESI Radiological Survey Report, December 12, 2016





AVESI RADIOLOGICAL SURVEY REPORT

	EY LOCATION: Pec					• .			RW	P: N/A		TE 10/1/	2/16	Page		3	
	OSE OF SURVEY: U					uipment				I		TE: 12/12	2/16				
(die 1) Area			Serial Nu			Cal. Due Date:			Background: (CPM)				Efficiency (%)				
		ter detector		or	meter		etector	Alpha (α)		Beta (β	() A	Alpha (α)		Beta (βγ)			
_XLudlum 2929/43-10-1 N/A 1587			789	6636	7 1	0/26/2017	10/	26/2017	0.4		45		30.6		26.7		
_XLudlum 2360/43-93 100 3277		746	36278	30 1	1/29/2017	11/	29/2017	0.1		201		13.2	1	16.2			
Lu	dlum 2221/44-9	15.5	y	K	X		X		X	X		X		X		X	
_XLı	_X_Ludlum Model 19 N/A 101			689	N/A		11/9/17 N		N/A	N/A		5 µrem		NA		N/A	
Contan	nination Limits: (dpm/100	0cm ²)		Remov	able α	20	Remova	able βγ	1000	Total α		100	Total βγ	,	5000		
Sample	Description/	Location		Gross CPM	Net CPM	dpm/100cm	² Gross CPM	Net CPM	dpm/100cm ²	Gross CPM	Net CPM	I dpm/100cm ²	Gross CPM	Net CPM	dpm/100cm ²	MR/hr	
No.	1			α Removable	α Removable	α Removable	βγ Removable	βγ Removable	βγ Removable	α Total	α Total	α Total	βγ Total	β γ Total	βγ Total	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	
	ARKS: Trash Roll off Bay		•	ng S/N: 1	2075	ı	•	ı				I		ı			
TECH	NICIAN(S) SIGNATI	URE/DATI	E:e	261	M	/ 1:	2/12/201	6					/				
REVII	EWER SIGNATURE/	DATE:	Dair O	Jula / 1	2/15/20	16											



AVESI RADIOLOGICAL SURVEY REPORT (Supplement)

Sample No. 10 11 12 13 14 15	Description/ Location Trash Roll Off 10 Porta Jon 1 Outside 1 Porta Jon 2 Outside 2 Porta Jon 2 Outside 2	Gross CPM	Net CPM	α Removable <20	Gross CPM By Removable 44	βγ Removable	dpm/100cm ² βγ Removable <1000	Gross CPM	Net CPM	dpm/100cm ² α Total <100	Gross CPM \$\beta\psi\$ Total 208	Net CPM βγ Total	$\begin{array}{c} \text{dpm/100cm}^2 \\ \boldsymbol{\beta} \boldsymbol{\gamma} \\ \text{Total} \\ < 5000 \end{array}$	MR/hr or μR/hr
11 12 13 14	Porta Jon 1 Outside 1 Porta Jon 1 Outside 2 Porta Jon 2 Outside 1	2 3	1.6	<20			<1000	0	0	<100	208	7	<5000	_
12 13 14	Porta Jon 1 Outside 2 Porta Jon 2 Outside 1	3	2.6		50					1100	200	,	\3000	5
13 14	Porta Jon 2 Outside 1			20		5	<1000	0	0	<100	196	0	<5000	6
14		2		<20	42	0	<1000	1	0.9	<100	207	6	<5000	7
	Porta Jon 2 Outside 2		1.6	<20	37	0	<1000	0	0	<100	186	0	<5000	5
15		0	0	<20	49	4	<1000	2	1.9	<100	190	0	<5000	5
13	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
Trailer Willian	pivey Port: Toilets (no S/N attached) as Scotsman S/N: CBS-742B or fixed radioactivity was detected.	,				,	,			,			<u>'</u>	

AVESI RADIOLOGICAL SURVEY REPORT (Supplement)

REVIEWER SIGNATURE/DATE: Warre July 12/15/2016



SURVI	EY LOCATION: Peck Iron: Portsm	outh, VA										Page	3 of	3
Contam	ination Limits: (dpm/100cm ²)	Remova	able α	20	Remova	able βγ	1000	Total α		100	Total β	γ	5000	
Sample No.	Description/ Location	Gross CPM	Net CPM α Removable	dpm/100cm ² α Removable	βγ	βγ	dpm/100cm ² βγ Removable	Gross CPM	Net CPM	dpm/100cm ² Q 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
DEMA			1	1		<u> </u>	1			1				1

REMARKS:

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

>		
TECHNICIAN(S) SIGNATURE/DATE:	/12/12/2016	/
REVIEWER SIGNATURE/DATE: Pair Synla	12/15/2016	

Appendix F.5

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



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



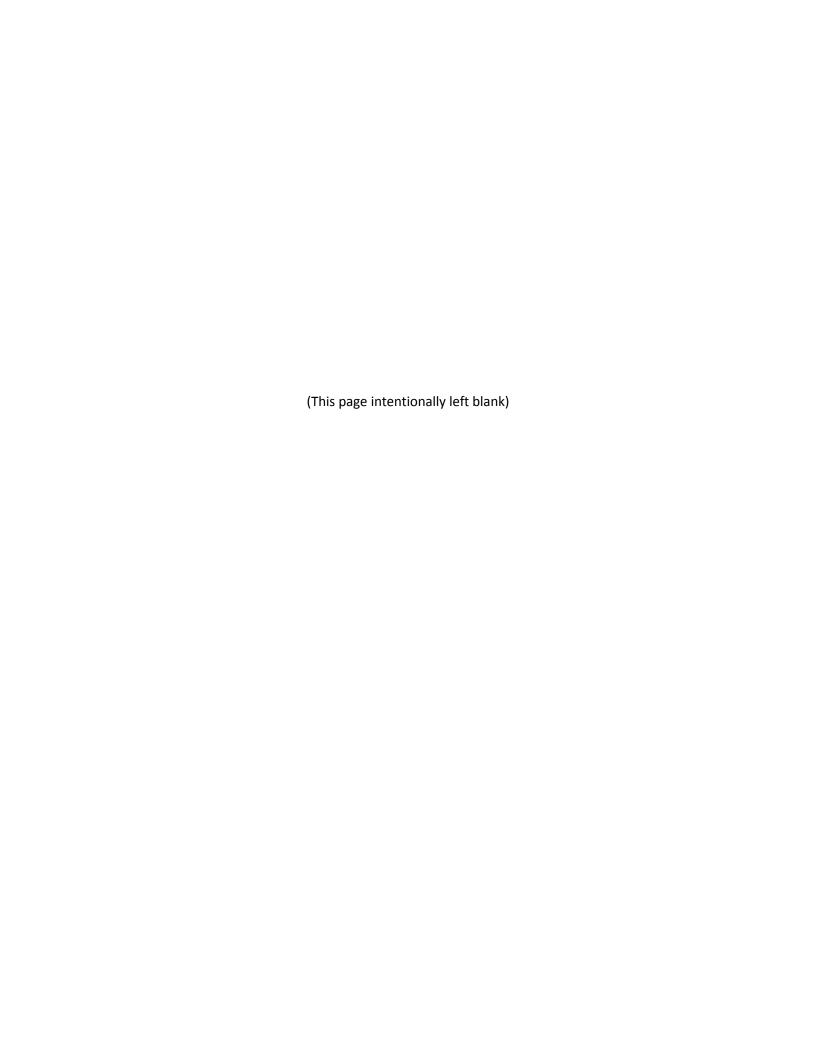


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ACRONYMS AND ABBREVIATIONS

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.

- 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 nonvegetated 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*)

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.
- 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.

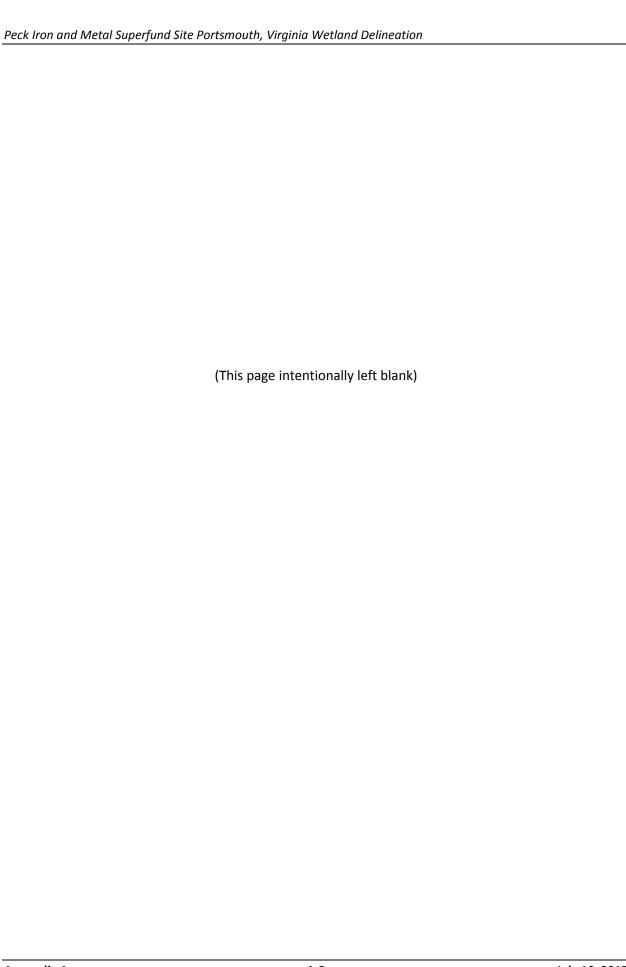
The Virginia Marine Resources Commission also regulates tidal wetlands, subaqueous of bottomlands primary sand dunes.

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



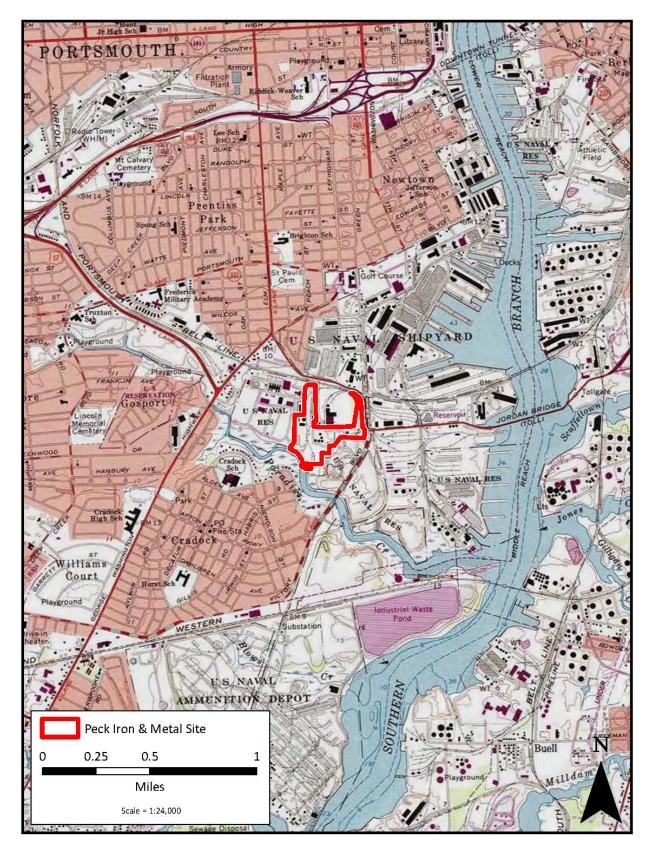


Figure 1. Peck Iron and Metal USGS Map

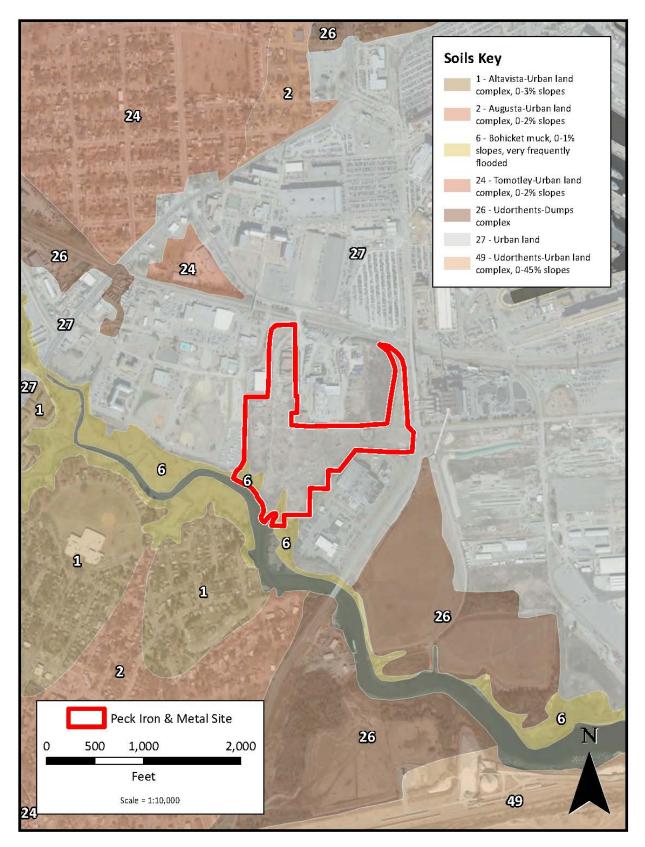


Figure 2. Peck Iron and Metal Soils Maps



Figure 3. Peck Iron and Metal Color Infrared Photograph

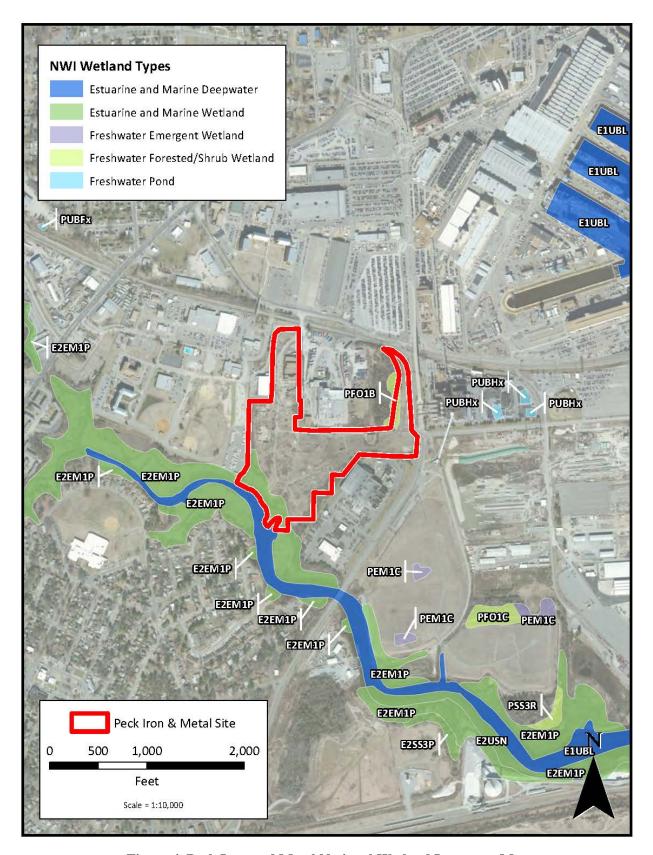


Figure 4. Peck Iron and Metal National Wetland Inventory Map

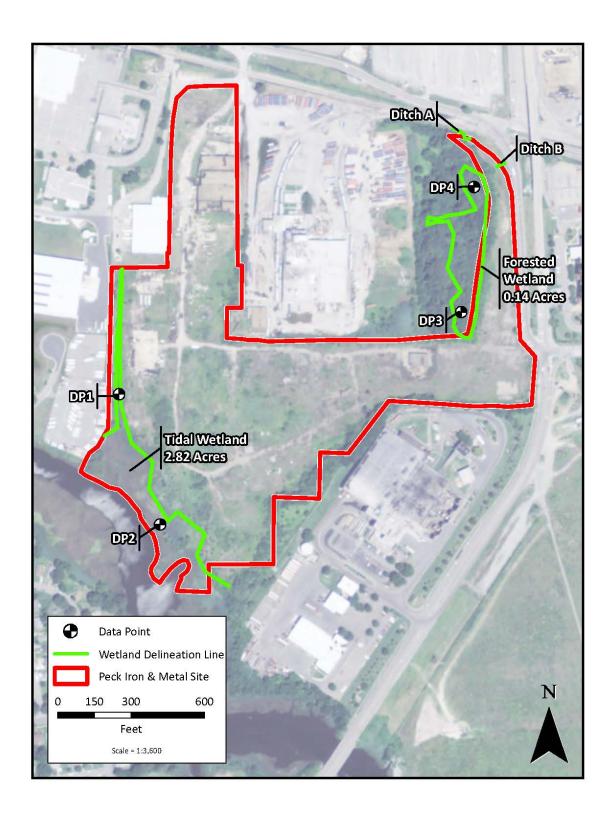
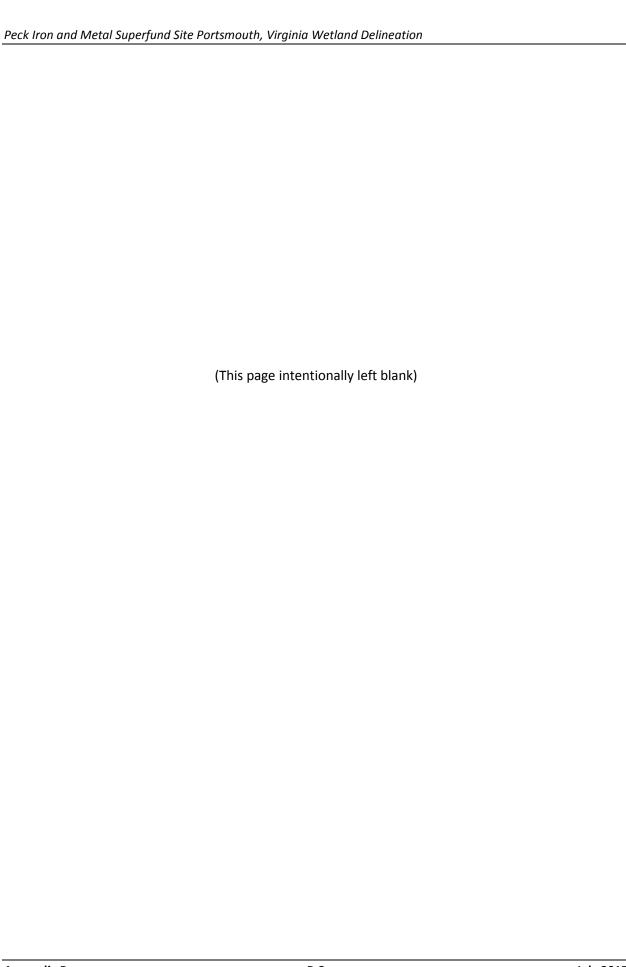


Figure 5. Peck Iron and Metal Wetland Delineation Exhibit

APPENDIX B WETLAND DATA SHEETS



WETLAND DETERMINATION DATA FORM - Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal	City/County: Por	smouth	Sampling Date: 6/16/15
Applicant/Owner: Peck		State: VA	Sampling Point: DP 1
Investigator(s): John Lowenthal	Section, Township		
Landform (hillslope, terrace, etc.): Terrace		ive, convex, none): None	Slope (%):
Subregion (LRR or MLRA): LRRT	Lat: 36.807709	Long: -76.310037	Datum:
Soil Map Unit Name: Urban Land			fication: E2EM
Are climatic / hydrologic conditions on the site typical for	r this time of year? Yes X		
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 answ	vers in Remarks.)
SUMMARY OF FINDINGS - Attach site ma	ap showing sampling po	nt locations, transect	ts, important features, etc.
Hydrophytic Vegetation Present? Yes X	No le the Sam		
Hydric Soil Present? Yes X	No.		No
Wetland Hydrology Present? Yes X	. No Within a vi	edand res <u></u>	NO
Remarks:			
Normal Circumstances is typically de			
last five years, however it is significa	ntly disturbed from pre	e-development cond	dition.
HYDROLOGY			
Wetland Hydrology Indicators:		Secondary Indi	cators (minimum of two required)
Primary Indicators (minimum of one is required; check	all that apply)		il Cracks (B6)
	atic Fauna (B13)		egetated Concave Surface (B8)
	Deposits (B15) (LRR U)	— · · ·	Patterns (B10)
Saturation (A3)	rogen Sulfide Odor (C1)		Lines (B16)
	fized Rhizospheres along Living f	Roots (C3) 🔲 Dry-Seasoi	n Water Table (C2)
	sence of Reduced Iron (C4)	Crayfish Bu	ırrows (C8)
	ent Iron Reduction in Tilled Soils	(C6) Saturation	Visible on Aerial Imagery (C9)
	Muck Surface (C7)		ic Position (D2)
	er (Explain in Remarks)	☐ Shallow Aq	, , ,
Inundation Visible on Aerial Imagery (B7) Water-Stained Leaves (B9)		_	al Test (D5) moss (D8) (LRR T, U)
Field Observations:		Spriagrium	moss (Do) (ERR 1, O)
	Depth (inches):		
Water Table Present? Yes No X	Depth (inches):		
Saturation Present? Yes X No	Depth (inches): 4	Wetland Hydrology Prese	ent? Yes X No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitoring w	ell, aerial photos, previous inspec	tions), if available:	
,	,,,	,	
Remarks:			
Area subject to intermittent inundation	n after rainfall events.	Hydrology criteria	met.
,		,	

US Army Corps of Engineers

VEGETATION (Four Strata) - Use scientific n	ames of plants.		Sampling Point: DP 1
	Absolute Dominant	Indicator	Dominance Test worksheet:
Tree Stratum (Plot size:) 1. NA	% Cover Species?		Number of Dominant Species That Are OBL, FACW, or FAC: (A)
2			,
			Total Number of Dominant Species Across All Strata: (B)
3			Species Across All Strata(b)
4			Percent of Dominant Species
5			That Are OBL, FACW, or FAC: 100 (A/B)
6			Prevalence Index worksheet:
7			Total % Cover of: Multiply by:
8			OBL species x 1 =
	= Total Cove		FACW species x 2 =
50% of total cover:	20% of total cover:		FAC species x 3 =
Sapling/Shrub Stratum (Plot size:)			FACU species x 4 =
1. NA			
2			UPL species x 5 =
3			Column Totals: (A) (B)
4			Prevalence Index = B/A =
5			Hydrophytic Vegetation Indicators:
6			1 - Rapid Test for Hydrophytic Vegetation
7			2 - Dominance Test is >50%
8	= Total Cove		3 - Prevalence Index is ≤3.0¹
EON of total course			Problematic Hydrophytic Vegetation ¹ (Explain)
	20% of total cover:		
Herb Stratum (Plot size:) 1. Phragmites australis	100 Yes	FACW	¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
2			Definitions of Four Vegetation Strata:
3			Tree - Woody plants, excluding vines, 3 in. (7.6 cm) or
4			more in diameter at breast height (DBH), regardless of
5			height.
6			Sapling/Shrub - Woody plants, excluding vines, less
7			than 3 in. DBH and greater than 3.28 ft (1 m) tall.
8			Herb - All herbaceous (non-woody) plants, regardless
9			of size, and woody plants less than 3.28 ft tall.
10			Woody vine – All woody vines greater than 3.28 ft in
11.			height.
12			
	100 = Total Cove	er	
50% of total cover:	20% of total cover:		1
Woody Vine Stratum (Plot size:)			
1. NA			
2			
3			
4			
5			Hydrophytic
	= Total Cove		Present? Yes X No
	20% of total cover:		
Remarks: (If observed, list morphological adaptations be			
Mono-culture of phragmites, vegetation	n criteria met.		

SOIL									Sampling Point: DP 1
Profile Desc	ription: (Describe	to the dep	th nee	eded to docum	ent the	indicator	or confir	m the absence	
Depth	Matrix	0/			Feature		12		Damada
(inches) 0-1	Color (moist) organic			olor (moist)	%	Type ¹	_Loc ²	Texture	Remarks
2-10	2.5Y 5/2	90	7.5Y	'R 5/5	10	- C		sandy clay loam	
10-16	2.5 Y 5.1	85	_	'R 5/6	15	- c	M	clay loam	
10-10	2.5 1 5.1		7.01	11 0/0	10	- —		- Clay Ioani	
			_						
			_						
			_						
¹Tuno: C=C	oncentration, D=Dep	alation PM:	-Dodu	and Matrix MS	-Macka	d Sand Gr		² l postion:	PL=Pore Lining, M=Matrix.
	Indicators: (Applic						ali 15.		s for Problematic Hydric Soils ³ :
Histosol	(A1)			Polyvalue Bel	low Surfa	ace (S8) (L	.RR S, T,		Muck (A9) (LRR O)
least .	oipedon (A2)			Thin Dark Su	-				Muck (A10) (LRR S)
	stic (A3) n Sulfide (A4)		H	Loamy Mucky Loamy Gleye			(0)		ced Vertic (F18) (outside MLRA 150A,B nont Floodplain Soils (F19) (LRR P, S, T)
	Layers (A5)		Ī	Depleted Mat		(-)			alous Bright Loamy Soils (F20)
	Bodies (A6) (LRR F			Redox Dark S		. ,		· · ·	RA 153B)
	icky Mineral (A7) (L esence (A8) (LRR l		Н	Depleted Dark Redox Depre					Parent Material (TF2) Shallow Dark Surface (TF12)
	ick (A9) (LRR P, T)			Marl (F10) (L	,	0,			(Explain in Remarks)
= .	d Below Dark Surface	ce (A11)		Depleted Och				1	
	ark Surface (A12) rairie Redox (A16) (MI RA 150	" H	Iron-Mangane Umbric Surfa					cators of hydrophytic vegetation and tland hydrology must be present,
The same of the sa	fucky Mineral (S1) (" 🗖	Delta Ochric			, 0,		less disturbed or problematic.
	Gleyed Matrix (S4)			Reduced Ver		-		-	
June 1	Redox (S5) Matrix (S6)		Н	Piedmont Flo	-		-	149A) RA 149A, 1530	C. 153D)
_	rface (S7) (LRR P,	S, T, U)	_	7 41011141043 15	ngin Lot	a, 005 (. 20) (1407, 1000	, 1335,
	Layer (if observed)	:							
Type:	ah aa V							Udaia Cai	1 P19 V X
Depth (in Remarks:	cnes):		_					Hydric Soi	Present? Yes X No
S	oil criteria me	et.							

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal	City/County: Portsm	nouth	_ Sampling Date: 6/16/15
Applicant/Owner: Peck			Sampling Point: DP 2
label assemble	Section, Township, R		
		, convex, none): None	Slope (%):
Subregion (LRR or MLRA): LRRT Lat: 36.806	595	Long: -76.309697	
Soil Map Unit Name: Bohick Muck			Datum:ication: E2EM
	- X		
Are climatic / hydrologic conditions on the site typical for this time of year		(If no, explain in	•
Are Vegetation No., Soil No., or Hydrology No. significantly of			present? Yes X No
Are Vegetation No , Soil No , or Hydrology No naturally prot	•	needed, explain any answ	•
SUMMARY OF FINDINGS – Attach site map showing	sampling point	locations, transect	s, important features, etc.
Hydrophytic Vegetation Present? Yes X No			
Hydric Soil Present? Yes X No	Is the Sample		
Wetland Hydrology Present? Yes X No	within a Wetla	and? Yes 🔨	No
Remarks:			
Normal Circumstances is typically defined as the	e last five yea	ars. Site has not	changed use in the
last five years, however it is significantly disturb	ed from pre-d	levelopment cond	lition.
HYDROLOGY			
Wetland Hydrology Indicators:		Casandan India	atom (minimum of the constant)
Primary Indicators (minimum of one is required; check all that apply)			ators (minimum of two required)
Surface Water (A1) Aquatic Fauna (B13)	`		l Cracks (B6) egetated Concave Surface (B8)
High Water Table (A2) High Water Table (A2) Mari Deposits (B15)	•	<u> </u>	atterns (B10)
Saturation (A3) Hydrogen Sulfide Od		Moss Trim	
Water Marks (B1) Oxidized Rhizosphe			Water Table (C2)
Sediment Deposits (B2)	ed Iron (C4)	Crayfish Bu	rrows (C8)
	on in Tilled Soils (C6	S) 🔲 Saturation	/isible on Aerial Imagery (C9)
Algal Mat or Crust (B4)		_	Position (D2)
☐ Iron Deposits (B5) ☐ Other (Explain in Re	emarks)	☐ Shallow Aq	, ,
Inundation Visible on Aerial Imagery (B7)		FAC-Neutra	
Water-Stained Leaves (B9) Field Observations:		Sphagnum	moss (D8) (LRR T, U)
Surface Water Present? Yes X No Depth (inches):	tidal		
Water Table Present? Yes X No Depth (inches):	6		
Saturation Present? Yes X No Depth (inches):	2 W	Vetland Hydrology Prese	nt? Yes X No
(includes capillary fringe) Describe Recorded Data (stream gauge, monitoring well, aerial photos			
Describe Recorded Data (stream gauge, monitoring well, aerial priotos	s, previous inspection	ns), if available:	
Remarks:			
Area subject to tidal action. Hydrology criteria r	met		
The subject to trade determining a cherical	1101.		

US Army Corps of Engineers

EGETATION (Four Strata) – Use scientific n	ames of pl	ants.		Sampling Point: DP 2
		Dominant		Dominance Test worksheet:
Free Stratum (Plot size:) NA		Species?		Number of Dominant Species That Are OBL, FACW, or FAC:(A)
				Total Number of Deminent
				Total Number of Dominant Species Across All Strata:(B)
				Percent of Dominant Species
				That Are OBL, FACW, or FAC: 100 (A/E
S				Prevalence Index worksheet:
7				Total % Cover of: Multiply by:
3				OBL species x 1 =
		= Total Cov	rer	FACW species x 2 =
50% of total cover:	20% of	total cover		
Sapling/Shrub Stratum (Plot size:)				FAC species x 3 =
Baccharis hamilifolia	10	Υ	FACW	FACU species x 4 =
2.				UPL species x 5 =
				Column Totals: (A) (B
				Prevalence Index = B/A =
5				Hydrophytic Vegetation Indicators:
S				1 - Rapid Test for Hydrophytic Vegetation
7				2 - Dominance Test is >50%
3				3 - Prevalence Index is ≤3.01
		= Total Cov	/ег	Problematic Hydrophytic Vegetation ¹ (Explain)
50% of total cover:				
Herb Stratum (Plot size:)				Indicators of hudric call and watland hudrology must
Phragmites australis	10	Yes	FACW	¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
Spartina alternaflora	40	Yes	OBL	Definitions of Four Vegetation Strata:
Conding autona	40	Yes	FACW	Definitions of Four vegetation Strata.
3. Spartina patens	_ 40	165	FACVV	Tree - Woody plants, excluding vines, 3 in. (7.6 cm) of
4				more in diameter at breast height (DBH), regardless of
5				height.
6				Sapling/Shrub - Woody plants, excluding vines, less
7				than 3 in. DBH and greater than 3.28 ft (1 m) tall.
В				Herb – All herbaceous (non-woody) plants, regardles:
9				of size, and woody plants less than 3.28 ft tall.
10				Woody vine – All woody vines greater than 3.28 ft in
11				height.
12				
	100	= Total Cov	/er	
50% of total cover:	20% of	f total cover	:	
Noody Vine Stratum (Plot size:)				
2.				
3.				
4				
5				Hydrophytic
		= Total Co	ver	Vegetation Present? Yes X No
50% of total cover:	20% o	f total cover	:	
Remarks: (if observed, list morphological adaptations be	elow).			·
	,			
Tidal marsh, vegetation criteria met.				

SOIL									Sampling Point: DP 2
Profile Desc	ription: (Describe	to the dep	th nee	ded to docum	ent the	indicator	or confir	n the absence	
Depth	Matrix				Feature				
(inches)	Color (moist)	%	Co	lor (moist)	%	Type ¹	_Loc ² _	Texture	Remarks
0-2	organic								
3-12	2.5Y 5/1	90		R 5/6	10	<u> </u>	<u>M</u>	sandy clay	
12-16	5Y 5/1	90	7.5Y	R 5/6	10	<u>c</u>	M	silty clay	
¹Type: C=Cr	oncentration, D=Dep	letion PM:		ced Matrix MS	=Macker	d Sand Gr	aine	2l ocation:	PL=Pore Lining, M=Matrix.
	Indicators: (Applic						ali is.		for Problematic Hydric Soils ³ :
☐ Histosol	(A1)		П	Polyvalue Bel	ow Surfa	ace (S8) (L	.RR S, T,	U) 🔲 1 cm l	Muck (A9) (LRR O)
	pipedon (A2)			Thin Dark Sur				. —	Muck (A10) (LRR S)
Black His				Loamy Mucky			R (O)		ced Vertic (F18) (outside MLRA 150A,B)
	n Sulfide (A4) Layers (A5)		닖	Loamy Gleyed Depleted Matr		(F2)			ont Floodplain Soils (F19) (LRR P, S, T) alous Bright Loamy Soils (F20)
	Bodies (A6) (LRR P.	T. U)	Ħ	Redox Dark S		F6)			RA 153B)
	icky Mineral (A7) (LF		Ī	Depleted Dark		,		П,	arent Material (TF2)
	esence (A8) (LRR U)		Redox Depres		8)			Shallow Dark Surface (TF12)
=	ick (A9) (LRR P, T)		님	Marl (F10) (LF				U Other	(Explain in Remarks)
-	l Below Dark Surfact ark Surface (A12)	e (A11)	Η	Depleted Och Iron-Mangane				T) ³ India	cators of hydrophytic vegetation and
_	rairie Redox (A16) (N	/LRA 150/	ᇬద	Umbric Surfac					tland hydrology must be present,
	lucky Mineral (S1) (L			Delta Ochric (ess disturbed or problematic.
	leyed Matrix (S4)			Reduced Vert					
	edox (S5)		Н	Piedmont Floo					4500
	Matrix (S6) rface (S7) (LRR P, S	T 11)	Ц	Anomaious Br	ngnt Loa	imy Soils (F20) (ML)	RA 149A, 153C	s, 153D)
_	_ayer (if observed):							T	
Type:									
Depth (inc	ches):							Hydric Soil	Present? Yes X No
Remarks:	. !! !								
S	oil criteria me	t.							
1									

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Peck Iron and Metal City/County: Ports	smouth Sampling Date: 6/16/15
Applicant/Owner: Peck	State: VA Sampling Point: DP 3
Investigator(s): John Lowenthal Section, Township,	
_	/e, convex, none): None Slope (%):
	Long: -76.305335 Datum:
Soil Map Unit Name: Urban Land	NWI classification: PFO1J
	lo (If no, explain in Remarks.)
	Are "Normal Circumstances" present? Yes X No
Are Vegetation No, Soil No, or Hydrology No naturally problematic? (I SUMMARY OF FINDINGS – Attach site map showing sampling point	If needed, explain any answers in Remarks.)
V	
Hydrophytic Vegetation Present? Yes X No Is the Samp	oled Area
Hydric Soil Present? Wetland Hydrology Present? Yes X No within a We	etland? Yes X No
Remarks:	
Normal Circumstances is typically defined as the last five years, however it is significantly disturbed from pre-	
HYDROLOGY	
Wetland Hydrology Indicators:	Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that apply)	Surface Soil Cracks (B6)
Surface Water (A1) Aquatic Fauna (B13)	Sparsely Vegetated Concave Surface (B8)
High Water Table (A2) Marl Deposits (B15) (LRR U)	Drainage Patterns (B10)
✓ Saturation (A3)	Moss Trim Lines (B16)
	· / = /
Sediment Deposits (B2) Presence of Reduced Iron (C4) Recent Iron Reduction in Tilled Soils (C	Crayfish Burrows (C8) Saturation Visible on Aerial Imagery (C9)
Algal Mat or Crust (B4) Thin Muck Surface (C7)	Geomorphic Position (D2)
☐ Iron Deposits (B5) ☐ Other (Explain in Remarks)	☐ Shallow Aquitard (D3)
Inundation Visible on Aerial Imagery (B7)	FAC-Neutral Test (D5)
✓ Water-Stained Leaves (B9)	Sphagnum moss (D8) (LRR T, U)
Field Observations:	
Surface Water Present? Yes No X Depth (inches):	
	Walland III and III an
Saturation Present? Yes X No Depth (inches): 4 (includes capillary fringe)	Wetland Hydrology Present? Yes X No
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspecti	ions), if available:
Remarks:	
Area subject to intermittent inundation after rainfall events. I	Hydrology criteria met.

US Army Corps of Engineers

Absolute	Dominant	Indicator	Dominance Test worksheet:
			Number of Dominant Species
			That Are OBL, FACW, or FAC: 3 (A)
			mackie obt, racvv, dirac.
			Total Number of Dominant
20	Yes	FACW	Species Across All Strata: 3 (B)
			Descent of Demiserst Secolor
			Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B
			markie obc, rkovi, driko.
			Prevalence Index worksheet:
			Total % Cover of: Multiply by:
			OBL species x 1 =
100	= Total Cov	/er	
20% of	total cover	:	FACW species x 2 =
			FAC species x 3 =
10	No	FAC	FACU species x 4 =
			UPL species x 5 =
			Column Totals: (A) (B)
			Column Totals(A)
			Prevalence Index = B/A =
			Hydrophytic Vegetation Indicators:
			1 - Rapid Test for Hydrophytic Vegetation
			2 - Dominance Test is >50%
			3 - Prevalence Index is ≤3.01
10	= Total Cov	/er	Problematic Hydrophytic Vegetation ¹ (Explain)
20% of	total cover		
	1014. 0070.		
-	No	EACH	Indicators of hydric soil and wetland hydrology must
	140	PACO	be present, unless disturbed or problematic.
			Definitions of Four Vegetation Strata:
			Tree - Woody plants, excluding vines, 3 in. (7.6 cm) o
			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.
5	= Total Co	ver	N
20% of	total cover		
5	No	EAC	
	140		•
	- T-1-1 0		Vegetation
			Present? Yes X No
20% of	total cover	:	
below).			
	% Cover 60 20 20 20 100 5 5 5 20% of 5	Species Species	20 Yes

SOIL									Sampling Point: DP 3
Profile Des	cription: (Describe	to the de	pth needed	l to docun	nent the	indicator	or confin	m the absence	
Depth	Matrix			Redo	x Feature		. 2		
(inches)	Color (moist)		Color	moist)	%	Type¹	Loc2	Texture	Remarks
0-1	organic								
1-8	10YR 5/1	90	7.5YR 5		10	<u> </u>	M	clay loam loam	
8-16	2.5Y 5/1	85	7.5YR 5	/6	15	<u>c</u>	М	clay loam	
¹Type: C=C	Concentration, D=De	pletion, RN	I=Reduced	Matrix, MS	=Maske	d Sand Gr	ains.	² Location:	PL=Pore Lining, M=Matrix.
	Indicators: (Appli								for Problematic Hydric Soils ³ :
☐ Histoso	l (A1)		☐ Po	lyvalue Be	low Surfa	ace (S8) (L	RR S, T,	U) 🔲 1 cm f	Muck (A9) (LRR O)
_	pipedon (A2)					9) (LRR S,			Muck (A10) (LRR S)
_	listic (A3)					(F1) (LRF	R O)		ced Vertic (F18) (outside MLRA 150A,B)
	en Sulfide (A4) ed Layers (A5)		=	amy Gleye pleted Mat		(F2)			nont Floodplain Soils (F19) (LRR P, S, T) alous Bright Loamy Soils (F20)
	Bodies (A6) (LRR I	P. T. U)	_	dox Dark		F6)			RA 153B)
_	ucky Mineral (A7) (L		_	pleted Dar				п,	arent Material (TF2)
====	resence (A8) (LRR		_	dox Depre		F8)			Shallow Dark Surface (TF12)
	uck (A9) (LRR P, T)		_	rl (F10) (L			E4)	Other	(Explain in Remarks)
	ed Below Dark Surfa Park Surface (A12)	ce (A11)	_) (MLRA 1 ses (F12) (T) ³ India	cators of hydrophytic vegetation and
_	Prairie Redox (A16) (MLRA 150	_	_		(LRR P, T			tland hydrology must be present,
	Mucky Mineral (S1)		· =	Ita Ochric			, -,		ess disturbed or problematic.
	Gleyed Matrix (S4)		☐ Re	duced Ver	tic (F18)	(MLRA 15	50A, 150B)	
 -	Redox (S5)					Soils (F19)	-	-	
	d Matrix (S6) urface (S7) (LRR P,	8 T II\	LL An	omalous E	right Loa	amy Soils (F20) (MLI	RA 149A, 153C	c, 153D)
	Layer (if observed								
Type:		,-							
Depth (ir	nches):							Hydric Soil	Present? Yes X No
Remarks:								,	
8	Soil criteria me	et.							
İ									

WETLAND DETERMINATION DATA FORM - Atlantic and Gulf Coastal Plain Region

City/County: Portsmouth Sampling Date: 6/16/15 Applicant/Owner: Peck State: VA Sampling Date: DP 4 Applicant/Owner: Peck Section, Township, Range: None Slope (%):
Andform (hillslope, terrace, etc.): Terrace
Local relief (concave, convex, none): None Slope (%):
Subregion (LRR or MLRA): LRRT Lat: 36.809353 Long:76.305175 Datum:
Coli Map Unit Name: Urban Land
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 (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
Are Vegetation No , Soil No , or Hydrology No , or Hydrology No naturally problematic? Are Vegetation No , Soil No , or Hydrology No naturally problematic? GUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc. Hydrophytic Vegetation Present? Yes X No Is the Sampled Area
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
SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc. Hydrophytic Vegetation Present? Yes X No Is the Sampled Area
Hydrophytic Vegetation Present? Yes X No Is the Sampled Area
Is the Sampled Area
is the Sampled Area
within a Wetland? Yes X
Hydric Soil Present? Yes A No within a Wetland? Yes X No Wetland Hydrology Present? Yes X No 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: Secondary Indicators (minimum of two required)
Primary Indicators (minimum of one is required; check all that apply) Surface Soil Cracks (B6)
☐ Surface Water (A1) ☐ Aquatic Fauna (B13) ☐ Sparsely Vegetated Concave Surface (B8)
High Water Table (A2) Marl Deposits (B15) (LRR U) Drainage Patterns (B10)
Saturation (A3) Hydrogen Sulfide Odor (C1) Moss Trim Lines (B16)
Water Marks (B1)
Sediment Deposits (B2) Presence of Reduced Iron (C4) Drift Deposits (B3) Presence of Reduced Iron (C4) Recent Iron Reduction in Tilled Soils (C6) Saturation Visible on Aerial Imagery (C9)
☐ Drift Deposits (B3) ☐ Recent Iron Reduction in Tilled Soils (C6) ☐ Saturation Visible on Aerial Imagery (C9) ☐ Algal Mat or Crust (B4) ☐ Thin Muck Surface (C7) ☐ Geomorphic Position (D2)
Iron Deposits (B5) Other (Explain in Remarks) Shallow Aquitard (D3)
☐ Inundation Visible on Aerial Imagery (B7) ☐ FAC-Neutral Test (D5)
✓ Water-Stained Leaves (B9) ☐ 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? Yes X No Depth (inches): 3 Wetland Hydrology Present? Yes X No (includes capillary fringe)
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.
And subject to intermittent mutuation after rainian events. Hydrology offeria met.

US Army Corps of Engineers

		te Dominant		Dominance Test worksheet:
ree Stratum (Plot size:		er Species?		Number of Dominant Species
Acer rubrum	50	Yes	FAC	That Are OBL, FACW, or FAC: 4 (A)
Quercus phellos	25	Yes	FACW	Total Number of Deminant
Platanus occidentalis	25	Yes	FACW	Total Number of Dominant Species Across All Strata: 4 (B)
				Percent of Dominant Species
·				That Are OBL, FACW, or FAC: 100 (A/E
				Prevalence Index worksheet:
				Total % Cover of: Multiply by:
	100			OBL species x 1 =
E09/	of total cover: 20%	_ = Total Cov		FACW species x 2 =
		or total cover		FAC species x 3 =
apling/Shrub Stratum (Plot size:				FACU species x 4 =
Acer rubrum	5	<u>No</u>	FAC	
				UPL species x 5 =
				Column Totals: (A) (B
				Prevalence Index = B/A =
				Hydrophytic Vegetation Indicators:
i,				_ · · ·
				1 - Rapid Test for Hydrophytic Vegetation
				2 - Dominance Test is >50%
				3 - Prevalence Index is ≤3.0¹
		_ = Total Co		Problematic Hydrophytic Vegetation¹ (Explain)
50%	of total cover: 20%	of total cover	:	
Herb Stratum (Plot size:				¹ Indicators of hydric soil and wetland hydrology must
Hedera helix	5	No	FACU	be present, unless disturbed or problematic.
2.				Definitions of Four Vegetation Strata:
3				
				Tree – Woody plants, excluding vines, 3 in. (7.6 cm) of more in diameter at breast height (DBH), regardless of
ļ,				height.
5				
3				Sapling/Shrub – Woody plants, excluding vines, less
7				than 3 in. DBH and greater than 3.28 ft (1 m) tall.
3				Herb - All herbaceous (non-woody) plants, regardless
9				of size, and woody plants less than 3.28 ft tall.
10				Manda vine All woods vince greater than 2.29 ft in
11				Woody vine – All woody vines greater than 3.28 ft in height.
				noight.
12	_			
		= Total Co		
50%	6 of total cover: 20%	of total cover		
Noody Vine Stratum (Plot size:)			
Smilax rotundifolia	10	Yes	FAC	
2.				
3.				
4.				
5	10			Hydrophytic
		= Total Co		Vegetation Present? Yes X No
50%	6 of total cover: 20%	of total cove	r:	
Remarks: (If observed, list morpholo	ogical adaptations below).			
/egetation criteria met.				

SOIL									Sampling Point: DP 4
Profile Desc	ription: (Describe	to the dep	th nee	ded to docum	nent the	indicator	or confirm	n the absence	of indicators.)
Depth	Matrix			Redox	x Feature	es	1 - 2	-	
(inches) 0-1	Color (moist)			lor (maist)	%_	_Type ¹	_Loc ²	Texture	Remarks
	organic		===	D =14					
1-8	10YR 5/1	90		R 5/4	10	<u> </u>	<u>M</u>	clay loam loam	
8-16	2.5Y 5/1	85	7.5Y	R 5/6	15	<u>c</u>	M	clay loam	
			_						
1=								2, ,,	
	oncentration, D=Dep Indicators: (Applic						ains.		PL=Pore Lining, M=Matrix. for Problematic Hydric Soils ³ :
Histosol		Jabie to an		Polyvalue Bei			PPS T I		Muck (A9) (LRR O)
_	oipedon (A2)		Ħ	Thin Dark Su					Muck (A10) (LRR S)
	stic (A3)		Ħ	Loamy Mucky					ced Vertic (F18) (outside MLRA 150A)
	n Sulfide (A4)			Loamy Gleye		(F2)			iont Floodplain Soils (F19) (LRR P, S,
=	Layers (A5)	. =	14	Depleted Mat		50			alous Bright Loamy Soils (F20)
= -	Bodies (A6) (LRR F icky Mineral (A7) (L		ιH	Redox Dark S Depleted Dark				п,	RA 153B) Parent Material (TF2)
	esence (A8) (LRR L		'H	Redox Depre					Shallow Dark Surface (TF12)
	ick (A9) (LRR P, T)	-,	Ħ	Marl (F10) (L		-,			(Explain in Remarks)
_	d Below Dark Surface	ce (A11)		Depleted Och) (MLRA 1	51)	_	,
_	ark Surface (A12)		📙	Iron-Mangane					cators of hydrophytic vegetation and
	rairie Redox (A16) (^) H	Umbric Surfa			, U)		tland hydrology must be present,
= .	fucky Mineral (S1) (Gleyed Matrix (S4)	LKK (), 5)	H	Delta Ochric Reduced Ver			OA 150R)		ess disturbed or problematic.
=	Redox (S5)		Ħ	Piedmont Flo			- ,		
= '	Matrix (S6)						•	RA 149A, 153C	, 153D)
	rface (S7) (LRR P,		000						
	Layer (if observed)	:							
Type:									~
Depth (in	ches):							Hydric Soil	Present? Yes X No
Remarks:	oil criteria me	ot .							
•	on ornoria mo								

Appendix F.6

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





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:

<u>Site</u>	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

<u>Site</u>	# Mummichogs	<u>Total</u>	Average	CPUE (# per trap
	<u>Collected</u>	Weight (g)	<u>Weight (g)</u>	<u>minute)</u>
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

				<u>Total Tissue</u>
	# Oysters	Total #	<u>Percent</u>	<u>Harvested for</u>
<u>Site</u>	<u>Deployed</u>	<u>Harvested</u>	<u>Survival</u>	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	82	44	50.0%	562
Scuffletown				
Control 2	83	57	68.7%	565
Gilligan				
*Control 3	82	29	35.4%	464
Newtown				

^{*} 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)





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 shall not be reproduced, except in full, without written approval of EA Engineering, Science, and Technology, Inc., PBC

This report contains 22 pages plus 5 attachments.

Wayne L. Mceulloch Laboratory Director Date

28 December 2016

inelac ID# E87550

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 $20\pm1^{\circ}\text{C}$ 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

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

Testing Dates: 11/17/16 – 12/7/16

Sample Identification	EA Accession Number	Day 0 Pore Water (mg/L NH3-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

Testing Dates: 11/10/16 – 12/8/16

Sediment	EA		Range				
Sample Identification	Accession Number	Temperature (°C)	рН	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

Testing Dates: 11/17/16 – 12/7/16

Sediment	EA		Range				
Sample Identification	Accession Number	Temperature (°C)	pН	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	EA		Range				
Sample Identification	Accession Number	Temperature (°C)	pН	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	$0.058 (\pm 0.009)$	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	$0.70~(\pm 0.05)$	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	$0.78 (\pm 0.15)$	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	$0.74 (\pm 0.07)$	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)

Page 1 of 3

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	Preservativ e	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	4.4
	PCSD02_TOX00	PCSD02_TOX00	C0504	12671	Toxicity 6 of 10	Sediment	10/25/2016	1	Bucket	4 C	4.1
44.111	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	38
	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

	SAMPLES TRANSFERRED FROM
Special Instructions:	CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time Sample Condition Upon Receipt
initial Riliage	C/ AHGL	10/24/16 800 AM	W.P. Fife of	10.26.16 Gove
			BUNNET (EA)	10/26/16 Good

Custody seaks intact 10/26/16 mm

25

Page 2 of 3

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	Preservativ e	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
M	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

mail (4) P - PP	 		SAMPLES TRANSFERRED FROM	
Special Instructions:		•	CHAIN OF CUSTODY #	· n/a
•				•

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
initial	CA HOL	10124/14	W. P. Alm)	10.26.16	2000
			BANGES (EA)	10/2/1/6	GIGEN

Constroly sends intact 10/26/16 Alle

Page 3 of 3

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	Preservativ e	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	28
,	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
					A CONTRACT PROPERTY AND A			·	1		
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		1					<u> </u>	<u> </u>	<u> </u>		<u> </u>

Special Instruction	ns:	CHAIN OF CUSTOD	Y #		
Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
initial	5/12/1466	10/26/6	W. Aglen 7	10.26.16	Eoro.

Items/Reason Relinquished by (Signature and Organization) Date/Time Received by (Signature and Organization) Date/Time Sample Condition Upon Re	ceipt
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Belle (FA) 10/26/16 (7000)	
The state of the s	

Custody Seals Intact 10/26/66

SAMPLES TRANSFERRED FROM

ATTACHMENT II

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



Project Number: 70005.15

SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Client: HGL		
QC Test Number: _	TN-16-396	
		TEST ORGANISM INFORMATION
Common Name:	Amphipod	Adults Isolated (Time, Date):

Scientific Name: <u>Leptocheirus plumulosus</u>	Neonates Pulled (Time, Date):
Lot Number: <u>iD-086</u>	Acclimation: <u>∠24hrэ</u> Age: <u>>250 µm <500 µm</u>
Source: Chesapeake Cultures	Culture Water (T/S): <u>23.6</u> °C <u>19.4</u> ppt

		TEST INITIATION	ON
<u>Date</u>	<u>Time</u>	<u>Initials</u>	<u>Activity</u>
ulalice	1530	MI/BO BO	Sediment Added to Chambers
*	V	pe	Overlying Water Added to Chambers
illiolite	1409	20/MM/05	Organisms Transferred

	TEST SET-UP	
Sample Number(s): <u>AT6-4%5</u> , <u>AT</u> Overyling Water: <u>20 ppt Crystal</u>	<u></u>	
<u>Treatment</u>	Volume Test Sediment	Volume Overlying Water
AT6- (Lab Control) AT6-638 AT6-639 AT6-640 AT6-641 AT6-642	175 ml	725 ml



TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM RECOVERY RECORD

Project Number: 70005.15	TEST ORGANISM	Л	
Client: HGL	Common Name:	Amphipod	_
QC Test Number: TN-16-396	Scientific Name: _	Leptocheirus plumulosus:	
Organisms Recovered (date time initials):	izlatile ngaci	with	

Treatment	Replicate	Number of	Number of Organisms	Total Neonates
rreatment	Replicate	Organisms Loaded	Recovered	
AT6-486	A	20	160	44
(Lab Control)	В	20.	19	37
	С	20	20	16
	D	20	ia	
	E	20	20	1Ce 19
AT6-638	Α	20	18	33
	В	20	18	H
	С	20	15	21
	D	20	18 20	3 I
	E	20	20	23
T6-639	A	20	18	12
	В	20	ĭ1	53
	С	20	18	ñ
	D	20	18	18
	E	20	17	19
AT6-640	Α	20	16	28
	В	20	i 7	10
	С	20	20	30
	D	20	16 17 O*	0*
	E	20	15	26
AT6-641	Α	20	20	1Z
	В	20	12	16
	С	2ව	15	
	D	20	ile	12
	E	20	19	14
AT6-642	A	20	9	18
~	В	20	O.r.	13
	С	20	i2	16
	D	20	. 17	15
	Е	20	15	30

15/2



	1		WE	IGHT DATA (Tes	t Species: <i>L</i> .	plumulosus	5))
Project Number:	7	<u> 0005.15</u>		•	-		<u>Date Time Ini</u>	<u>tials</u>
Client: HG	<u>L</u>		L	oaded tins placed in o	ven:		11/19/16 1424	m
QC Test Numbe	r: <u>TN</u>	<u>-16-396</u>			Loaded tins remove			
Tin Lot:					Loaded tins weighed	d:12	12 16 1500	<u> 60</u>
Oven Temp (°C)): Start	t: 107°C	End:2	2/16-101° 12/12	Oven Number:	BLM-01	Balance Num	ber: <u>P0115825</u>
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	Α	118	29.81	31.73	1.92	10	0.192	0.172
	В	129	27.9931.16	3245	1.29	10	0.129	0.129
•	С	128	28.24	29.15	0.91	10	0.091	0.091
•	D	108	30.13 28.67	30.19	1.52	10	0.152	0.152
			,			,		
			· · · · · · · · · · · · · · · · · · ·					
Dry wt. calculation	ns check	ed (date,	initials):	10 m	Biomass calculation	s checked (date, ir	nitials):/2//5//	m-

ATS-T46 09/29/08



WEIGHT DATA (Test Species: ___L. plumulosus Project Number: 70005.15 Date Initials Time 12/8/10 Client: HGL Loaded tins placed in oven: 1037 UB BO QC Test Number: Loaded tins removed from oven: 12/12/16 1300 TN-16-396 Black 1100 BO Tin Lot: 1500 Loaded tins weighed:

Oven Temp (°C): Start: (04 End: 1212116-101° (2112117) Oven Number: BLM-01 Balance Number: P0115825

_				(21-20)		<u></u>		
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.)
АТ6- <i>495</i> ,	Α	40	29.05	58.96	29.91	ماا	1.86	1.50
(Lab Control)	В	69	27.63	47.30	19.67	19	1.03	0.98
	С	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	150 1.51	1501.51
AT6-638 ,	A	150	29.11	56.95	27.84	18,	50 1.59	1.39
,	В	137	29.27	5254	23.27	18	1.29	1.16
	С	136	27.73	52.53	24.8	15	1.65	1.24
12/8mg	D	13/3	30.02	69.59	39.57	20	1.97	1.98
v	Е	5	28.98	62.90	33.92	20	1691.70	1.70
AT6-639 .	Α	15	. 29.64	67.95	28.31	18	1.57	1. 42
	В	9	19.56	59.88	30.32	17	1.78	1.52
	С	525	7 29.1829.6	64.15	34.52	18	1.91	1.73
*	D	55	28.41	58.19	29.78	18	1.65	1.49
,	Е	-37	27.92	61.70	33.78	17	1,98	1.69

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

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

ATS-T46 09/29/08



	, ,			WF	IGHT DATA (Tes	t Species: /	nlumulosus	. 1)	
Project Num	nber: _	7	0005.15			<u> </u>	pramarosas	<u>-</u> -	<u>tials</u>	
Client:	HGL					Loaded tins placed i	n oven:	12/8/16 09/037	JB	SIS.
QC Test Nu	ımber:	<u>1</u>	N-16-396	3		Loaded tins removed	d from oven:	2/12/16 1300	Bo	
Γin Lot:		Black	460			Loaded tins weighed	l:1	2/12/16 1500	BO	
Oven Temp	o (°C):	Start	:_104	End: 2	12/16 10/0	Oven Number:		1 '	ber: <u>P0115825</u>	
•			·	Α	В	B-A	C	(B-A)/C	(16 1 1 -	
Test Concentrat	tion	Rep	Tin #	Weight of Tin (mg)	Weight of Tin and Dried Organisms (mg)	Total Dry Organism Weight (mg)	Number of Organisms Weighed	Mean Dry Organism Weight (mg)	(if applicable) Mean Biomass (mg/exposed org.)	
AT6-640		Α	37	29.43	58.18	28.75	16	1.79	1.44	
	,	В	ĺ	30.01	62.54	32.53	17	1,91	1.63	
		O	54	28.17	63.08	34.91	20	1.74	1.75	
	A	D	业	·			260			
	•	Ш	13	.28.86	60.40	31.54	18	1.75	1.57	
AT6-641	u '	A	145	28.18	65.79	37.61	20	1.88	1.88	
		В	141	27.41	41.85	14.44	12	1.20	0.72	
		С	124	27.72	59.30	31.58	15	2.10	1.58	
	•	D	112	28.71	5 894	30.23	16	1.88	1.51	
		E	125	29.61	62.93	33.32	19	1.75	1.67	
AT6-642	,	Α	19	27.32	40.37	13.05	9	1.45	0.65	
	1518	В	10.10-	28.71	: 43.51	44.8	20	2.24	2.24	
	v	С	42	27.67	39.52	11.85	12	20.98	0.59	80 121
	ų,	D	104	29.36,	63.79	34.43	17	2.02	8.1.72	12/2
	,	E	44	28.07	55.82	27.75	15	1.85	1.39	<i></i> _

Dry wt. calculations checked (date, initials): 12/15/14 M

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



Project Number:	70005.15	TEST ORGANISM	Beginning Date:	:Time:	1409
Client: HGL	<u>-</u>	Common Name: <u>Amphipod</u>	Ending Date: _	12816 Time	0930
QC Test Number:	TN-16-396	Scientific Name: <u>Leptocheirus plumulos</u>	sus		
TARGET VALUES: 1	Temp: 25 °C nH: 60-90	DO: >2.5 mg/l Salinity: 20 ppt Ph	notoperiod: 16787 Li	ight Intensity: 50 - 100 fc	

				Temp	eratui	re (°C)					рН				·	Disa	solved	Ι Οχγ	gen (n	ng/L)				Sal	inity (ppt)		
Sample #		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							19.3						
AT6-638		24.0							7.1							1.6							19.5						
AT6-639		24.0							7.2							7.6							19.4						
AT6-640		240							7.3	-						7.6							19.6						
AT6-641		240							7.3							7.6							19.8						
AT6-642		240							1.3							7.7							19.2						
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Project Number: 70005.15	TEST ORGANISM	Beginning Date:	11/10/16	Time:	1409
Client: HGL	Common Name: <u>Amphipod</u>	Ending Date:	12/8/16	Time:	0930
QC Test Number: TN-16-396	Scientific Name: <u>Leptocheirus plumulosus</u>				

TARGET VALUES Temp: __25_°C pH: _6.0 - 9.0 DO: _ >2.5 mg/L Salinity: _ 20_ ppt Photoperiod: _ 16 \(\ell \), 8 \(\ell \) Light Intensity: 50 - 100 fc

		i																			•		Γ					—	
				Temp	eratu	re (°C)					рН					Diss	solved	І Охуд	jen (n	ng/L)				Sal	inity (ppt)		
Sample #		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
AT6-455	Lab Control	240	240	245	24.0	247	240	260	7.1	7.3	7.2	7.4	1.4	7.9	8.2	8.4	8.0	75	8.1	7.9	7.9	1,2	18.3	18.0	139	IA, 3	1009	21.0	705
AT6-638		Z4.6	240	24%	24.1	24.54	24	26.0	7.7	7.4	7.2.	7.4	1.5	7.9	8.1	7.5	7.5	7.0	8.0	7.4	7.3	7.0	14.2	19.0	20.1	20.3	19.0	21.1	20.0
AT6-639																												21.0	
AT6-640		24.3	24.0	24.2	24.7	24.0	24.5	25%	7.7	7.5	7.21	7.5	1.0	21	8.1	7.4	7.4	75	7.5	13	7.1	(00)	20.1	20.3	21.6	20.4	19.9	21.9	20.0
AT6-641																												22.0	
AT6-642		7.9.4	74.0	24.0	24.0	24.7	242	15.5	7.8	7.10	7,5	7.6	7.1	8.i	8.2	7.3	7.5	76	7.5	7.4	7.2	7.1	19.3	19.	26.4	20.9	19.7	21.6	, Za'
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	Meter Number	(,28	:28	618	678	(1)	G79	671	628	WX.	1518	678	1079	629	1.79	1008	618	1514	679	1997	270	674	678	1598	1.78	1078	121C/	670	1.74
10,	Time	7203	SER SCX	160.2	100'3	11/62	1200	120	1703	PILAZI	IMI3	100	15/12	1/100)	1014	1707	H137	INGO	192	1412	(2000)	1711	1703	11120	JY4.5	1003	1108	1200	171
	Initials	NW	MAS	(SP)	NM	60.6	MIT	1710	NV	40.5	10-2	M	MIT	AAT	NA	1/1	M3	107	AIAN	100	11/1	1/10	M	17.30	1012	M()	MX	111	1/6

ryky,



Project Number: 70005.15	TEST ORGANISM	Beginning Date:	1410/16	Time:	1409
Client: HGL	Common Name: <u>Amphipod</u>	Ending Date:	12/8/10	Time:	<u> </u>
QC Test Number: TN-16-396	Scientific Name: <u>Leptocheirus plumulosus</u>				

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

				Temp	eratu	re (°C))					рН					Diss	solved	l Oxyg	jen (m	ng/L)				Sal	inity (ppt)		
Sample #		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- 1465	Lab Control	25.6	24.3	24.8	242	24.2	240	25%	7.7	-7.9	7.6	7.3	7.8	7.0	20	7.7	8.0	7.5	8.l	7.7	7,7	6.8	206	21.0	214	211	21.60	220	ei 3
AT6-638		260	255	15,3	254	25.7	24,1	25.7	7.5	1.9	7.6	7.4	7.9	1.3	7.1	7.3	7.9	7.2	15	7.1	7.6	7.0	20.5	20:7	21.0	20.5	210	21.6	20.5
AT6-639		20.0	25.W	25.0	25.2	25.3	24.6	253	79	1.0	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. j	20.3	21.0	21.3	21.8	22.0	215
AT6-640		26.0	25.4	24.9	24.4	240	24.7	2H.LO	7.9	7.0	7.8	7.4	7.9	7.4	7.5	7.1	7.1	7.2	1.3	7.(7.3	7.1	20.8	21.0	21.7	21.5	22.0	270	820
AT6-641		25.1	253	24,8	24.9	24.\	24.9	24.12	7,9	7.9	7.8	7.4	7.9	7.5	76	7.1	7.1	7.2	1.3	7.1	7.3	7.2	21.5	21.6	Z2.0	220	22.0	22.0	225
AT6-642		25.2	253	25.2	25.0	24.5	2 5.J	24.18	8.0	19	7.8	7.5	1.9	7.5	1.7	7.2	7.2	6.8	7.3	7.2	7.3	22	20,9	21.0	216	21.2	21.7	21.9	213
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<u></u>	Meter Number	174	618	678	WR.	676	678	<u>-</u>	1078	G78	(978	678	(57°b	678	679	678	678	628	618	698	1078	(oB	(97%	<i>ሬገጽ</i>	108	G18	1318	678	OF
																												0917	
	Initials	NM	MK	NM	WZ	MY.	N	13	MA	MT	NM	MS	I M	V. V	B	M	M	NN	MS	MT	NN	13					MJ	M	3 5



Project Number: 70005.15	TEST ORGANISM	Beginning Date:	11/10/16	Time:	1409
Client: HGL	Common Name: <u>Amphipod</u>	Ending Date:	12/8/16	Time:	_0930
QC Test Number: TN-16-396	Scientific Name: <u>Leptocheirus plumulosus</u>				

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

		<u> </u>		-															•										\neg
				Temp	eratu	re (°C)					рН					Diss	solvec	Охус	jen (m	ng/L)				Sal	inity (ppt)		
Sample #		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	240	24.4	<u> </u>	24.1	24.4	250	15.2	6.4	7.3	7.7	7.4	1.5	7.	7.3	8,0	6.8	7.4	6.9	1.5	7.3	7.2	22.0	21.6	229	21.4	220	189	19.7
AT6-638		25 ⁰	25.5	254	25.7	254	258	25.5	46	7.3	7.8	7.6	7.6	3	7.4	7.00	5.8	7.1_	6.5	હ	69	7.1	21.6	209	21.6	21:7	21.3	19.te	20.1
AT6-639		2572	25.60	24,7	25.7	26.3	259	25.7	65	7.4	7.8	7.0	76	7.3	7.4	7.4	6.60	72	5.6	10:7	68	6.9	22.0	21.5	22.0	22.0	19.4	22.O	21.7
AT6-640		145	24.C	711	24.9	25.1	25°]	25.4	(g.V)	7.8	7.8	7.6	7.7	7.14	7.5	7.4	69	7.3	6.4	10.7	6.6	6.8	220	21.5	22.0	12.0	220	201	20.4
AT6-641		24.5	2496	250	24.7	25.	259	25.2	(e:1	7.9	7.8	7.7	7.7	7.5	7.5	7.4	7.0	7.2	68	6.7	6.6	-50	21.2	20.9	21.9	220	220	192	19.9
AT6-642		VHO	24.7	249	24.4	25.0	150	14.8	(¿:7)	7.	7.8	7.7	7.7	ÿ.5	7.6	73	7.0	7.3	6.8	6.7	45	6.9	220	27.0	27.0	22.0	22,C)	2012	20.8
																													1
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	Meter Number																												
	Time	1302)	0914	1115	0961	1140	(05)	0845	1204	0914	1115	09 <i>0</i> 1	1140	1051	0845	1204	0914	1115	0901	1140	1051	0845	1304	0914	1115	0 901	114C)	1051	0845
	Initials	MS	MJ	M	MM	MS	MT	M	MJ	M	M	NM	MT	M	MJ	MJ	MJ	M	M	MT	M	MJ	MJ	MJ	M	M	Mt	M	MJ
				121t MA	•						,							,				ill							

ATS-T14 06/21/06



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

TARGET VALUES Temp: __25_°C pH: _6.0 - 9.0 DO: __>2.5 mg/L Salinity: __20_ ppt Photoperiod: __16 & 8 & Light Intensity: _50 - 100 fc

				Temp	eratu	re (°C)					рН	·	•			Diss	solved	I Охус	jen (m	ng/L)				Sa	linity (ppt)		
Sample #		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	240	24,4	24.2	24.	21.2	254	7.7	7.1	7.3	7.4	1:7	18	Q8	7.7	7.7	7.6	3O	7.60	1.6	65	20:1	214	20.4	21.1	21.3	21.6	21,9
AT6-638		24.7	24:3	249	24.6	25.1	24.2	255	2.7	1.3	73	7.0	7.8	7.8	7.7	7.4	7.3	7.1	7.3	7.1	7.2	7.2	20.9	215	21.8	22.0	21.9	21.4	220
AT6-639		24.5	24.5	24,9	2460	24.9	27.2	25D	1.8	7.3	74	7.7	7.8	7.8	78	7.3	7.3	7.2	7.1	60.0	7-0	7,0	20	22.0	21.3	21.7	21.7	21.5	22.0
AT6-640		2458	24.0	24.4	25.2	248	29.4	253	7:8	7.4	7.4	7.8	79	7-7	7,9	7.3	7.2	7.3	7.	7.0	7.0	7.2	21.2	21.5	21.8	27.0	22.0	21-9	220
AT6-641		25.1	24.6	24.6	24.0	24.60	210	250	18	7,4	74	7.9	4 .0	8-0	8D	7,3	7.2	7.3	7.1	7.0	7.0	7.1	20.7	21.3	21.7	220	22.0	21.0	22.0
AT6-642															જ્ય					70	70	7.2	21.9	22.0	20.0	208	21.3	21.4	220
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	Meter Number	1018	ψK	<i>io</i> 18	679	619	677	6H	618	67B	618	679	619	177	479	678	678	678	679	019	679	679	678	618	6078	619	æ19	677	672
	Time	ioile	0913	11958	0903	0913	1330	0632	Mile	0913	1138	0903	0913	1330	6632	1010	A(3	1138	0903	0913	1330	0637	10110	ળાઉ	1138	0903	0913	1330	063Z
	Initials ————	233	M	13	M	M	<i>p</i> -	20	B	M	5B	MJ	MJ	<u></u>	B	B	MT	53	MJ	M	~					MJ			13

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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		10 10	
3			
4	11114116	1115	NM/NO
5			•
2 3 4 5 6 7	11/16/16	1611	BO
8	11/18/16	14/4	NM
9	. /		
10	<u> </u>		
1	1121116	1500	<u>β</u> σ
12			
®	11/23/10	1409	M
14	1-411		
1 5	11/25/16	1309	MJ
16			
17	11/28/16	49 P A	
19	11/25/10	0930	MJ
20	11/30/16	î 105	M
21	1 th Jorna	(1.2)	,,,,,
2 2	12/2/16	1045	B
23	12 12 17	<u> </u>	
24			
25	12/5/16	1022	MOT
26			
27	12/7/16	1347 1440	M
28	•		

12/7pm

ATS-T31 03/01/00



TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number:	70005.15	TEST ORGANISM	
Client: HGL		Common Name:	Amphipod
QC Test Number:	TN-16-396	Scientific Name:	Leptocheirus plumulosus
Overlying Water:	20 ppt Crystal Sea Artificial S	Seawater	

Sample Number	Preparation Time, Date	Initials	Date of First Use	Date of Final Use
LDG-511	11/2/10 1500	B	11996 1530	11/21/16 1254
LAG 537	11/23/16 1400	MT	11/23/16	12/16/1254
			C(Z)RC	
			-	
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TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project	Number: _	70005.15	
Client:	HGL		
QC Tes	t Number:	TN-16-396	

Day	Date	Time	Initials
0			
1			
2			
3			
(4)	11/14/16	1020	60
5	11662 1.		
6	11/16/16	1610	B0
1	1.11.	1	
ය (ශි	11/18/10	1300	MW
10			
1	11/21/16	1254	MJINM
12	, , (, , , , , , , , , , , , , , , , ,		
1 3	11/23/16	0931	MINM
14			•
15	u[25lib	i308	MJ
16			
17		28.0 C	MJINM
<u>18</u>	11/28/16	0930	1010 1101-1
20	11/30/16	1105	M
21	(d'Mhe	1100	24 6/7
(22)	12/2/16	1040	3 6
23	** 1 *	-	
24			10.4
25)	12/5/10	0950	NW/NO
26	1.65/-		7,4 (/ f
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/K 1401 NO		640 D Spilled over

				Gro	wth and Surviv	/al Test-Survival	
Start Date: End Date: Sample Date: Comments:	11/10/2016 12/8/2016	3	Lab ID:	TN-16-396 EPAM 87-	BEPA Marine	Sample ID: Sample Type: Test Species:	HGL Sediment LP-Leptocheirus plumulosus
Conc-	1	2	3	4	5		-
Control	0.8000	0.9500	1.0000	0.9500	1.0000		<u> </u>
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		

		_	Tra	ansform:	Arcsin Sc	quare Roof	ŧ		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

				Gro	wth and Surviv	/al Test-Survival	-
Start Date:	11/10/2016	3	Test ID:	TN-16-396	<u></u>	Sample ID:	HGL
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Conc-	1	2	3	4	5	, <u> </u>	
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		

		_	<u> </u>	ansform:	Arcsin Sc	guare Root	t	_	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	M\$B	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.1112	0.11717	0.00637	0.02521	0.62868	1, 8

				Gro	wth and Surviv	/al Test-Survival	
Start Date:	11/10/2010	3	Test ID:	TN-16-396	3	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		

		_	Tra	ansform:	Arcsin So	uare Roo	t		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		7-11	
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



				Gro	wth and Surviv	/al Test-Survival	······································
Start Date: End Date: Sample Date: Comments:	11/10/2016 12/8/2016	3	Lab ID:	TN-16-396 EPAM 87-	BEPA Marine	Sample ID: Sample Type: Test Species:	HGL Sediment LP-Leptocheirus plumulosus
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		

			Tra	ansform:	Arcsin So	uare Roo	t		1-Tailed	***************************************
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MŞD
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

				Gro	wth and Surviv	/al Test-Survival	
Start Date:	11/10/201	6	Test ID:	TN-16-396	3	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		

		·	Tra	ansform:	Arcsin So	uare Root	t		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)	MŞDu	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

				Gro	wth and Surviv	/al Test-Survival		
Start Date:	11/10/2010	ô	Test ID:	TN-16-396	3	Sample ID:	HGL	
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment	
ample Date: omments:			Protocol:	EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus	
Conc-	1	2	3	4	5	<u></u>	-	
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			

		_	Tr	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	M\$B	MSE	F-Prob	df
Homoscedastic t Test indicates significant differences	0.16839	0.17744	0.20016	0.04876	0.07732	1, 8



		_		Growt	h and Surviva	Test-Growth Rate	
Start Date:	11/10/201	_		TN-16-390	3	Sample ID:	HGL
End Date:	12/8/2016		Lab ID:			. Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus
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

				Gro	wth and Survi	val Test-Growth	
Start Date:	11/10/2016	3	Test ID:	TN-16-390	3	Sample ID:	HGL
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment
Sample Date: Protocol: EPAM 87-EPA Marine Comments:				Test Species:	LP-Leptocheirus plumulosus		
Conc-	1	2	3	4	5	<u> </u>	
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		

		_		Transforr	n: Untran	sformed			1-Tailed	***
Conc-	Mean	N-Mean	Mean	Mean Min Max CV% N t-5	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

				Gro	wth and Survi	val Test-Growth	<u> </u>
Start Date:	11/10/2016	=		TN-16-396	3	Sample ID:	HGL
	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

				Gro	wth and Survi	val Test-Growth		
Start Date:	11/10/2010	-		TN-16-396	3	Sample ID:	HGL	
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment	
Sample Date: Comments: Conc-			Protocol: EPAM 87-EPA Marine			Test Species:	LP-Leptocheirus plumulosus	
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							
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

				Gro	wth and Survi	val Test-Growth	
Start Date: End Date: Sample Date: Comments:	11/10/2016 12/8/2016	5	Lab ID:	TN-16-396 EPAM 87-	EPA Marine	Sample ID: Sample Type: Test Species:	HGL Sediment LP-Leptocheirus plumulosus
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

				Gro	wth and Survi	val Test-Growth	
Start Date: End Date:	11/10/2016 12/8/2016	3	Test ID: Lab ID:	TN-16-396		Sample ID: Sample Type:	HGL Sediment
Sample Date: Comments:		Protocol: EPAM 87-EPA Marine		Test Species:	LP-Leptocheirus plumulosus		
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		

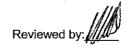
		_		Transforr	n: Untran	sformed			1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MŞD
Control	0.0529	1.0000	0.0529	0.0370	0.0668	21.168	5			
AT6-638	0.0583	1.1020	0.0583	0.0462	0.0707	15.212	5			
AT6-639	0.0637	1.2030	0.0637	0.0562	0.0710	9.735	5			
AT6-640	0.0644	1.2157	0.0644	0.0623	0.0683	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

				Re	production Tes	t-Reproduction	
Start Date: End Date:	11/10/2016 12/8/2016	6	Test ID: Lab ID:	TN-16-39	6	Sample ID: Sample Type:	HGL Sediment
Sample Date: Comments:				EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus
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		

		_		Transforr	n: Untran	sformed			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



				Re	production Tes	t-Reproduction	·
Start Date:	11/10/2010	6	Test ID:	TN-16-396	<u></u>	Sample ID:	HGL
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus
Conc-	1	2	3	4	5		
Control	2.7500	1.9474	0.8000	0.8421	0.9500	, <u> </u>	
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	n: Untran	sformed			1-Tailed	<u> </u>	
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

				Re	production Tes	t-Reproduction	
Start Date: End Date: Sample Date:	11/10/2016 12/8/2016	3	Lab ID:	TN-16-390 FPAM 87-	EPA Marine	Sample ID: Sample Type: Test Species:	HGL Sediment LP-Leptocheirus plumulosus
Comments:						root opcoics.	Li -Leptochellus plamaiosus
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		

		_		Transforr	n: Untran	sformed		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

				Re	production Tes	t-Reproduction	
Start Date: End Date:	11/10/2016 12/8/2016	•	Test ID:	TN-16-39	6	Sample ID:	HGL
	12/8/2016		Lab ID:		EDANA :	Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAM 87-	-EPA Marine	Test Species:	LP-Leptocheirus plumulosus
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		

		_		Transforr	n: Untran	sformed		<u> </u>	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		•	7.
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)	M\$Du	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

				Re	production Tes	t-Reproduction	
Start Date:	11/10/2016	3	Test ID:	TN-16-39	ĵ	Sample ID;	HGL
End Date:	12/8/2016		Lab ID:			Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAM 87-	EPA Marine	Test Species:	LP-Leptocheirus plumulosus
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. 44 44			
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	n: Untran	sformed			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			<u>" -</u>
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

Reviewed by:

				Re	production Tes	t-Reproduction	· · · · · · · · · · · · · · · · · · ·
Start Date:	11/10/201	6	Test ID:	TN-16-396	3	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)



Project Number: 70005.15

SEDIMENT TOXICITY TEST SET-UP BENCH SHEET

Client: HGL		
QC Test Number:	TN-16-399	
•	TEST ORGA	NISM INFORMATION
Common Name:	Polychaete	Adults Isolated (Time, Date):
Scientific Name:	Neanthes arenaceodentata	Neonates Pulled (Time, Date):

 Lot Number:
 NA -02€
 Acclimation:
 ∠244₂
 Age:
 il/2 Empe

 Source:
 ATS
 Culture Water (T/S):
 20-2 °C
 30-2 ppt

		TEST INITIA	ATION
<u>Date</u>	<u>Time</u>	<u>Initials</u>	<u>Activity</u>
nfirle	1200	Bo	Sediment Added to Chambers
ď	1700	fun	Overlying Water Added to Chambers
11/13/16	1313	No.	Organisms Transferred

	TEST SET-UP	
Sample Number(s): <u>AT6-นะร์</u> , A Overyling Water: <u>30 ppt Crysta</u>		
<u>Treatment</u>	Volume Test Sediment	Volume Overlying Water
AT6- (Lab Control) AT6-638 AT6-639 AT6-640 AT6-641 AT6-642	175 ml	725 ml



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

Organisms Recovered (date, time, initials):	12/7/16 12	237 m
Treatment	Replicate	Number of Organisms Loaded	Number of Organisms Recovered
AT6- 485	A	5	4
(Lab Control)	В	5	5
	С	5	5
	D	5	5
	E	5	5
AT6-638	Α	5	5
	В	C	5
	С	5	5
	D	5	5
	E	5	5
AT6-639	Α	Ś	5
	В	5	5
	С	5	84 12/7m
	D	Ć	5
	Е	Γ	Ч
AT6-640	A		Ч
	В	5	
	С	5	5
	D		Ч
	E	5	5
AT6-641	А	5	57.
	В	5	4
	С	5	5
-"	D	5	4
	E	5	5
AT6-642	Α	5	5
	В	5	7
	С	5	5
	D	5	5
	E	5	5



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

Project Number:70	005.15	Client:	HGL		QC Test Number:	TN-16-	397
	<u>Date</u>	<u>Time</u>	<u>Initials</u>		<u>Date</u>	<u>Time</u>	<u>Initials</u>
Loaded pans in oven: _	12/7/16	/330	M	Loaded pans in furnace:	12/12/16	1100	Mu
Loaded pans out oven:	12/12/16	1500	Me	Loaded pans out furnace	: 12/12/16	1300	ALL
Loaded pans weighed:	12/12/16	1604	<i>5</i> B	Loaded pans weighed: _	12/4/160	1300	<i>0</i> B
Oven Temp (°C):	100°C			Furnace Temp (°C):	550 °C		

		,	Α	В	С	B-C	D	(B-C)/D
Test			Weight of Don	Weight of Pan and	Weight of Pan and	Total Ash-Free	Number of	Mean Ash-Free Dry
Concentration	Rep	Pan #	Weight of Pan (mg)	Oven-Dried Organisms (mg)	Furnace-Dried Organisms (mg)	Dry Weight (mg)	Organisms Weighed	Organism Weight (mg)
AT6- 465	Α	41	3860.96	3921.64	3870,66	50.98	4	12.75
	В	4	3655-55	3710.83	3ldd;37	44.46	5	8.89
	С	À	3 730.08	3785.04	3739.31	45.73	5	9.15
	D	001	4258.14	4321.66	4271.04	50.64	75	10-13
	E	llb	4478.09	4537.05	4488.49	48.56	5	9.71
AT6-638	Α	K	3761.96	3825,18	3777.H	48.04	S	9.61
	В	109	4620.88	4691.59	4638.94	52.65	25	10-53
	С	121	4374.31	4448.55	4393.96	54.59	5	10.92
	D	108	4250.00	4347.92	4296,06	51.86	\$ 5	10.37
	E	Μ	3808.93	3442.5	3528,67	53.83	5	10.77
AT6-639	A	エ	3657.32	3734,29	3683,05	51.74	5	10.25
	В	Q	3650.15	3728.84	3674.09	54.75	<u> </u>	10.75
	С	2	3737.99	3807,30	3756,77	50.53	84	17.63
	D	W	3681.18	3762.98	3698.87	54-11	5	10.8Z
	E	3	3638.90	3706.59	3654.70	51.83	84	17.96

Dry wt. calculations checked (date, initials): 12/15/14 Ash-Free calculations checked (date, initials): 12/15/14



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

Project Number:70	005.15	Client:	HGL		QC Test Number:	TN-16-3	397
	<u>Date</u>	<u>Time</u>	<u>Initials</u>		<u>Date</u>	<u>Time</u>	<u>Initials</u>
Loaded pans in oven: _	12/7/16	1330	Mu	Loaded pans in furnace:	12/12/16	1100	pu
Loaded pans out oven:	12/12/16	1500	du	Loaded pans out furnace	: 12/14/16	1300	M
Loaded pans weighed: _	12/12/16	1604	JB	Loaded pans weighed: _	12/14/16	1300	B
Oven Temp (°C):	1000			Furnace Temp (°C):	5770 °C		

			Α	В	С	B-C	D	(B-C)/D
Test			Weight of Pan	Weight of Pan and Oven-Dried Organisms	Weight of Pan and Furnace-Dried Organisms	Total Ash-Free	Number of	Mean Ash-Free Dry
Concentration	Rep	Pan#	(mg)	(mg)	(mg)	Dry Weight (mg)	Organisms Weighed	Organism Weight (mg)
AT6-640	Α	95	4759.01	4842.58	4793.94	48.64	4	12-16
	В	Н	3 731-72	3803.31	3751.45	51.86	5	10.37
	С	L	37-63.52	3832.43	3780.52	51.91	2	10.38
	D	O	4294.53	4353,60	4306.96	46.64	\$4	11.66
	E	119	4465.32	4537.15	4483,40	53.75	5	16.75
AT6-641	Α	103	711774	2000	20 20			6) 1 0
	В	F	3613.24	3677.76	36.29.65	48.11	5	9.62
	ļ		3862-11	3975.50	3877.07	48.43	84	12-11
	С	106	3626.15	3693.72	3642,92	50.80	<u> </u>	10.16
	D	3 6	3616.13	3691.92	3640.09	51.83	94	12.96
-	E	41	3 598.71	3669,59	3617.12	52.47	5	10.49
AT6-642	A	40	3656.80	3719.03		48.36	5	9.67
-	В		3503.29	3111.05	3670,67			
		48			35/5,53	48.72	84	12-18
	С	39	3534.20	3613,13	3560.03	53.10	X 5	10.62
	D	37	3521.81	3602.73	3551,65	51.08	5	/0.22
	Е	36	3529.36	3604.39	3550,80	53.59	13	10-72

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



Proiect Number:

Client: HGL

70005.15

WEIGHT DATA (Test Species: N. arenaceodenata)

Date Time Initials

Loaded tins placed in oven:

CC Test Number: TN-16-397 Loaded tins removed from oven: 11/18/16 1400 mm.

Loaded tins weighed: 11/18/16 1500 mm.

Oven Temp (°C): Start: /oo End: //O End: //O Oven Number: BLM-01 Balance Number: P0115825

oven remp (*C,	. Stair	t. <u>7-0</u>		<u> </u>	Oven Number	BLIVI-UT	_ balance ivum	ber: <u>P0115825</u>
Test Concentration	Rep	Tin #	A Weight of Tin (mg)	B — 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	Α	33	3609.86	3612.01	2.15	5	0.43	0.43
	В	34	3489.83	3492.95	3./2	5	0.62	0.62
	С	42	3608.19	3609.99	1.80	5	0.36	0.36
	D	3}	3587.18	3589.96	2.78	5	0.56	0.56

12/15/16



TOXICITY TEST WATER QUALITY DATA SHEET - NEW SOLUTIONS

Project Number:	70005.15	TEST ORGANISM	Beginning Date: 11/17/16	Time: /3/3_
Client: HGL		Common Name: Polychaete	Ending Date:	Time: <u>/シァ</u>
QC Test Number:	TN-16-397	Scientific Name: <u>Neanthes arenceodentata</u>	<u>.</u>	
TARGET VALUES:	Temp: 20 °C pH: 60-9	0 DO: ≥2.5 mg/l Salinity: 30 nnt Photon	neriod: 16 / 8 / Light Intensity: 50 - 10	0 fc

				Temp	eratu	re (°C	;)			рН					Diss	solved	Охус	jen (n	ng/L)				Sal	inity (ppt)				
Sample #		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							289				-		
AT6-638		21.0							7.6							7.3			" "				27.7						
AT6-639		210							7.7							7.3							28.0						
AT6-640		21.0							7.7							7.3							28.0						
AT6-641	1	21.0							1.1							7.3							78°°						
AT6-642		21.0							7.%							7.2	_						283						
	Meter Number								678							678							68						
	Time	1252							1252							1252							1252						
	Initials	MJ							MJ							M							MJ						



TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number:	70005.15	TEST ORGANISM		Beginning Date	11/17/16	Time: <u>/3/3</u>
Client: HGL		Common Name: _	Polychaete	Ending Date: _	12/7/12	Time: <u>/237</u>
QC Test Number: _	TN-16-397	_ Scientific Name: _	Neanthes arenceodentata		·	
TARGET VALUES:	Temp: 20 °C nH: 60-00	1 DO: >25 ma/l S	alinity 30 ppt Photoporio	d: 16 / 9 / 1	ight Intensity 50	100 fo

				Temp	eratu	re (°C)					рΗ					Diss	solved	і Охуд	jen (m	ng/L)			•	Sal	linity (_l	ppt)		
Sample #		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	lla	20.3	19,6	19.)	19.8	19.7	19.7	7.6	7.7	1.8	1.(7.8	79	8,1	7-1	7.8	79	7.9	69	7,0	7.5	29.0	29.6	30.4	29.8	31.0	320	31.2
AT6-638		21.0	20-8	20.3	$\alpha 0$	20.2	204	20.1	74,	1.8	19	7.	7.7	80	8./	21	7.9	76	7.7	7.2	7.4	7,5	281)	285	28.9	21.3	21.2	298	29.7
AT6-639		21.0	20.60	21.0	204	203	20.7	20.2	77	15	79	1.5	7.7	8.1	8.1	3.1	8.3	7.5	7.60	7.4	7.4	2.5	28-1	28.2	.783	27.6	283	285	28 ₅
AT6-640		21.0	21.0	71.0	20.60	20.7	19.1	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	73	284	28.2	28.4	21.9	18.K	293	29.0
AT6-641		Zho	21.0	21.0	20.60	10.6	20.1	20.7	7.6	7.9	5.0	7.7	7.7	8.2	8/	7-0	7.8	7.3	7.4	7.5	7.6	7.4	284	2x.4	28.7	27.9	XX	14.7	29.1
AT6-642		210	21.0	21.0	zi.0	207	20.1	20.%	7.7	7.9	8.0	7.3	17	43	8.1	2-1	7.7	7.3	7.4	7.4	7.60	2.3	251	29.2	28.3	29.0	303	31.3	285
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										-																			
																								-					
	Meter Number	ርን _ሚ	(x)2/	1,74	120	6578	1079	1029	695	0.70	1.28	108	1518	c.79	669	678	1518	C028	2:79	138	6579	1,19	678	678	678	618	1.78	1.79	1574
	Time	6943	102	اماد	0905	(RSD	15WJ	0845	why	0937	101/2	riariz	11(17)	1000	OTHE	0343	1937	in/lo	m	1857	MAD	OUE	12797	11921	SOL	1905	נט קינט	1000	ords:
	Initials	100	MK	A/M	M	MJ	1/4	\$12	100	MJ	AM	W	MI	M	133	1	MI	MM	MS	MY	/A	AP.	<i>/~</i>	MI	NA	MJ	MIT	565	723

1120 MN



TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number:	70005.15	TEST ORGANISM		Beginning Date	e: <u>11/17-//4</u>	Time: <u>/ 3/3</u>
Client: HGL		Common Name:	Polychaete	Ending Date:	12/7/16	Time: <u>/233</u>
QC Test Number: _	TN-16-397	Scientific Name:	Neanthes arenceodentata		•	
TARGET VALUES:	Temp: 20 °C nH: 60-0	0 DO:>25 ma/l S	alinity 20 not Photonoria	d: 16 / 0 / 1	ight Intonsity 50	100 fo

				Temp	eratu	re (°C)					рН					Diss	olved	Oxyg	jen (m	ng/L)				Sal	inity (ppt)		
Sample #		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-¥\$≶	Lab Control	M.5	19.4	19.4	i9.6	202	208	20.4	6.9	1.8	7.7	7.0	7.9	7.4	6.9	8.2	18	7.9	70	7.60	7.0	7.3	328	328	32.9	730	33C	328	33.0
AT6-638		200	19.9	19.9	[9,1	26:7	20.9	20.6	7.0	7.9	7.7	7.3	7.7	7.5	1.0	$\mathcal{S}_{\hat{\mathcal{O}}}$	7.4	7.7	32	7.4	72	7.3	309	30.7	3).4	32.0	321	31.8	32.
AT6-639		20.1	20.0	20.2	20.2	21.0	21.0	21.0	7.0	g.0	7.7	7.4	7.7	7.6	7.1	80	7.5	7.60	7.4	7.3	7.2	7.3	21.3	28.9	30.7	30.7	304	30.60	30.4
AT6-640		20.4	20.4	20.6	20.6	21,0	21.0	21.0	7.1	¥.0	7.8	7.4	7.7	7.6	7.1	7.7	7.3	7.5	7.4	73	7.2	7.3	300	29.6	30.6	30.7	30.6	34.6	<u></u> 30.7
AT6-641		25	20.5	26.8	20.9	21.0	21.0	21.0	7.	g.O	4.8	7.5	7.7	7.6	7.2	7.7	7.3	7.4	7,3 ,	1.3	7.7	1.2	30.0	29.60	30.5	366	204	305	30
AT6-642		<i>705</i>	20.4	20.2	70.2	210	210	21.0	7.2	GD	ን,ፋ	7.5	7.7	7.60	7.2	7.00	7.2	7.5	75	7.2	7.1	7.1	31.6	31-3	317	77.Z	32.4	31.9	32.1
																	-												
																									_		,		
	Meter Number	•="{}		1 7×	2 73 63	4 59 69	/بوس		late.	e sort	ל מיני ל	1.78	3 CZASTV.	c 26%				6. 179 50	190	(water	a am (2)	100	sur O	£ 25 C	F'	ر ناوس ع	والمودود	2 60	
	Meter Number	2201	619 1000	110%	(200	6/8	568	(e78	1201	1000	100	WZ W 7	(E/X	018	678	08	674	000	(01/0	6/8	018	618	7221	019	168	CO 103	ON.	670	670
	Initials	AM.	0120	100	MY	1135	145	0055 M	104	0920	100	0°0 C	1133	1115	0635 MG	154	0920	M.	0000	1133	1115	0435 M	121 MH	0120 MJ		NA	1155	Mor	7835



TOXICITY TEST WATER QUALITY DATA SHEET - OLD SOLUTIONS

Project Number: 70005.15	TEST ORGANISM	Beginning Date: 13/3
Client: HGL	Common Name: Polychaete	Ending Date: 12/3/16 Time: 1239
QC Test Number: TN-16-397	Scientific Name: <u>Neanthes arenceodentata</u>	, ,
TARGET VALUES: Temp: 20 °C pH: 6.0 - 9	.0 DO: ≥2.5 mg/L Salinity: 30 ppt Photoperio	od: 16 % 8 % Light Intensity: 50 ~ 100 fc

				Temp	eratu	re (°C)					рH					Diss	solved	і Охус	gen (n	ng/L)		•		Sal	inity (ppt)		·
Sample #		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
ΑΤ6-	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	1.8	7.9	7.0	7.0	2.7		33 O	330	292	29.9	299	37.v	
AT6-638		19.7	19.1	19.0	19,0	19.0	14,0		2.5	7.9	7.2	7.7	79	7,8		7.7	7.0	7.8	7.4	7.9	7.8					303			
AT6-639	_	20.1	19.	19.0	14.3	19.0	19,0		7.5	8,0	7.2	7.5	80	8.0					7.4		7.6		31,3	32,3	32.3	32.2	305	<i>71.</i> 2	
AT6-640		20.5					19.0					7.9		81		7.5	7.4	76	7.3	A	7.5		31,4	32.4	32.4	325	310	<i>3</i> 1. (.	
AT6-641						19.3			7.4	8/1	1.2	8,0	80	81							7,4			1	1	37.7			
AT6-642							19.0			જ.ાં		8.1			·	6.9	7.4	7.6	7.2	7.1	7.4					297			-
_																													
																													
															<u> </u>														
	Meter Number	to 2A	679	628	679	679	(279		614	679	678	672	679	6H					679							679			
							0 906	_				1030									090/2		0956	<i>0</i> 104	1058	1030	OHB	moto	
	Initials	SB	M	ΛM	4	MS	M		3 B	MJ	MM	M	MJ	M					M							M			



TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number:	70005.15	TEST ORGANISM	
Client: HGL		Common Name:	Polychaete
QC Test Number:	TN-16-397	Scientific Name:	Neanthes arenceodenata
Overlying Water:	30 ppt Crystal Sea Artificial	Seawater	

Sample Number	Preparation	Initiala	Data of First Use	Data of Final III
	Time, Date	Initials	Date of First Use	Date of Final Use
LD6-531	11/14/16 1300	M	11/20/16	11[23]16
EDC:540	11 (23/16 1200)	MM	11 126 160	1128/16
LD6-531 LD6-540 LD6-544	11/23/16 1300	MM NW	11/2016 11/2016	12/2/16
32 5771	-100111001000	7 . V	11(20112	(2/21/4
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TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project	Number: _	70005.15	
Client:	HGL_	-	
QC Tes	t Number:	TN-16-397	

Day	Date	Time	Initials
0			
1		-	
2	***		
<u>③</u>	11/20/16	1409	NM
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14			
1 5)	12/2/16	1000	<u> </u>
17	101-14		W a
18	12/5/16	1050	ВО
19 20			
21			
22			
23			
24			
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26		"	<u> </u>
27			
28			



TOXICOLOGY LABORATORY BENCH SHEET - FEEDING RECORD

Project Nu	ımber: _	70005.15
Client:	HGL	
QC Test N	lumber:	TN-16-397

Day	Date	Time	Initials
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3		<u>"</u>	
(4)	11/21/16	1530	MI
1 5			
6	11/23/16	1414	M
7			
8	11/25/16	1222	MJ
9			
9	11/27/40	1115	315
11			
13	11/29/16	1210	NJ/MIC/OB
(14)	12/1/14	1300	NM
15			
17	12/3/16	1325	80
17			
<u>(18)</u> 19	12/5/14	1056	ВО
20			
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23	<u> </u>		
24			
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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	3	Test ID:	TN-16-399	9	Sample ID:	HGL					
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment					
Sample Date: Comments:			Protocol: EPAM 87-EPA Marine			Test Species:	NA-Neanthes arenaceodentata					
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)		71		
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								

			Tra	ansform:	Arcsin Sc	uare Roo	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				_

ToxCalc v5.0.23

Reviewed by

	Growth and Survival Test-Survival												
Start Date:	11/17/2016	3	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	100							
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								

			Tr	ansform:	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				



				Gro	wth and Survi	val Test-Survival	
Start Date:	11/17/201	6	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		

		_	Tra	ansform:	Arcsin Sc	uare Roo	t	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		·		

Reviewed by:

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

		_	Tr	ansform:	Arcsin Sc	uare Roo	t	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				



				Gro	wth and Survi	val Test-Survival	
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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		

			Tra	ansform:	Arcsin Sc	uare Roo	t	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	

0.781	-1.7788	1.40625
		1.40025
23.1545		
	·	

				Gro	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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		

		_	•	Transforn	n: Untran	sformed			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

			-	Gro	owth and Survi	val Test-Growth	· · · · · · · · · · · · · · · · · · ·
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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	n: Untran	sformed			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

				Gro	wth and Survi	val Test-Growth	
Start Date:	11/17/2016	6	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		

				Transforr	n: Untran	sformed			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	M\$B	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.08118	0.16037	0.0122	0.00476	0.14817	1, 8

				Gro	wth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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		

				Transforr	n: Untran	sformed			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	MŞB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.07236	0.14293	0.00552	0.00379	0.26149	1, 8

				Gro	owth and Survi	val Test-Growth	······································
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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



				Gro	owth and Survi	val Test-Growth	· · · · · · · · · · · · · · · · · · ·
Start Date:	11/17/2010	6	Test ID:	TN-16-399	9	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		

***		_		Transforr	n: Untran	sformed			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

				Gro	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	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		

		_		Transforr	n: Untran	sformed		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	2.09918
Bartlett's Test indicates equal variances (p = 0.23)	6.93738	15.0863		
Hypothesis Test (1-tail, 0.05)				
Charle Many One Bonk Test indicates as significant differences		*****		

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

Reviewed by

			· ·	Gro	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	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	n: Untran	sformed			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



				Gre	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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		

		_	,	Transforr	n: Untran	sformed			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	M\$B	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.08871	0.14374	0.07765	0.00569	0.00609	1, 8

				Gro	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	3	Test ID:	TN-16-399	9	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		

				Transforr	n: Untran	sformed		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	3	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	n: Untran	sformed			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

Reviewed by:

				Gro	owth and Survi	val Test-Growth	
Start Date:	11/17/2016	i	Test ID:	TN-16-399	9	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		

		_		Transforn	n: Untran	sformed		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			<u></u>						
QC Test Number:	TN-16-395		<u></u>						
TEST ORGANISM INFORMATION									
Common Name:	Sand worm	A	Adults Isolated (Time, Date):						
Scientific Name:	Neries virens	N	Neonates Pulled (Time, Date):						
Lot Number:	NV-057	A	cclimation: <u>1 day</u> Age: <u>Adult</u>						
Source: Al	RO	с	Culture Water (T/S):oCppt						
		TEST IN	TIATION						
<u>Date</u>	<u>Time</u>	<u>Initials</u>	<u>Activity</u>						
11/7/16	1 <i>5</i> 00	MTBO	Sediment Added to Chambers						
, lalu.	V	NM	Overlying Water Added to Chambers						
11 9વિ	1330	MJ/BO	Organisms Transferred						
		TEST S	ET-UP						
Compale Niverband	-). ATC #05 AT	2 000 TO 040							
Sample Number(s									
Overyling Water:	30 ppt Crysta	al Sea (LD6- <i>5</i> 01	<u>) </u>						
<u>Treatment</u>		Volume Test Sed	liment 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	TEST ORGANISM
Client: HGL	Common Name: Sand worm
QC Test Number: TN-16-395	Scientific Name: Neries virens
	Lot Number: NV-057 Source: ARO
	Acclimation: <24 hour Age: Adult
Organisms Transferred (date, time, initials):	11/9/16 MJ/BO

Treatment	Replicate	Number of Organisms Loaded
AT6- &87	А	MIHIMIM
(Control)	В	MIMMIM (D MIMMIM)
	С	MIMMIM (E MIMMIMM
AT6-638	Α	MMMMM
	В	HIMIMIM
	С	UM MUMUM UM
	D	Munumum
	E	41 41 41 41 41
AT6-639	Α	MHIMIM
	В	HT HT HI LIN IM
	С	MINIMIM
	D	MIMMIMIM
	E	MHIMMIM
AT6-640	A	M HIM HIM
	В	HY HY HY HY
	С	MMMMM
	D	MMMMM
	Ш	Mimmim
AT6-641	Α	Min mynun
	В	In in Wilmin
···	C	MINIMUMIM
	D	MHMHMH
	E	HILM WILLIAM



TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM LOADING RECORD

Project Number:	7 <u>0</u> 005.15	TEST ORGANISM
Client: HGL		Common Name: Sand worm
QC Test Number:	TN-16-395	Scientific Name: <u>Neries virens</u>
		Lot Number: NV-057 Source: ARO
		Acclimation: <24 hour Age: Adult
Organisms Transferre	ed (date, time	e, initials): 12/9/16 1330 MJ/80
Treatment	Replicate	Number of Organisms Loaded
AT6-642	Α	When which the
_	В	Munimim
	С	Un un un un
	D	HIMMM
-	Е	MMMMM



TOXICOLOGY LABORATORY BENCH SHEET - ORGANISM RECOVERY RECORD

Project Number:	70005.15		TEST ORGANISM	1	
Client: HGL			Common Name:	Sand worm	
QC Test Number:	TN-16-395		Scientific Name:	Neries virens	
Organisms Recovere	d (date, time, initials):	12/7/1	16 1500	Mac Iwan	

Treatment	Replicate	Number of Organisms Loaded	Number of Organisms Recovered
AT6- 687	Α	25	24 .
(Lab Control)	В	25	23
	С	25	25
	D	25	23
	E	25	25' .
AT6-638	Α	25.	22
	В	25	24
	С	25	2.5
	D	25	73 23 12/7 ju
<u></u>	E	25	24
AT6-639	A	25	23
	В	25	24
	С		21
,	D	25	24
•	E	25	25
AT6-640	A	25	25
	В	25	2 2
	С	25	24
A 1 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -	D	25	23
	E	25	24
AT6-641	Α	25	25
·	В	25	v7 7
	С	25	27 23 25 HTM
	D		23 25 47/11
	E	2.5	25
AT6-642	A	25 25 25	25
	В	75	
	С	25 25	25 24
	D	25	251
	E	25 25	24



Project Number: 70005.15	EST ORGANISM	Beginning Date: [\\q\\& Time: 1330
Client: HGL	Common Name: Sand worm	Ending Date: 12/7/16 Time: 1500
QC Test Number: TN-16-395	Scientific Name: <u>Neries virens</u>	
TARGET VALUES: Temp: 20 °C pH: 6.0 - 9.0	DO: <u>≥2.5</u> mg/L Salinity: <u>30</u> ppt Photoperiod	d: <u>16 ℓ, 8 ℓ</u> Light Intensity: <u>50 - 100</u> fc

				Temp	eratu	re (°C)		рН						Disa	solved	І Охуд	jen (n	ng/L)				Sa	linity (ppt)				
Sample #	(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-(67	Lab Control	Q.PJ							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		T				
AT6-640		19.0				-			8.2			_				7.4					 	<u> </u>	28.8						
AT6-641		190		<u> </u>	 			1 -	8.1	_		t -				1.3						† ·	286		+		ļ —		
AT6-642		190			1				8-2							7.4							29.1						
																		-							-				<u> </u>
				<u> </u>			-	-										<u> </u>		<u>. </u>		<u> </u>							
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			<u> </u>					-						-	<u> </u>	-									-				-
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	Meter Number	ina							હાવ							679							6119						
		0956							g ^o gS							1958							1958						
	Initials						1		MJ							M							MJ						

ATS-T13 06/21/06



Project Number:70005.15	TEST ORGANISM	Beginning Date:	me: <u>[1330</u>
Client: HGL	Common Name: Sand worm	Ending Date: 12/7/14 Tin	me: /570
QC Test Number: TN-16-395	Scientific Name: <u>Neries virens</u>	• •	

TARGET VALUES Temp: 20 °C pH: 6.0 - 9.0 DO: >2.5 mg/L Salinity: 30 ppt Photoperiod: 16 4, 8 4 Light Intensity: 50 - 100 fc

				Temp	eratu	ıre (°C)					рН					Diss	solved	Ι Оху	jen (n	ng/L)				Sal	linity (ppt)		
Sample #		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
AT6-187	Lab Control		19.0			19.0	QA			7,4			7.6	79			68			7.6	6.9			28.9			30.5	283	
AT6-638			19.0			190	Q.Pl			8.0			l'	7.9			7.0				6.8			28.2		-		28.4	
AT6-639			14.0			19.0	C.PI			8.0				7.9			(94			l	6.8			28.5			1	28.2	
AT6-640			19.0			14,0	19.0			8,0				8.0			6.9				7.0			26.				28.0	
AT6-641			19.0			19.60	C.PI			8.1			7.6	8.0	·		7.5				2.0			28.5				280	
AT6-642			[9.0			0,P)	19.1			8.(7.6	7.9			7.4		-	7.6	1.7			28.0			78.9	なつ	
										.45																			
N	Meter Number		દેરધ			618	619			(ત્ય	(₉ 78		હિંધ			674			678	619			679			618	<i>ତ</i> ୀବ	
	Time		1108				0922		<u> </u>	110 8		<u>)</u> 644		555		l 	iloz			0844	OPEZ		-	1108			ony	0922	
	Initials		NN			ph	80			M		Nn		3 3			NΝ			M	380			M			MΛ	33	

ATS-T14 06/21/06



Project Number: 70005.15	TEST ORGANISM	Beginning Date: 11916	Time: <u>[330</u>
Client: HGL	Common Name: Sand worm	Ending Date: 12/7/11	Time: _/570
QC Test Number: TN-16-395	Scientific Name: <u>Neries virens</u>		

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

				Temp	eratu	re (°C))					рН					Diss	olved	Oxyg	jen (m	g/L)				Sal	inity (ppt)		
Sample #	<u> </u>	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- (87 -	Lab Control		11.0	20		P.d		19:7		7-9			76		7.8		7.0			5.7		6.6		29.1			30:3		310
AT6-638			140			19.7		19.6		7.9		!	7.8		7,9		71			6.7		6.7		21.3			70 <u>5</u>		31.6
AT6-639			í la			19.8		19,6		7.9			7.5		6.0		72			6.7	_	7.1		289			30.2		31.4
AT6-640			120			19.0		14.7		7.9			7.8		4.0		70			6.7		6.8		2:4			30.0		31.2
AT6-641			140			[9.1		19.7		80			7.9		7.9		6-9			70		6.6		21.2			305		31.6
AT6-642			[4.3			19.0		19.7		1-9			1,1		7.9		7-1			72		5.9		21-1			30.3		31.9
	Meter Number		678			(029		(J8	i	678			WIR		618		610			679		6B		GP8			679		670
	Time		6734			0901		0949		67%			0967		0944		071/4			0901		0949		6731.			696j		6-96
	Initials	_	<i>></i>			MM		MM	_	1,~			NΛ		1		~	[MM		1//^		-			NN		200



Project Number:70005.15	TEST ORGANISM	Beginning Date: Time:
Client: HGL	Common Name: Sand worm	Ending Date: 12/7/11 Time: 1500
QC Test Number: TN-16-395	Scientific Name: <u>Neries virens</u>	•

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

		l					•									<u> </u>		•					I	-,	<u> </u>				
				Temp	eratu	re (°C)					рН					Dis	solved	Охуд	gen (n	ng/L)				Sal	inity (ppt)		
Sample #		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-(87-	Lab Control			19.9		19.7		20.6			79		7.5	7.4	7.4			6.3		6.4	7-1	7,1			30/3	,	31.8	₹0 ή	201
AT6-638				19.9		19.6		20.7			1.9		7.5	76				4.5		6.7	1 —	1.1			30.5		315	30.4	30
AT6-639				19.0		19.6		20.7		an land	1.9		7.5	7.7	7.7			4.7	1	6.8		2.1			30.7		31.5	3	30
AT6-640				19.9		19.7		20.7		9	3.0		7.6		7.8			ug		6.9	3-1	7.1			30.5		31.1		30.1 30.1
AT6-641	-			[9,9		19.7		20.7	-		Z,O		7.6		7.8			6.9		6.8		6.8			30. G		31.3	1	303
AT6-642				19.9		10.7		26.7			7.9		7.6		7.8			G7		6.5		6.7		_	30.3		31,1		30.
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	Meter Number	φ(a		(NA		678		ina	49	6	,79		678		679	629		679		678		64	679		619		678		67
	Time			1890		0851		1326		0	931		5851	_	1325			0931		0851		1326			1931		0851		13.25
	Initials			MS		₩		80		1	WJ		V Park		60			M	•	MIST.		130			Mt		M	·	60

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ATS-T14 06/21/06



Project Number:70005.15	TEST ORGANISM	Beginning Date:(<u> </u> <u> </u> <u> </u> <u> </u> <u> </u> <u> </u>	Time: <u>1330</u>
Client: HGL	Common Name: Sand worm	Ending Date:	Time: <u>ו</u> ששנו
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 & 8 & Light Intensity: 50 - 100 fc

			•	Temp	eratu	re (°C))					рН					Diss	solved	l Оху	gen (m	ng/L)		Salinity (ppt)						
Sample #		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- (Lab Control		20,2			190		9.0		7.4			7.9		7:7	77	7.7			7.4		7.4		31.9			32.5		31.7
AT6-638			19.7			19.0		14.0		7.4			7,9		7.5		7.4			7.2		6.4		319			32.Z		31.3
AT6-639			19.6			190		19.0		7.4			7,0		7.7		7.3			6.8		66		3/.7			32.5		31.5
AT6-640			199			19.0		190		7.4			7,9		7.5		7.0			6.8		6.7		31.7			32.3		3/.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			19.6			19.0		19,0		7.4			7.9		7,4		6.7			67.1	<u> </u>	7.2		31.7			32.7		315
		***************************************				!																				_			
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	Meter Number		ارس و			- مر ا											1000												
	Time		678			629		19		678			679		679		678			679		679		618			619		679
	Initials		NW Ody			NA 1035		Ni~ Ω84J		MM 8911			103c		Thing M	\	VV Qbii			NIJ		0847 NM		0911 MM			032 m		084 057

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ATS-T14 06/21/06



TOXICOLOGY LABORATORY BENCH SHEET - OVERLYING WATER PREPARATION / USAGE LOG

Project Number:	70005.15	TEST ORGANISM	V I
Client: HGL		Common Name:	Sand worm
QC Test Number:	TN-16-395	Scientific Name:	Neries virens
Overlying Water:	30 ppt Crystal Sea Artificial Sea	awater	

				,
Sample Number	Preparation Time, Date	Initials	Date of First Use	Date of Final Use
LD6-504	114/16/1500	NM	11/7/16	11/8/16
LD6-510	11/5/16 1400	13	ululu	uli4lle
106-513	11/8/16/1425	MJ	11/15/16	11/18/16
LDG-531	11/14/16 1300	NM	11/21/16	11/23/16
LD6:540	11/23/16 1300	NMWAY	1126116	11/28/16
CCC0-544	11/28/16 1038	MJ	11/20/16	12/2/16
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TOXICOLOGY LABORATORY BENCH SHEET - RENEWAL RECORD

Project	Number: _	70005.15	
Client:	HGL	и.	
QC Tes	t Number:	TN-16-395	

Day	Overlying Water	Date	Time	Initials
0				
1				
2	106-510	11/11/16	1315	NMITB
3				1,4,5
4				
(5)	iD6-510	11/14/16	0919	MJ/NM
6	106-513	11/15/16	1030	JB
\bigcirc				
8				
9	406-513	1/18/16	0750	pe
10				
11		1 1.2		· i · - a A
12	LD6-581	11/21/16	1343	MT/NM
13	1De 10-531	11/23/16	10:20	MIMM
<u>(</u> 14) 15	116-201	11123110	1038	100 /10001
1 5				
17	106-540	11/20/16	1105	MJ
18		11120110	1	11/2
(19)	LD6-540	11/28/16	1010	MINM
20	•			
(21)	D6-544	11/30/16	1419	BOIMS
22				
(23)	LDG- syd	12/2/16	1011	NM
24		, ,		
25				
2 6)	LD6-553	12/5/16	1120	NW M2
27		ļ ·	_	['
28				

11/21



TOXICOLOGY LABORATORY BENCH SHEET

Project Number:	70005.15		
Client: HGL			
QC Test Number: _	TN-16-395		
Date/Time/Initials		Comments/Activity	

				2	8-Day Surviva	Test-Survival	•	
Start Date:	11/9/2016		Test ID:	TN-16-395	5	Sample ID:	HGL	
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment	
Sample Date:			Protocol: I	EPAA 91-1	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			

			Tra	ansform:	_	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

				2	8-Day Surviva	l Test-Survival		
Start Date:	11/9/2016		Test ID:	TN-16-395	5	Sample ID:	HGL	
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment	
Sample Date:			Protocol: I	EPAA 91-I	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			

			Tra	ansform:	Arcsin So		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



			-	2	8-Day Surviva	l Test-Survival	
Start Date:	11/9/2016		Test ID:	TN-16-395	5	Sample ID:	HGL
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment
Sample Date: Comments:			Protocol:	EPAA 91-I	EPA Acute	Test Species:	NV-Nereis virens
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		

		_	Tra	ansform:	Arcsin So	quare Root	t		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	M\$B	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences	0.06085	0.06323	0.00511	0.01113	0.51726	1, 8



				2	8-Day Surviva	Test-Survival	
Start Date:	11/9/2016		Test ID:	TN-16-395	5	Sample ID:	HGL
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment
Sample Date:			Protocol: I	EPAA 91-1	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		

		_	Tra	ansform:	Arcsin Sc	uare 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



				2	3-Day Surviva	Test-Survival	
Start Date:	11/9/2016		Test ID:	TN-16-395	5	Sample ID:	HGL
End Date:	12/7/2016		Lab ID:			Sample Type:	Sediment
Sample Date:			Protocol: I	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		

			Tra	ansform:	Arcsin So	quare Root	_			
Conc-	Mean	N-Mean ^a	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



				2	8-Day Survival	Test-Survival	
Start Date:	11/9/2016		Test ID:	TN-16-395	5	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		

		_	Tra	ansform:	Arcsin So	uare 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	- 10		-
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	M\$B	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

	nt: H6L nor: Michael Chance	Project Number: 70005 EA Report Number: 775	
· · ·	REPO	RT CHECKLIST	
	QA/QC ITEM	REVIEWER	DATE
1.	Samples collected, transported, and received according to study plan requirements.	pykap	jz/10/10
2.	Samples prepared and processed according to study plan requirements.	MKM	12/11/11
3.	Data collected using calibrated instruments and equipment.	when	12/11/16
4.	Calculations checked: - Hand calculations checked	w/k D	12/10/16
	 Documented and verified statistical procedure used. 	- MKI	12/14/11
5.	Data input/statistical analyses complete and correct.		12/2016
6.	Reported results and facts checked against original sources.		19/9/14
7.	Data presented in figures and tables correct and in agreement with text.		13/20110
8.	Results reviewed for compliance with study plan requirements.	MIKE	refu fu
		<u>AUTHOR</u>	DATE
9.	Commentary reviewed and resolved.	MUNE	12/20/10
10.	All study plan and quality assurance/control requapproved:	uirements have been met and the repo	ort is
		July Colo	12/23/16
		PROJECT MANAGER	1 2/22/16
		QUALITY CONTROL OFFICER	DATE
		Whillod	12/28/16
		SENIOR TECHNICAL REVIEWER	DATE