

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

## ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045  
Tel: (314)298-8566

TestAmerica Job ID: 160-10196-2

Client Project/Site: HDP

For:

Perma-Fix Environmental Services Inc.  
2800 Solway Road  
Knoxville, Tennessee 37931

Attn: Brian Miller



Authorized for release by:  
2/19/2015 10:25:51 AM

Ivan Vania, Project Manager II  
(314)298-8566

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*This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.*

*Results relate only to the items tested and the sample(s) as received by the laboratory.*

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## Case Narrative

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

**Job ID: 160-10196-2**

**Laboratory: TestAmerica St. Louis**

**Narrative**

### CASE NARRATIVE

**Client: Perma-Fix Environmental Services Inc.**

**Project: HDP**

**Report Number: 160-10196-2**

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

#### **RECEIPT**

The samples were received on 01/20/2015; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the coolers at receipt was 20.0 C.

#### **RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)**

Samples L10-04-01-B-R-S-00 (160-10196-1), L10-04-02-B-E-S-00 (160-10196-2), L10-04-03-B-E-S-00 (160-10196-3), L10-04-04-B-R-S-00 (160-10196-4), L10-04-05-B-E-S-00 (160-10196-5), L10-04-06-B-E-S-00 (160-10196-6), L10-04-07-B-E-S-00 (160-10196-7), L10-04-08-B-E-S-00 (160-10196-8), L10-04-08-B-E-Q-00 (160-10196-9), L10-04-09-B-E-S-00 (160-10196-10), L10-04-10-B-R-S-00 (160-10196-11), L10-04-11-B-E-S-00 (160-10196-12) and L10-04-12-B-E-S-00 (160-10196-13) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were leached on 01/21/2015, prepared on 01/23/2015 and analyzed on 02/13/2015.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

## Chain of Custody Record

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☒ Other:

TestAmerica Laboratories, Inc.

<b>Client Contact</b>		<b>Project Manager: Brian Miller</b>		<b>Site Contact: Ellen Jakub</b>		<b>Date: 01/20/15</b>		<b>COC No: 012015-FSS1</b>						
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		1 of 2 COCs						
2800 Solway Road		<b>Analysis Turnaround Time</b>						Sampler:						
Knoxville, TN 37931		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS						For Lab Use Only:						
(865) 690-0501 Phone		TAT if different from Below						Walk-in Client:						
(865) 539-9868 FAX		<input type="checkbox"/> 2 weeks						Lab Sampling:						
Project Name: Hematite Decommissioning Project		<input checked="" type="checkbox"/> 1 week						Job / SDG No.:						
Site: Westinghouse Hematite, MO		<input type="checkbox"/> 2 days												
P O # 832953		<input type="checkbox"/> 1 day												
<b>Sample Identification</b>		<b>Sample Date</b>	<b>Sample Time</b>	<b>Sample Type</b> (C=Comp, G=Grab)	<b>Matrix</b>	<b># of Cont.</b>	<b>Filtered Sample (Y/N)</b>	<b>Perform MS / MSD (Y/N)</b>	<b>Gamma Spec (Ra-226, Th-232, U-235, U-238)</b>	<b>Alpha Spec</b>	<b>ICP/MS (Tc-99)</b>	<b>Gamma Spec (Ra-226; post-21 day ingrowth)</b>	<b>Sample Specific Notes:</b>	
L10-04-01-B-R-S-00		1/15/15	14:30	C	Soil	1	N	X	X	X				
L10-04-02-B-E-S-00		1/15/15	14:32	G	Soil	1	N	X	X	X				
L10-04-03-B-E-S-00		1/15/15	15:10	G	Soil	1	N	X	X	X				
L10-04-04-B-R-S-00		1/15/15	14:45	C	Soil	1	N	X	X	X				
L10-04-05-B-E-S-00		1/15/15	14:50	G	Soil	1	N	X	X	X				
L10-04-06-B-E-S-00		1/17/15	11:05	G	Soil	1	N	X	X	X				
L10-04-07-B-E-S-00		1/15/15	15:15	G	Soil	1	N	X	X	X				
L10-04-08-B-E-S-00		1/15/15	15:20	G	Soil	1	N	X	X	X				
L10-04-08-B-E-Q-00		1/15/15	15:20	G	Soil	1	N	X	X	X				
L10-04-09-B-E-S-00		1/17/15	14:10	G	Soil	1	N	X	X	X				
L10-04-10-B-R-S-00		1/15/15	15:25	C	Soil	1	N	X	X	X				
L10-04-11-B-E-S-00		1/15/15	15:27	G	Soil	1	N	X	X	X				
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4= HNO3, 5= NaOH, 6= Other None														
<b>Possible Hazard Identification:</b> Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.														
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown														
<b>Sample Disposal ( A fee may be assessed if samples are retained longer than 1 month)</b> <input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months														
<b>Special Instructions/QC Requirements &amp; Comments:</b> Dry and homogenize samples before analyses; potential for radiological contamination														
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No														
Relinquished by: <i>Brian Miller</i> Company: Perma-Fix Date/Time: 1/20/15														
Relinquished by: <i>[Signature]</i> Company: <i>[Signature]</i> Date/Time: 1/20/15														
Relinquished by: Company: Date/Time: Received in Laboratory by: Company: Date/Time:														
Hematite Decommissioning Project Perma-Fix (for Westinghouse) Non-Proprietary Class 3 Procedure: HDP-PR-QA-006, Chain of Custody Revision: 3														



160-10196 Chain of Custody

Earth City, MO 63045  
phone 314.298.8566 faxRegulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☒ Other:

TestAmerica Laboratories, Inc.

Client Contact		Project Manager: Brian Miller		Site Contact: Ellen Jakub		Date: 1/20/15		COC No: 012015-FSS1					
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		2 of 2 COCs					
2800 Solway Road		Analysis Turnaround Time						Sampler:					
Knoxville, TN 37931		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS						For Lab Use Only:					
(865) 690-0501 Phone		TAT if different from Below						Walk-in Client:					
(865) 539-9868 FAX		<input type="checkbox"/> 2 weeks						Lab Sampling:					
Project Name: Hematite Decommissioning Project		<input checked="" type="checkbox"/> 1 week						Job / SDG No.:					
Site: Westinghouse Hematite, MO		<input type="checkbox"/> 2 days											
P O # 832953		<input type="checkbox"/> 1 day											
Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Gamma Spec (Ra-226, Th-232, U-238)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (Ra-226; post-21 day ingrowth)	Sample Specific Notes:	
L10-04-12-B-E-S-00	1/15/15	15:35	G	Soil	1	N	X	X	X				
N / A													
Preservation Used: 1=Ice, 2=HCl, 3=H2SO4, 4=HNO3, 5=NaOH, 6=Other None													
Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.						Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)							
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown						<input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months							
Special Instructions/QC Requirements & Comments: Dry and homogenize samples prior to analyses; potential for radiological contamination													
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____		Corr'd: _____		Therm ID No.:					
Relinquished by: <i>[Signature]</i>		Company: Perma-Fix		Date/Time: 1/20/15		Received by: <i>[Signature]</i>		Company: <i>[Signature]</i>		Date/Time: 1/20/15			
Relinquished by: <i>[Signature]</i>		Company: <i>[Signature]</i>		Date/Time: 1/20/15		Received by:		Company:		Date/Time:			
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:			
Hematite Decommissioning Project		Perma-Fix (for Westinghouse) Non-Proprietary Class 3		Procedure: HDP-PR-QA-006, Chain of Custody		Revision: 3							

## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-10196-2

Login Number: 10196

List Source: TestAmerica St. Louis

List Number: 1

Creator: Daniels, Brian J

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	Thermal preservation not required.
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	False	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	



## Definitions/Glossary

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

### Qualifiers

#### Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.

### Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

# Method Summary

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Method	Method Description	Protocol	Laboratory
GA-01-R	Radium-226 & Other Gamma Emitters (GS)	DOE	TAL SL

**Protocol References:**

DOE = U.S. Department of Energy

**Laboratory References:**

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566



## Sample Summary

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10196-1	L10-04-01-B-R-S-00	Solid	01/15/15 14:30	01/20/15 10:51
160-10196-2	L10-04-02-B-E-S-00	Solid	01/15/15 14:32	01/20/15 10:51
160-10196-3	L10-04-03-B-E-S-00	Solid	01/15/15 15:10	01/20/15 10:51
160-10196-4	L10-04-04-B-R-S-00	Solid	01/15/15 14:45	01/20/15 10:51
160-10196-5	L10-04-05-B-E-S-00	Solid	01/15/15 14:50	01/20/15 10:51
160-10196-6	L10-04-06-B-E-S-00	Solid	01/17/15 11:05	01/20/15 10:51
160-10196-7	L10-04-07-B-E-S-00	Solid	01/15/15 15:15	01/20/15 10:51
160-10196-8	L10-04-08-B-E-S-00	Solid	01/15/15 15:20	01/20/15 10:51
160-10196-9	L10-04-08-B-E-Q-00	Solid	01/15/15 15:20	01/20/15 10:51
160-10196-10	L10-04-09-B-E-S-00	Solid	01/17/15 14:10	01/20/15 10:51
160-10196-11	L10-04-10-B-R-S-00	Solid	01/15/15 15:25	01/20/15 10:51
160-10196-12	L10-04-11-B-E-S-00	Solid	01/15/15 15:27	01/20/15 10:51
160-10196-13	L10-04-12-B-E-S-00	Solid	01/15/15 15:35	01/20/15 10:51

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-01-B-R-S-00

Lab Sample ID: 160-10196-1

Date Collected: 01/15/15 14:30

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.814		0.136	0.160		0.131	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Bismuth 212	1.34		0.504	0.523		0.456	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Bismuth 214	1.06		0.120	0.163		0.0701	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Lead 212	0.766		0.0811	0.128		0.0876	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Lead 214	1.14		0.110	0.162		0.0847	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Potassium 40	13.8		1.26	1.89		0.473	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Protactinium 231	0.495	U	0.404	0.407		1.41	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Radium 226	1.06		0.120	0.163	1.00	0.0701	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Thorium 232	0.814		0.136	0.160		0.131	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Thorium 234	0.887		0.305	0.319		0.883	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Uranium 235	0.0947	U	0.157	0.157		0.284	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Americium 241	0.0518	U	0.0655	0.0657		0.108	pCi/g	01/23/15 12:21	02/13/15 08:53	1
Protactinium 234m	0.000	U	1.14	1.14		10.1	pCi/g	01/23/15 12:21	02/13/15 08:53	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.284		0.0573	0.0644		0.0479	pCi/g	01/23/15 12:21	02/13/15 08:53	1

Client Sample ID: L10-04-02-B-E-S-00

Lab Sample ID: 160-10196-2

Date Collected: 01/15/15 14:32

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.870		0.111	0.142		0.0669	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Bismuth 212	1.45		0.424	0.450		0.357	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Bismuth 214	0.983		0.0963	0.140		0.0608	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Lead 212	0.856		0.0619	0.127		0.0537	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Lead 214	1.03		0.0774	0.132		0.0557	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Potassium 40	15.2		0.945	1.82		0.207	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Protactinium 231	0.456	U	0.200	0.206		0.839	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Radium 226	0.983		0.0963	0.140	1.00	0.0608	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Thorium 232	0.870		0.111	0.142		0.0669	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Thorium 234	1.12		0.446	0.461		0.702	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Uranium 235	0.124	U	0.120	0.121		0.194	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Americium 241	0.00838	U	0.0508	0.0508		0.0855	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Protactinium 234m	3.07	U	2.05	2.07		4.68	pCi/g	01/23/15 12:21	02/13/15 08:55	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	0.985		0.485	0.499		0.658	pCi/g	01/23/15 12:21	02/13/15 08:55	1
Tl-208	0.239		0.0364	0.0440		0.0299	pCi/g	01/23/15 12:21	02/13/15 08:55	1

TestAmerica St. Louis

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-03-B-E-S-00

Lab Sample ID: 160-10196-3

Date Collected: 01/15/15 15:10

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	0.939		0.120	0.154		0.104	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Bismuth 212	1.29		0.412	0.433		0.367	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Bismuth 214	0.981		0.0944	0.139		0.0608	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Lead 212	0.924		0.0671	0.137		0.0628	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Lead 214	1.15		0.0887	0.149		0.0591	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Potassium 40	17.5		1.06	2.08		0.339	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Protactinium 231	0.558	U	0.226	0.235		1.10	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Radium 226	0.981		0.0944	0.139	1.00	0.0608	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Thorium 232	0.939		0.120	0.154		0.104	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Thorium 234	1.43		0.533	0.554		0.836	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Uranium 235	0.282		0.164	0.166		0.199	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Americium 241	0.00197	U	0.0458	0.0458		0.0778	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Protactinium 234m	4.58	U	1.87	1.93		7.13	pCi/g	01/23/15 12:21	02/13/15 09:44	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
TI-208	0.307		0.0401	0.0513		0.0297	pCi/g	01/23/15 12:21	02/13/15 09:44	1

Client Sample ID: L10-04-04-B-R-S-00

Lab Sample ID: 160-10196-4

Date Collected: 01/15/15 14:45

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	0.827		0.140	0.164		0.119	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Bismuth 212	1.20		0.377	0.397		0.304	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Bismuth 214	1.08		0.106	0.154		0.0602	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Lead 212	0.851		0.0679	0.129		0.0536	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Lead 214	1.08		0.103	0.152		0.0872	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Potassium 40	13.7		1.07	1.76		0.241	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Protactinium 231	0.326	U	0.432	0.433		1.10	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Radium 226	1.08		0.106	0.154	1.00	0.0602	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Thorium 232	0.827		0.140	0.164		0.119	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Thorium 234	1.18		0.583	0.596		0.791	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Uranium 235	0.137	U	0.136	0.136		0.195	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Americium 241	-0.0245	U	0.0608	0.0609		0.102	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Protactinium 234m	0.121	U	3.05	3.05		5.51	pCi/g	01/23/15 12:21	02/13/15 09:41	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Pb-210	0.960		0.507	0.520		0.698	pCi/g	01/23/15 12:21	02/13/15 09:41	1
TI-208	0.271		0.0502	0.0576		0.0408	pCi/g	01/23/15 12:21	02/13/15 09:41	1

TestAmerica St. Louis

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-05-B-E-S-00

Lab Sample ID: 160-10196-5

Date Collected: 01/15/15 14:50

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	0.731		0.120	0.141		0.161	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Bismuth 212	0.989		0.357	0.372		0.327	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Bismuth 214	0.929		0.111	0.147		0.0735	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Lead 212	0.627		0.0686	0.106		0.0742	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Lead 214	0.988		0.0988	0.142		0.0680	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Potassium 40	11.5		1.02	1.56		0.286	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Protactinium 231	0.984		0.434	0.448		0.790	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Radium 226	0.929		0.111	0.147	1.00	0.0735	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Thorium 232	0.731		0.120	0.141		0.161	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Thorium 234	0.927		0.313	0.328		0.860	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Uranium 235	0.234	U	0.144	0.146		0.261	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Americium 241	0.0139	U	0.0631	0.0631		0.106	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Protactinium 234m	1.25	U	3.46	3.46		6.00	pCi/g	01/23/15 12:21	02/13/15 09:42	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208			0.0399	0.0473		0.0262	pCi/g	01/23/15 12:21	02/13/15 09:42	1

Client Sample ID: L10-04-06-B-E-S-00

Lab Sample ID: 160-10196-6

Date Collected: 01/17/15 11:05

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.19		0.156	0.197		0.0860	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Bismuth 212	1.40		0.414	0.438		0.389	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Bismuth 214	1.14		0.101	0.156		0.0600	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Lead 212	1.11		0.0731	0.161		0.0598	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Lead 214	1.32		0.0997	0.170		0.0654	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Potassium 40	17.3		1.07	2.07		0.231	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Protactinium 231	0.552	U	0.235	0.243		1.14	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Radium 226	1.14		0.101	0.156	1.00	0.0600	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Thorium 232	1.19		0.156	0.197		0.0860	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Thorium 234	1.58		0.301	0.344		0.807	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Uranium 235	0.328		0.142	0.146		0.221	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Americium 241	0.00420	U	0.0546	0.0546		0.0922	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Protactinium 234m	0.990	U	2.90	2.91		4.82	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210			0.731	0.764		0.901	pCi/g	01/23/15 12:21	02/13/15 09:43	1
Tl-208			0.0503	0.0603		0.0397	pCi/g	01/23/15 12:21	02/13/15 09:43	1

TestAmerica St. Louis

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-07-B-E-S-00

Lab Sample ID: 160-10196-7

Date Collected: 01/15/15 15:15

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.11		0.161	0.197		0.0520	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Bismuth 212	0.529	U	0.498	0.501		0.800	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Bismuth 214	1.16		0.130	0.177		0.0604	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Lead 212	0.883		0.0971	0.150		0.112	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Lead 214	1.22		0.119	0.174		0.0978	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Potassium 40	18.6		1.49	2.42		0.324	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Protactinium 231	-0.684	U	0.972	0.975		1.61	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Radium 226	1.16		0.130	0.177	1.00	0.0604	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Thorium 232	1.11		0.161	0.197		0.0520	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Thorium 234	0.952	U	0.341	0.356		0.977	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Uranium 235	0.00583	U	0.0161	0.0161		0.312	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Americium 241	-0.00684	U	0.0594	0.0594		0.101	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Protactinium 234m	2.50	U	3.41	3.42		7.19	pCi/g	01/23/15 12:21	02/13/15 09:40	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.328		0.0574	0.0667		0.0424	pCi/g	01/23/15 12:21	02/13/15 09:40	1

Client Sample ID: L10-04-08-B-E-S-00

Lab Sample ID: 160-10196-8

Date Collected: 01/15/15 15:20

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.864		0.134	0.160		0.107	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Bismuth 212	1.30		0.336	0.363		0.294	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Bismuth 214	0.997		0.100	0.144		0.0676	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Lead 212	0.872		0.0666	0.131		0.0655	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Lead 214	1.13		0.0901	0.148		0.0665	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Potassium 40	16.7		1.05	2.00		0.380	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Protactinium 231	0.313	U	0.186	0.189		1.13	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Radium 226	0.997		0.100	0.144	1.00	0.0676	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Thorium 232	0.864		0.134	0.160		0.107	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Thorium 234	1.34		0.484	0.504		0.753	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Uranium 235	0.152	U	0.147	0.148		0.233	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Americium 241	0.000213	U	0.0462	0.0462		0.0786	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Protactinium 234m	2.47	U	2.87	2.88		4.78	pCi/g	01/23/15 12:21	02/13/15 11:35	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.305		0.0446	0.0547		0.0335	pCi/g	01/23/15 12:21	02/13/15 11:35	1

TestAmerica St. Louis

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-08-B-E-Q-00

Lab Sample ID: 160-10196-9

Date Collected: 01/15/15 15:20

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	0.830		0.120	0.147		0.0651	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Bismuth 212	1.07		0.402	0.417		0.364	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Bismuth 214	0.931		0.0951	0.136		0.0669	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Lead 212	0.966		0.0666	0.142		0.0558	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Lead 214	1.12		0.0880	0.146		0.0686	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Potassium 40	16.3		1.03	1.96		0.331	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Protactinium 231	0.377	U	0.221	0.225		0.947	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Radium 226	0.931		0.0951	0.136	1.00	0.0669	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Thorium 232	0.830		0.120	0.147		0.0651	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Thorium 234	1.11		0.301	0.323		0.807	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Uranium 235	0.162	U	0.151	0.152		0.193	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Americium 241	0.00531	U	0.0531	0.0531		0.0896	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Protactinium 234m	1.81	U	2.56	2.57		4.33	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.310		0.0431	0.0538		0.0332	pCi/g	01/23/15 12:21	02/13/15 11:37	1

Client Sample ID: L10-04-09-B-E-S-00

Lab Sample ID: 160-10196-10

Date Collected: 01/17/15 14:10

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	0.816		0.124	0.149		0.0895	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Bismuth 212	0.566	U	0.377	0.382		0.574	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Bismuth 214	0.782		0.101	0.130		0.0592	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Lead 212	0.597		0.0715	0.105		0.0825	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Lead 214	0.773		0.0988	0.127		0.0736	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Potassium 40	12.0		1.08	1.64		0.263	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Protactinium 231	0.298	U	0.335	0.337		0.757	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Radium 226	0.782		0.101	0.130	1.00	0.0592	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Thorium 232	0.816		0.124	0.149		0.0895	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Thorium 234	1.35		0.701	0.715		0.908	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Uranium 235	0.165	U	0.146	0.147		0.238	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Americium 241	-0.0134	U	0.0553	0.0554		0.0933	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Protactinium 234m	1.39	U	3.45	3.45		5.98	pCi/g	01/23/15 12:21	02/13/15 11:38	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.234		0.0479	0.0537		0.0388	pCi/g	01/23/15 12:21	02/13/15 11:38	1

TestAmerica St. Louis

# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-10-B-R-S-00

Lab Sample ID: 160-10196-11

Date Collected: 01/15/15 15:25

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.23		0.143	0.191		0.102	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Bismuth 212	1.45		0.500	0.522		0.467	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Bismuth 214	1.26		0.126	0.182		0.0754	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Lead 212	1.06		0.0818	0.159		0.0735	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Lead 214	1.33		0.104	0.173		0.0726	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Potassium 40	20.0		1.36	2.46		0.418	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Protactinium 231	0.368	U	0.216	0.220		1.40	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Radium 226	1.26		0.126	0.182	1.00	0.0754	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Thorium 232	1.23		0.143	0.191		0.102	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Thorium 234	3.15		0.474	0.577		1.07	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Uranium 235	0.304		0.164	0.167		0.270	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Americium 241	-0.000905	U	0.0455	0.0455		0.0779	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Protactinium 234m	7.95		4.17	4.25		5.68	pCi/g	01/23/15 12:21	02/13/15 11:36	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208			0.0571	0.0681		0.0446	pCi/g	01/23/15 12:21	02/13/15 11:36	1

Client Sample ID: L10-04-11-B-E-S-00

Lab Sample ID: 160-10196-12

Date Collected: 01/15/15 15:27

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.12		0.185	0.217		0.129	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Bismuth 212	1.77		0.526	0.558		0.435	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Bismuth 214	1.25		0.150	0.198		0.101	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Lead 212	1.03		0.0963	0.165		0.103	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Lead 214	1.39		0.139	0.200		0.111	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Potassium 40	19.7		1.47	2.49		0.344	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Protactinium 231	0.632	U	0.410	0.416		1.36	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Radium 226	1.25		0.150	0.198	1.00	0.101	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Thorium 232	1.12		0.185	0.217		0.129	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Thorium 234	3.21		1.00	1.06		1.20	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Uranium 235	0.185	U	0.199	0.199		0.335	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Americium 241	-0.0199	U	0.0889	0.0889		0.149	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Protactinium 234m	4.19	U	4.75	4.77		7.94	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210			0.880	0.890		1.09	pCi/g	01/23/15 12:21	02/13/15 11:37	1
Tl-208			0.0605	0.0723		0.0451	pCi/g	01/23/15 12:21	02/13/15 11:37	1

TestAmerica St. Louis



# Client Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

Client Sample ID: L10-04-12-B-E-S-00

Lab Sample ID: 160-10196-13

Date Collected: 01/15/15 15:35

Matrix: Solid

Date Received: 01/20/15 10:51

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.19		0.183	0.219		0.100	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Bismuth 212	1.45		0.703	0.719		0.652	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Bismuth 214	1.30		0.134	0.190		0.0812	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Lead 212	1.09		0.0874	0.166		0.0842	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Lead 214	1.36		0.125	0.189		0.0853	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Potassium 40	18.9		1.39	2.38		0.436	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Protactinium 231	0.325	U	0.269	0.272		1.44	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Radium 226	1.30		0.134	0.190	1.00	0.0812	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Thorium 232	1.19		0.183	0.219		0.100	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Thorium 234	1.03	U	0.403	0.417		1.06	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Uranium 235	0.172	U	0.174	0.174		0.274	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Americium 241	-0.0144	U	0.0756	0.0756		0.127	pCi/g	01/23/15 12:21	02/13/15 16:06	1
Protactinium 234m	6.62	U	3.42	3.48		7.34	pCi/g	01/23/15 12:21	02/13/15 16:06	1
<b>Other Detected</b>										
<b>Radionuclides</b>	<b>Result</b>	<b>Qualifier</b>	<b>Count Uncert. (2σ+/-)</b>	<b>Total Uncert. (2σ+/-)</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Tl-208	0.392		0.0556	0.0689		0.0393	pCi/g	01/23/15 12:21	02/13/15 16:06	1

# QC Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-170044/1-A

Matrix: Solid

Analysis Batch: 174352

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 170044

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.003037	U	0.00930	0.00930		0.0584	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Bismuth 212	-0.03011	U	1.20	1.20		0.109	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Bismuth 214	0.005810	U	0.0170	0.0170		0.0345	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Lead 212	0.0001358	U	0.0120	0.0120		0.0242	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Lead 214	-0.007905	U	0.0918	0.0918		0.0388	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Potassium 40	-0.08334	U	3.33	3.33		0.191	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Protactinium 231	0.04213	U	0.0791	0.0793		0.289	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Radium 226	0.005810	U	0.0170	0.0170	1.00	0.0345	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Thorium 232	0.003037	U	0.00930	0.00930		0.0584	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Thorium 234	0.1512	U	0.177	0.178		0.255	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Uranium 235	0.03114	U	0.0316	0.0317		0.0532	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Americium 241	0.003930	U	0.0119	0.0119		0.0208	pCi/g	01/23/15 12:21	02/13/15 08:54	1
Protactinium 234m	-0.4384	U	3.31	3.31		2.09	pCi/g	01/23/15 12:21	02/13/15 08:54	1

Other Detected Radionuclides	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Other Detected Radionuclide	None						pCi/g	01/23/15 12:21	02/13/15 08:54	1

Lab Sample ID: LCS 160-170044/2-A

Matrix: Solid

Analysis Batch: 174357

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 170044

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	103.6		10.8		0.520	pCi/g	103	87 - 116
Cesium 137	35.0	35.26		3.69		0.196	pCi/g	101	87 - 120
Cobalt 60	36.8	36.93		3.73		0.108	pCi/g	100	87 - 115

Lab Sample ID: 160-10196-13 DU

Matrix: Solid

Analysis Batch: 174355

Client Sample ID: L10-04-12-B-E-S-00

Prep Type: Total/NA

Prep Batch: 170044

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	1.19		1.087		0.168		0.0980	pCi/g	0.26	1
Bismuth 212	1.45		1.493		0.466		0.393	pCi/g	0.03	1
Bismuth 214	1.30		1.359		0.186		0.0806	pCi/g	0.14	1
Lead 212	1.09		1.101		0.161		0.0730	pCi/g	0.03	1
Lead 214	1.36		1.484		0.181		0.0797	pCi/g	0.32	1
Potassium 40	18.9		19.47		2.27		0.272	pCi/g	0.12	1
Protactinium 231	0.325	U	-0.5908	U	0.715		1.17	pCi/g	0.93	1
Radium 226	1.30		1.359		0.186	1.00	0.0806	pCi/g	0.14	1
Thorium 232	1.19		1.087		0.168		0.0980	pCi/g	0.26	1
Thorium 234	1.03	U	1.196		0.555		0.861	pCi/g	0.17	1
Uranium 235	0.172	U	0.1147	U	0.0972		0.156	pCi/g	0.21	1
Americium 241	-0.0144	U	0.01287	U	0.0637		0.107	pCi/g	0.20	1

TestAmerica St. Louis

# QC Sample Results

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS) (Continued)

Lab Sample ID: 160-10196-13 DU

Matrix: Solid

Analysis Batch: 174355

Client Sample ID: L10-04-12-B-E-S-00

Prep Type: Total/NA

Prep Batch: 170044

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	6.62	U	2.603	U	2.83		4.61	pCi/g	0.64	1
<hr/>										
Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Other Detected Radionuclide	None		None					pCi/g		
Tl-208	0.392		0.4323		0.0735		0.0437	pCi/g	0.29	1

## QC Association Summary

Client: Perma-Fix Environmental Services Inc.  
Project/Site: HDP

TestAmerica Job ID: 160-10196-2

### Rad

#### Leach Batch: 169559

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10196-1	L10-04-01-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10196-2	L10-04-02-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-3	L10-04-03-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-4	L10-04-04-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10196-5	L10-04-05-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-6	L10-04-06-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-7	L10-04-07-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-8	L10-04-08-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-9	L10-04-08-B-E-Q-00	Total/NA	Solid	Dry and Grind	
160-10196-10	L10-04-09-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-11	L10-04-10-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10196-12	L10-04-11-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-13	L10-04-12-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10196-13 DU	L10-04-12-B-E-S-00	Total/NA	Solid	Dry and Grind	

#### Prep Batch: 170044

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10196-1	L10-04-01-B-R-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-2	L10-04-02-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-3	L10-04-03-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-4	L10-04-04-B-R-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-5	L10-04-05-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-6	L10-04-06-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-7	L10-04-07-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-8	L10-04-08-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-9	L10-04-08-B-E-Q-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-10	L10-04-09-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-11	L10-04-10-B-R-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-12	L10-04-11-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-13	L10-04-12-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
160-10196-13 DU	L10-04-12-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169559
LCS 160-170044/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-170044/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	