

# 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: 160-11841-2  
Client Project/Site: HDP

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

Attn: Brian Miller



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Authorized for release by:  
6/11/2015 4:23:37 PM

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### LINKS

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[www.testamericainc.com](http://www.testamericainc.com)

*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: 160-11841-2

**Job ID: 160-11841-2**

**Laboratory: TestAmerica St. Louis**

**Narrative**

## CASE NARRATIVE

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

**Project: HDP**

**Report Number: 160-11841-2**

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 05/14/2015; 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 L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3) and L10-14-14-B-E-B-00 (160-11841-4) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were leached on 05/18/2015, prepared on 05/20/2015 and analyzed on 06/10/2015.

Preparation Batch 191728:

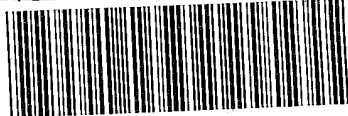
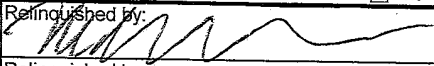
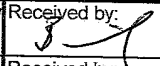
Insufficient samples were provided for the following samples to fit the geometry: L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3), L10-14-14-B-E-B-00 (160-11841-4) and (160-11841-A-1-A DU).

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

Earth City, MO 63045  
phone 314.298.8566 fax

Regulatory Program:  DW  NPDES  RCRA  Other:

TestAmerica Laboratories, Inc.

<b>Client Contact</b> Perma-Fix Environmental Services 2800 Solway Road Knoxville, TN 37931 (865) 690-0501 Phone (865) 539-9868 FAX Project Name: Hematite Decommissioning Project Site: Westinghouse Hematite, MO P O # 832953		<b>Project Manager: Brian Miller</b> Tel/Fax: (314) 810-3333		<b>Site Contact: Ellen Jakub</b> Lab Contact: Ivan Vanya		Date: 05/14/2015 Carrier: Courier		COC No: 051415-FSS2 ___1___ of ___1___ COCs																					
		<b>Analysis Turnaround Time</b> <input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____ <input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day		Filtered Sample (Y/N) Perform MS / MSD (Y / N) Gamma Spec Westinghouse Hematite Library Alpha Spec ICP/MS (Tc-99) Gamma Spec (With post-21 day ingrowth)		Sampler: For Lab Use Only: Walk-in Client: Lab Sampling:		Job / SDG No.:		Sample Specific Notes:																			
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	Westinghouse Hematite Library	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (With post-21 day ingrowth)																	
L10-13-14-B-E-B-00	5/14/15	1415	G	Soil	1	N		X	X	X										Matt Cushman									
L10-13-15-B-E-B-00	5/14/15	1425	G	Soil	1	N		X	X	X										Matt Cushman									
L10-14-13-B-E-B-00	5/14/15	1430	G	Soil	1	N		X	X	X										Matt Cushman									
L10-14-14-B-E-B-00	5/14/15	1435	G	Soil	1	N		X	X	X										Matt Cushman									
N / A																													
														 160-11841 Chain of Custody															
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: Potential for Radiological Contamination																													
Custody Seals Intact: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					Custody Seal No.:					Cooler Temp. (°C): Obs'd:					Corr'd:					Therm ID No.:									
Relinquished by: 					Company: PERMAFIX					Date/Time: 5/14/15 1654					Received by: 					Company: TA					Date/Time: 5/14/15 1654				
Relinquished by:					Company:					Date/Time:					Received by:					Company:					Date/Time:				
Relinquished by:					Company:					Date/Time:					Received in Laboratory by:					Company:					Date/Time:				

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# Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-11841-2

**Login Number: 11841**

**List Number: 1**

**Creator: Daniels, Brian J**

**List Source: TestAmerica St. Louis**

Question	Answer	Comment
Radioactivity wasn't checked or is $\leq$ 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.	N/A	
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?	N/A	
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 $<6\text{mm}$ (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: 160-11841-2

### 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.
▫	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: 160-11841-2

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

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**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: 160-11841-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-11841-1	L10-13-14-B-E-B-00	Solid	05/14/15 14:15	05/14/15 16:54
160-11841-2	L10-13-15-B-E-B-00	Solid	05/14/15 14:25	05/14/15 16:54
160-11841-3	L10-14-13-B-E-B-00	Solid	05/14/15 14:30	05/14/15 16:54
160-11841-4	L10-14-14-B-E-B-00	Solid	05/14/15 14:35	05/14/15 16:54

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# Client Sample Results

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

TestAmerica Job ID: 160-11841-2

**Client Sample ID: L10-13-14-B-E-B-00**

**Lab Sample ID: 160-11841-1**

Date Collected: 05/14/15 14:15

Matrix: Solid

Date Received: 05/14/15 16:54

**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	1.17		0.303	0.325		0.237	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Bismuth 212	2.16		0.730	0.763		0.454	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Bismuth 214	1.45		0.236	0.280		0.101	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Lead 212	1.47		0.209	0.283		0.176	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Lead 214	1.59		0.193	0.254		0.146	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Potassium 40	17.5		2.37	2.97		0.840	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Protactinium 231	0.642	U	0.810	0.813		2.80	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Radium 226	1.45		0.236	0.280	1.00	0.101	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Thorium 232	1.17		0.303	0.325		0.237	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Thorium 234	2.57	U	1.90	1.92		3.13	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Uranium 235	1.79		0.508	0.539		0.595	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Americium 241	0.177	U	0.207	0.208		0.344	pCi/g	05/20/15 14:46	06/10/15 14:34	1
Protactinium 234m	-1.06	U	14.3	14.3		13.7	pCi/g	05/20/15 14:46	06/10/15 14:34	1
<b>Other Detected Radionuclides</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	0.461		0.0988	0.110		0.0667	pCi/g	05/20/15 14:46	06/10/15 14:34	1

**Client Sample ID: L10-13-15-B-E-B-00**

**Lab Sample ID: 160-11841-2**

Date Collected: 05/14/15 14:25

Matrix: Solid

Date Received: 05/14/15 16:54

**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	1.37		0.281	0.314		0.156	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Bismuth 212	0.507	U	0.773	0.775		1.30	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Bismuth 214	1.65		0.243	0.297		0.164	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Lead 212	1.24		0.200	0.257		0.180	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Lead 214	1.84		0.210	0.284		0.171	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Potassium 40	16.9		2.02	2.66		0.903	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Protactinium 231	0.572	U	0.530	0.533		2.85	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Radium 226	1.65		0.243	0.297	1.00	0.164	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Thorium 232	1.37		0.281	0.314		0.156	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Thorium 234	0.695	U	1.61	1.61		2.70	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Uranium 235	0.0835	U	0.303	0.303		0.604	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Americium 241	-0.0371	U	0.173	0.173		0.294	pCi/g	05/20/15 14:46	06/10/15 14:36	1
Protactinium 234m	0.000	U	7.82	7.82		16.0	pCi/g	05/20/15 14:46	06/10/15 14:36	1
<b>Other Detected Radionuclides</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	0.482		0.0905	0.103		0.0524	pCi/g	05/20/15 14:46	06/10/15 14:36	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11841-2

**Client Sample ID: L10-14-13-B-E-B-00**

**Lab Sample ID: 160-11841-3**

Date Collected: 05/14/15 14:30

Matrix: Solid

Date Received: 05/14/15 16:54

**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	1.26		0.316	0.341		0.153	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Bismuth 212	1.93		1.03	1.05		0.999	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Bismuth 214	1.25		0.241	0.274		0.190	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Lead 212	0.0323	U	0.237	0.237		0.405	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Lead 214	1.48		0.224	0.271		0.197	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Potassium 40	21.2		2.77	3.51		1.28	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Protactinium 231	0.260	U	0.366	0.367		3.22	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Radium 226	1.25		0.241	0.274	1.00	0.190	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Thorium 232	1.26		0.316	0.341		0.153	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Thorium 234	0.886	U	0.804	0.809		2.67	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Uranium 235	0.172	U	0.352	0.353		0.595	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Americium 241	-0.0589	U	0.150	0.150		0.255	pCi/g	05/20/15 14:46	06/10/15 14:37	1
Protactinium 234m	2.39	U	9.50	9.50		17.1	pCi/g	05/20/15 14:46	06/10/15 14:37	1
<b>Other Detected Radionuclides</b>			<b>Count</b>	<b>Total</b>						
	<b>Result</b>	<b>Qualifier</b>	<b>Uncert.</b>	<b>Uncert.</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
TI-208	0.402		0.127	0.134		0.122	pCi/g	05/20/15 14:46	06/10/15 14:37	1

**Client Sample ID: L10-14-14-B-E-B-00**

**Lab Sample ID: 160-11841-4**

Date Collected: 05/14/15 14:35

Matrix: Solid

Date Received: 05/14/15 16:54

**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	1.53		0.310	0.347		0.285	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Bismuth 212	0.658	U	0.900	0.903		1.49	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Bismuth 214	1.64		0.261	0.311		0.192	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Lead 212	1.35		0.237	0.294		0.229	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Lead 214	1.47		0.235	0.281		0.209	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Potassium 40	23.4		2.57	3.51		1.20	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Protactinium 231	0.492	U	0.502	0.505		3.16	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Radium 226	1.64		0.261	0.311	1.00	0.192	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Thorium 232	1.53		0.310	0.347		0.285	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Thorium 234	1.64	U	1.90	1.91		3.22	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Uranium 235	0.0475	U	0.113	0.113		0.874	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Americium 241	0.100	U	0.173	0.173		0.293	pCi/g	05/20/15 14:46	06/10/15 14:38	1
Protactinium 234m	-1.27	U	9.53	9.53		17.2	pCi/g	05/20/15 14:46	06/10/15 14:38	1
<b>Other Detected Radionuclides</b>			<b>Count</b>	<b>Total</b>						
	<b>Result</b>	<b>Qualifier</b>	<b>Uncert.</b>	<b>Uncert.</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
TI-208	0.552		0.127	0.139		0.113	pCi/g	05/20/15 14:46	06/10/15 14:38	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-11841-2

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

**Lab Sample ID: MB 160-191728/1-A**  
**Matrix: Solid**  
**Analysis Batch: 194384**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**  
**Prep Batch: 191728**

Analyte	MB MB		Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Actinium 228	0.07536	U	0.146	0.146		0.253	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Bismuth 212	0.06659	U	0.350	0.350		0.677	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Bismuth 214	0.03746	U	0.0665	0.0666		0.175	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Lead 212	-0.006016	U	0.0692	0.0692		0.114	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Lead 214	-0.03635	U	0.269	0.269		0.152	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Potassium 40	-0.1710	U	0.913	0.913		1.24	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Protactinium 231	0.2683	U	0.893	0.894		1.59	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Radium 226	0.03746	U	0.0665	0.0666	1.00	0.175	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Thorium 232	0.07536	U	0.146	0.146		0.253	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Thorium 234	0.6121	U	0.750	0.752		1.22	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Uranium 235	0.01401	U	0.168	0.168		0.308	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Americium 241	0.04760	U	0.0551	0.0553		0.0890	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Protactinium 234m	1.024	U	3.25	3.25		9.85	pCi/g	05/20/15 14:46	06/10/15 14:26	1
Other Detected Radionuclides	MB MB		Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Other Detected Radionuclide	None						pCi/g	05/20/15 14:46	06/10/15 14:26	1

**Lab Sample ID: LCS 160-191728/2-A**  
**Matrix: Solid**  
**Analysis Batch: 194386**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 191728**

Analyte	Spike Added	LCS Result	LCS Qual	Total	RL	MDC	Unit	%Rec	%Rec.
				Uncert. (2σ+/-)					Limits
Americium 241	97.3	99.96		10.5		1.35	pCi/g	103	87 - 116
Cesium 137	30.3	29.99		3.23		0.315	pCi/g	99	87 - 120
Cobalt 60	19.5	19.94		2.08		0.0587	pCi/g	102	87 - 115

**Lab Sample ID: 160-11841-1 DU**  
**Matrix: Solid**  
**Analysis Batch: 194286**

**Client Sample ID: L10-13-14-B-E-B-00**  
**Prep Type: Total/NA**  
**Prep Batch: 191728**

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total	RL	MDC	Unit	RER	RER
					Uncert. (2σ+/-)					Limit
Actinium 228	1.17		1.257		0.352		0.260	pCi/g	0.13	1
Bismuth 212	2.16		0.7660	U	0.642		0.984	pCi/g	0.99	1
Bismuth 214	1.45		1.129		0.239		0.162	pCi/g	0.61	1
Lead 212	1.47		1.396		0.264		0.160	pCi/g	0.13	1
Lead 214	1.59		1.522		0.247		0.163	pCi/g	0.13	1
Potassium 40	17.5		17.63		2.70		0.989	pCi/g	0.03	1
Protactinium 231	0.642	U	0.6043	U	0.674		2.55	pCi/g	0.03	1
Radium 226	1.45		1.129		0.239	1.00	0.162	pCi/g	0.61	1
Thorium 232	1.17		1.257		0.352		0.260	pCi/g	0.13	1
Thorium 234	2.57	U	1.171	U	1.64		2.71	pCi/g	0.39	1
Uranium 235	1.79		1.766		0.434		0.519	pCi/g	0.02	1
Americium 241	0.177	U	0.06297	U	0.171		0.287	pCi/g	0.30	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-11841-2

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

**Lab Sample ID: 160-11841-1 DU**  
**Matrix: Solid**  
**Analysis Batch: 194286**

**Client Sample ID: L10-13-14-B-E-B-00**  
**Prep Type: Total/NA**  
**Prep Batch: 191728**

Analyte	Sample Result	Sample Qual	DU		Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
			Result	Qual						
Protactinium 234m	-1.06	U	1.864	U	7.22		12.8	pCi/g	0.14	1

Other Detected Radionuclides	Sample Result	Sample Qual	DU		Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
			Result	Qual						
Tl-208	0.461		0.5288		0.102		0.0384	pCi/g	0.32	1



# QC Association Summary

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

TestAmerica Job ID: 160-11841-2

## Rad

### Leach Batch: 191189

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11841-1 DU	L10-13-14-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	Dry and Grind	

### Prep Batch: 191728

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191189
160-11841-1 DU	L10-13-14-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191189
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191189
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191189
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191189
LCS 160-191728/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-191728/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	