

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: 160-11960-2

Client Project/Site: HDP

For:

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

Attn: Brian Miller

Rhonda Ridenhower

Authorized for release by:

6/23/2015 12:20:41 PM

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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: 160-11960-2

Job ID: 160-11960-2

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-11960-2

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 05/21/2015; the samples arrived in good condition, properly preserved. The temperature of the coolers at receipt was 19.0 C.

RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)

Samples L10-01-19-B-E-B-00 (160-11960-1), L10-01-20-B-E-B-00 (160-11960-2), L10-02-14-B-E-B-00 (160-11960-3), L10-02-15-B-E-B-00 (160-11960-4), L10-02-16-B-R-B-00 (160-11960-5), L10-03-15-B-E-B-00 (160-11960-6) and L10-03-16-B-E-B-00 (160-11960-7) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA_01_R. The samples were dried on 05/21/2015, prepared on 05/27/2015 and analyzed on 06/17/2015.

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

TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045
phone 314.298.8566 fax

Chain of Custody Record

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

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

TestAmerica Laboratories, Inc.

Client Contact		Project Manager: Brian Miller		Site Contact: Ellen Jakub		Date: 05/21/2015		COC No: 052115-FSS1	
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		1 of 1 COCs	
2800 Solway Road		Analysis Turnaround Time		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.:	
Knoxville, TN 37931		<input type="checkbox"/> CALENDAR DAYS <input checked="" type="checkbox"/> WORKING DAYS TAT if different from Below 3							
(865) 690-0501 Phone		<input type="checkbox"/> 2 weeks <input type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day							
(865) 539-9868 FAX									
Project Name: Hematite Decommissioning Project									
Site: Westinghouse Hematite, MO									
P O # 832953									
Sample Identification		Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.			
L10-01-19-B-E-B-00	5/21/15	0715	G	Soil	1	N			
L10-01-20-B-E-B-00	5/21/15	0720	G	Soil	1	N			
L10-02-14-B-E-B-00	5/21/15	0655	G	Soil	1	N			
L10-02-15-B-E-B-00	5/21/15	0700	G	Soil	1	N			
L10-02-16-B-R-B-00	5/21/15	0705	G	Soil	1	N			
L10-03-15-B-E-B-00	5/21/15	0725	G	Soil	1	N			
L10-03-16-B-E-B-00	5/21/15	0735	G	Soil	1	N			
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 so)		
<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: <i>[Signature]</i>		Company: Perma-Fix		Date/Time: 5-21-15/0915		Received by: <i>[Signature]</i>		Company: CROSSROADS	
Relinquished by: <i>[Signature]</i>		Company: CROSSROADS		Date/Time: 5-21-15/1050		Received by: <i>[Signature]</i>		Company: TA	
Relinquished by: <i>[Signature]</i>		Company:		Date/Time:		Received in Laboratory by:		Company:	



160-11960 Chain of Custody

Hematite Decommissioning Project

Permafix (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: 160-11960-2

Login Number: 11960

List Source: TestAmerica St. Louis

List Number: 1

Creator: Daniels, Brian J

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.	False	
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 $<6\text{mm}$ (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: 160-11960-2

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: 160-11960-2

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: 160-11960-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-11960-1	L10-01-19-B-E-B-00	Solid	05/21/15 07:15	05/21/15 10:50
160-11960-2	L10-01-20-B-E-B-00	Solid	05/21/15 07:20	05/21/15 10:50
160-11960-3	L10-02-14-B-E-B-00	Solid	05/21/15 06:55	05/21/15 10:50
160-11960-4	L10-02-15-B-E-B-00	Solid	05/21/15 07:00	05/21/15 10:50
160-11960-5	L10-02-16-B-R-B-00	Solid	05/21/15 07:05	05/21/15 10:50
160-11960-6	L10-03-15-B-E-B-00	Solid	05/21/15 07:25	05/21/15 10:50
160-11960-7	L10-03-16-B-E-B-00	Solid	05/21/15 07:35	05/21/15 10:50

Client Sample Results

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

TestAmerica Job ID: 160-11960-2

Client Sample ID: L10-01-19-B-E-B-00

Date Collected: 05/21/15 07:15

Date Received: 05/21/15 10:50

Lab Sample ID: 160-11960-1

Matrix: Solid

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	1.18		0.145	0.187		0.106	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Bismuth 212	1.30		0.474	0.492		0.438	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Bismuth 214	1.14		0.124	0.171		0.0865	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Lead 212	1.14		0.0924	0.175		0.0813	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Lead 214	1.30		0.109	0.175		0.0852	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Potassium 40	21.0		1.24	2.45		0.318	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Protactinium 231	-0.618	U	0.795	0.798		1.31	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Radium 226	1.14		0.124	0.171	1.00	0.0865	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Thorium 232	1.18		0.145	0.187		0.106	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Thorium 234	1.45		0.511	0.533		0.791	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Uranium 235	0.253		0.164	0.166		0.200	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Americium 241	0.0209	U	0.0676	0.0676		0.114	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Protactinium 234m	1.05	U	3.05	3.05		5.27	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.48		0.714	0.735		0.924	pCi/g	05/27/15 15:23	06/17/15 12:40	1
Tl-208	0.400		0.0541	0.0679		0.0425	pCi/g	05/27/15 15:23	06/17/15 12:40	1

Client Sample ID: L10-01-20-B-E-B-00

Date Collected: 05/21/15 07:20

Date Received: 05/21/15 10:50

Lab Sample ID: 160-11960-2

Matrix: Solid

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	1.15		0.146	0.187		0.157	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Bismuth 212	1.75		0.364	0.407		0.245	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Bismuth 214	1.05		0.112	0.156		0.0760	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Lead 212	1.07		0.0997	0.171		0.0884	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Lead 214	1.18		0.105	0.161		0.0866	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Potassium 40	20.1		1.23	2.39		0.356	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Protactinium 231	-0.559	U	0.778	0.780		1.29	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Radium 226	1.05		0.112	0.156	1.00	0.0760	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Thorium 232	1.15		0.146	0.187		0.157	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Thorium 234	1.20		0.559	0.573		0.889	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Uranium 235	0.159	U	0.148	0.149		0.256	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Americium 241	0.0112	U	0.0684	0.0684		0.115	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Protactinium 234m	2.81	U	3.76	3.78		5.81	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.48		0.663	0.685		0.866	pCi/g	05/27/15 15:23	06/17/15 08:56	1
Tl-208	0.335		0.0573	0.0670		0.0474	pCi/g	05/27/15 15:23	06/17/15 08:56	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-11960-2

Client Sample ID: L10-02-14-B-E-B-00

Lab Sample ID: 160-11960-3

Date Collected: 05/21/15 06:55

Matrix: Solid

Date Received: 05/21/15 10:50

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	1.32		0.219	0.257		0.140	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Bismuth 212	0.444	U	0.407	0.410		0.649	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Bismuth 214	1.09		0.122	0.167		0.101	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Lead 212	1.09		0.0990	0.172		0.108	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Lead 214	1.23		0.114	0.171		0.0903	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Potassium 40	18.2		1.39	2.32		0.414	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Protactinium 231	0.382	U	0.756	0.757		1.27	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Radium 226	1.09		0.122	0.167	1.00	0.101	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Thorium 232	1.32		0.219	0.257		0.140	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Thorium 234	0.908	U	0.329	0.342		0.949	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Uranium 235	0.126	U	0.131	0.132		0.214	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Americium 241	-0.0181	U	0.0634	0.0635		0.107	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Protactinium 234m	-0.964	U	4.23	4.23		7.42	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.46		0.731	0.751		0.949	pCi/g	05/27/15 15:23	06/17/15 08:57	1
Tl-208	0.433		0.0634	0.0777		0.0444	pCi/g	05/27/15 15:23	06/17/15 08:57	1

Client Sample ID: L10-02-15-B-E-B-00

Lab Sample ID: 160-11960-4

Date Collected: 05/21/15 07:00

Matrix: Solid

Date Received: 05/21/15 10:50

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	1.23		0.150	0.194		0.151	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Bismuth 212	1.44		0.410	0.435		0.514	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Bismuth 214	1.11		0.117	0.163		0.0814	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Lead 212	1.23		0.119	0.199		0.105	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Lead 214	1.26		0.109	0.170		0.0889	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Potassium 40	23.5		1.34	2.72		0.332	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Protactinium 231	0.503	U	0.246	0.253		1.28	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Radium 226	1.11		0.117	0.163	1.00	0.0814	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Thorium 232	1.23		0.150	0.194		0.151	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Thorium 234	1.46		0.562	0.582		0.880	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Uranium 235	0.163	U	0.148	0.149		0.265	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Americium 241	0.0272	U	0.0682	0.0682		0.114	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Protactinium 234m	6.51		3.91	3.96		6.03	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.55		0.632	0.657		0.850	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Tl-208	0.443		0.0596	0.0750		0.0437	pCi/g	05/27/15 15:23	06/17/15 08:58	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-11960-2

Client Sample ID: L10-02-16-B-R-B-00

Lab Sample ID: 160-11960-5

Date Collected: 05/21/15 07:05

Matrix: Solid

Date Received: 05/21/15 10:50

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	1.16		0.149	0.190		0.161	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Bismuth 212	1.70		0.484	0.515		0.415	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Bismuth 214	1.16		0.114	0.166		0.0700	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Lead 212	1.08		0.0868	0.165		0.0727	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Lead 214	1.29		0.107	0.172		0.0687	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Potassium 40	18.1		1.20	2.21		0.339	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Protactinium 231	0.425	U	0.230	0.235		1.15	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Radium 226	1.16		0.114	0.166	1.00	0.0700	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Thorium 232	1.16		0.149	0.190		0.161	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Thorium 234	0.892	U	0.321	0.334		0.901	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Uranium 235	0.147	U	0.142	0.142		0.259	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Americium 241	0.0219	U	0.0669	0.0670		0.112	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Protactinium 234m	2.93	U	3.31	3.32		5.38	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.20		0.597	0.613		0.850	pCi/g	05/27/15 15:23	06/17/15 08:58	1
Tl-208	0.367		0.0498	0.0627		0.0353	pCi/g	05/27/15 15:23	06/17/15 08:58	1

Client Sample ID: L10-03-15-B-E-B-00

Lab Sample ID: 160-11960-6

Date Collected: 05/21/15 07:25

Matrix: Solid

Date Received: 05/21/15 10:50

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	1.25		0.150	0.197		0.129	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Bismuth 212	0.899		0.409	0.420		0.574	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Bismuth 214	1.52		0.140	0.211		0.0791	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Lead 212	1.27		0.115	0.201		0.102	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Lead 214	1.74		0.128	0.222		0.0920	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Potassium 40	17.4		1.36	2.24		0.435	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Protactinium 231	0.526	U	0.262	0.269		1.62	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Radium 226	1.52		0.140	0.211	1.00	0.0791	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Thorium 232	1.25		0.150	0.197		0.129	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Thorium 234	0.933	U	0.393	0.405		1.05	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Uranium 235	0.205	U	0.181	0.183		0.282	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Americium 241	0.00371	U	0.0775	0.0775		0.131	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Protactinium 234m	0.588	U	3.74	3.74		6.65	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.07		0.639	0.651		0.901	pCi/g	05/27/15 15:23	06/17/15 09:22	1
Tl-208	0.453		0.0655	0.0807		0.0493	pCi/g	05/27/15 15:23	06/17/15 09:22	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-11960-2

Client Sample ID: L10-03-16-B-E-B-00

Lab Sample ID: 160-11960-7

Date Collected: 05/21/15 07:35

Matrix: Solid

Date Received: 05/21/15 10:50

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	1.18		0.167	0.206		0.109	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Bismuth 212	1.40		0.494	0.515		0.473	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Bismuth 214	1.14		0.114	0.165		0.0729	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Lead 212	1.18		0.0911	0.178		0.100	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Lead 214	1.29		0.100	0.168		0.0921	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Potassium 40	16.7		1.14	2.05		0.224	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Protactinium 231	0.752	U	0.343	0.353		1.14	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Radium 226	1.14		0.114	0.165	1.00	0.0729	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Thorium 232	1.18		0.167	0.206		0.109	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Thorium 234	1.30		0.562	0.578		0.886	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Uranium 235	0.132	U	0.152	0.153		0.250	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Americium 241	0.0120	U	0.0599	0.0599		0.101	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Protactinium 234m	0.447	U	2.23	2.23		4.04	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.47		0.579	0.604		0.774	pCi/g	05/27/15 15:23	06/17/15 09:30	1
Tl-208	0.433		0.0565	0.0722		0.0416	pCi/g	05/27/15 15:23	06/17/15 09:30	1

QC Sample Results

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

TestAmerica Job ID: 160-11960-2

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

Lab Sample ID: MB 160-192493/1-A

Matrix: Solid

Analysis Batch: 195762

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 192493

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.005928	U	0.0215	0.0215		0.0456	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Bismuth 212	-0.0007008	U	0.0942	0.0942		0.184	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Bismuth 214	0.03574		0.0180	0.0184		0.0282	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Lead 212	0.005661	U	0.0140	0.0140		0.0264	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Lead 214	-0.01299	U	0.611	0.611		0.0342	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Potassium 40	-0.02411	U	0.176	0.176		0.296	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Protactinium 231	0.005086	U	0.188	0.188		0.347	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Radium 226	0.03574		0.0180	0.0184	1.00	0.0282	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Thorium 232	0.005928	U	0.0215	0.0215		0.0456	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Thorium 234	-0.04511	U	0.280	0.280		0.324	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Uranium 235	0.01100	U	0.0232	0.0233		0.0768	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Americium 241	0.001571	U	0.0134	0.0134		0.0252	pCi/g	05/27/15 15:23	06/17/15 08:25	1
Protactinium 234m	0.3393	U	0.985	0.985		1.82	pCi/g	05/27/15 15:23	06/17/15 08:25	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	05/27/15 15:23	06/17/15 08:25	1

Lab Sample ID: LCS 160-192493/2-A

Matrix: Solid

Analysis Batch: 195763

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 192493

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	100.6		10.5		0.473	pCi/g	100	87 - 116
Cesium 137	34.7	34.10		3.57		0.152	pCi/g	98	87 - 120
Cobalt 60	35.2	33.97		3.42		0.105	pCi/g	97	87 - 115

Lab Sample ID: 160-11960-1 DU

Matrix: Solid

Analysis Batch: 195760

Client Sample ID: L10-01-19-B-E-B-00

Prep Type: Total/NA

Prep Batch: 192493

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	1.18		1.091		0.189		0.116	pCi/g	0.25	1
Bismuth 212	1.30		0.9191		0.355		0.340	pCi/g	0.44	1
Bismuth 214	1.14		0.9496		0.143		0.0712	pCi/g	0.61	1
Lead 212	1.14		1.025		0.160		0.0812	pCi/g	0.35	1
Lead 214	1.30		1.130		0.158		0.0756	pCi/g	0.53	1
Potassium 40	21.0		18.91		2.26		0.330	pCi/g	0.44	1
Protactinium 231	-0.618	U	0.4676	U	0.236		1.23	pCi/g	1.05	1
Radium 226	1.14		0.9496		0.143	1.00	0.0712	pCi/g	0.61	1
Thorium 232	1.18		1.091		0.189		0.116	pCi/g	0.25	1
Thorium 234	1.45		1.238		0.585		0.906	pCi/g	0.19	1
Uranium 235	0.253		0.1495	U	0.143		0.243	pCi/g	0.33	1
Americium 241	0.0209	U	0.005017	U	0.0641		0.108	pCi/g	0.12	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-11960-2

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

Lab Sample ID: 160-11960-1 DU

Matrix: Solid

Analysis Batch: 195760

Client Sample ID: L10-01-19-B-E-B-00

Prep Type: Total/NA

Prep Batch: 192493

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	1.05	U	1.496	U	3.24		5.51	pCi/g	0.07	1
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Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Pb-210	1.48		1.882		0.797		0.909	pCi/g	0.26	1
Tl-208	0.400		0.3576		0.0614		0.0366	pCi/g	0.33	1

QC Association Summary

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

TestAmerica Job ID: 160-11960-2

Rad

Leach Batch: 191868

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11960-1	L10-01-19-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-1 DU	L10-01-19-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-2	L10-01-20-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-3	L10-02-14-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-4	L10-02-15-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-5	L10-02-16-B-R-B-00	Total/NA	Solid	Dry and Grind	
160-11960-6	L10-03-15-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11960-7	L10-03-16-B-E-B-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 192493

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11960-1	L10-01-19-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-1 DU	L10-01-19-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-2	L10-01-20-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-3	L10-02-14-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-4	L10-02-15-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-5	L10-02-16-B-R-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-6	L10-03-15-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
160-11960-7	L10-03-16-B-E-B-00	Total/NA	Solid	Fill_Geo-21	191868
LCS 160-192493/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-192493/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	