

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: 160-14321-2
Client Project/Site: HDP

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

Attn: Brian Miller



Authorized for release by:
11/12/2015 4:16:51 PM

Ivan Vania, Project Manager II
(314)298-8566
ivan.vania@testamericainc.com

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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: 160-14321-2

Job ID: 160-14321-2

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-14321-2

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 10/16/2015 11:14 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 20.3° C and 20.3° C.

RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)

Samples L03-02-01-P-S-S-00 (160-14321-1), L03-02-02-P-R-S-00 (160-14321-2), L03-02-04-P-S-S-00 (160-14321-3), L03-02-05-P-R-S-00 (160-14321-4), L03-02-07-P-S-S-00 (160-14321-5), L03-02-08-P-R-S-00 (160-14321-6), L03-02-10-P-S-S-00 (160-14321-7), L03-02-11-P-R-S-00 (160-14321-8), L03-02-13-P-S-S-00 (160-14321-9), L03-02-14-P-R-S-00 (160-14321-10), L03-02-16-P-S-S-00 (160-14321-11), L03-02-17-P-R-S-00 (160-14321-12), L03-02-19-P-S-S-00 (160-14321-13), L03-02-20-P-R-S-00 (160-14321-14), L03-02-22-P-S-S-00 (160-14321-15), L03-02-23-P-R-S-00 (160-14321-16), L03-02-11-P-S-Q-00 (160-14321-17) and L03-02-19-P-R-Q-00 (160-14321-18) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA_01_R. The samples were leached on 10/16/2015, prepared on 10/19/2015 and analyzed on 11/09/2015.

No additional 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

TestAmerica Laboratories, Inc.

Regulatory Program: DW NPDES RCRA Other:
 Project Manager: Brian Miller
 Tel/Fax: (314) 810-3333
 Date: 10/16/2015
 Carrier: Courier
 COC No: 101615-FSS1
 1 of 2 COCs

Client Contact
 Perma-Fix Environmental Services
 2800 Solway Road
 Knoxville, TN 37931
 Phone (865) 690-0501
 FAX (865) 539-9868
 Project Name: Hematite Decommissioning Project
 Site: Westinghouse Hematite, MO
 P O # 832953

Analysis Turnaround Time
 CALENDAR DAYS WORKING DAYS
 TAT if different from Below
 2 weeks
 1 week
 2 days
 1 day

Sample Identification	Sample Date	Sample Time	Sample Type (C-comp, G-Grab)	Matrix	# of Cont.	Performs MS/MSD (Y/N)				Sample Specific Notes:			
						Gamma Spec	Westinghouse Hematite Library	Alpha Spec	(CP/MS (Tc-99) Gamma Spec (With post-21 day ingrowth))				
L03-02-01-P-S-S-00	10/14/15	1515	G	Soil	1	X	X	X	X				Matt Cushman
L03-02-02-P-R-S-00	10/14/15	1600	C	Soil	1	X	X	X	X				Chris Chandler
L03-02-04-P-S-S-00	10/14/15	1615	G	Soil	1	X	X	X	X				Matt Cushman
L03-02-05-P-R-S-00	10/14/15	1650	C	Soil	1	X	X	X	X				Chris Chandler
L03-02-07-P-S-S-00	10/14/15	1705	G	Soil	1	X	X	X	X				Matt Cushman
L03-02-08-P-R-S-00	10/14/15	1725	C	Soil	1	X	X	X	X				Chris Chandler
L03-02-10-P-S-S-00	10/15/15	0835	G	Soil	1	X	X	X	X				Mark Shaffer
L03-02-11-P-R-S-00	10/15/15	0920	C	Soil	1	X	X	X	X				Chris Chandler
L03-02-13-P-S-S-00	10/15/15	940	G	Soil	1	X	X	X	X				Mark Shaffer
L03-02-14-P-R-S-00	10/15/15	1020	C	Soil	1	X	X	X	X				Mark Shaffer
L03-02-16-P-S-S-00	10/15/15	1030	G	Soil	1	X	X	X	X				Mark Shaffer
L03-02-17-P-R-S-00	10/15/15	1050	C	Soil	1	X	X	X	X				Mark Shaffer

Preservation Used: 1=Ice, 2=HC1, 3=H2SO4, 4=HNO3, 5=NaOH, 6=Other, None
 Possible Hazard Identification: Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
 Non-Hazard Flammable Skin Irritant Poison B Unknown
 Return to Client Disposal by Lab Archive for _____ Months

Special Instructions/QC Requirements & Comments: Potential for Radiological Contamination
 Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
 Cooler Temp. (°C): Obs'd: _____ Cor'd: _____ Therm ID No.: _____

Relinquished by: <i>Brian Miller</i>	Company: Perma-Fix	Date/Time: 10-15/0900	Received by: <i>[Signature]</i>	Company: CROSS ROADS	Date/Time: 10-16-15 9:10 AM
Relinquished by:	Company:	Date/Time:	Received by: <i>[Signature]</i>	Company: <i>[Signature]</i>	Date/Time: 10-16-15 11:14
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Earth City, MO 63045
phone 314.298.8566 fax

TestAmerica Laboratories, Inc.

Regulatory Program: DW NPDES RCRA Other:

Client Contact Perma-Fix Environmental Services 2800 Solway Road Knoxville, TN 37931 Phone (865) 690-0501 FAX (865) 539-9868 Project Name: Hematite Decommissioning Project Site: Westinghouse Hematite, MO P O # 832953		Project Manager: Brian Miller Tel/Fax: (314) 810-3333 Analysis Turnaround Time <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		Site Contact: Ellen Jakub Date: 10/16/2015 Lab Contact: Ivan Vanya Carrier: Courier		COC No: 101615-FSS1 2 of 2 COCs																									
Sample Identification L03-02-19-P-S-S-00 L03-02-20-P-R-S-00 L03-02-22-P-S-S-00 L03-02-23-P-R-S-00 L03-02-11-P-S-Q-00 L03-02-19-P-R-Q-00		Sample Date 10/15/15 10/15/15 10/15/15 10/15/15 10/15/15 10/15/15		Sample Type (C-Comp, G-Grab) G C G C G C		Matrix Soil Soil Soil Soil Soil Soil		# of Cont. 1 1 1 1 1 1		Filtered Sample (Y/N) N N N N N N		Perform MS/MSD (Y/N) X X X X X X		Gamma Spec X X X X X X		Westinghouse Hematite Library X X X X X X		ICP/MS (Tc-99) X X X X X X		Alpha Spec X X X X X X		(With post-21 day ingrowth) X X X X X X		Sample Specific Notes: Chris Chandler Mark Shaffer Mark Shaffer Chris Chandler Chris Chandler Chris Chandler							
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.		<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		Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)		Special Instructions/QC Requirements & Comments: Potential for Radiological Contamination		Cooler Temp. (°C): Obs'd: _____ Corr'd: _____ Therm ID No.: _____		Date/Time: 10-16-15 09:00 Received by: Brian Miller Company: Perma-Fix		Date/Time: 10-16-15 09:00 Received by: Cross Ross Company: Cross Ross		Date/Time: 10-16-15 11:14 Received by: [Signature] Company: [Signature]		Date/Time: _____ Received in Laboratory by: _____ Company: _____		Date/Time: _____ Received by: _____ Company: _____		Date/Time: _____ Received in Laboratory by: _____ Company: _____		Custody Seal No.: _____ Company: Perma-Fix Relinquished by: [Signature] Relinquished by: [Signature]		Company: _____ Date/Time: _____ Received in Laboratory by: _____ Company: _____		Company: _____ Date/Time: _____ Received in Laboratory by: _____ Company: _____		Company: _____ Date/Time: _____ Received in Laboratory by: _____ Company: _____	



Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-14321-2

Login Number: 14321

List Number: 1

Creator: Clarke, Jill C

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?	True	
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 <math><6\text{mm}</math> (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: 160-14321-2

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: 160-14321-2

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: 160-14321-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-14321-1	L03-02-01-P-S-S-00	Solid	10/14/15 15:15	10/16/15 11:14
160-14321-2	L03-02-02-P-R-S-00	Solid	10/14/15 16:00	10/16/15 11:14
160-14321-3	L03-02-04-P-S-S-00	Solid	10/14/15 16:15	10/16/15 11:14
160-14321-4	L03-02-05-P-R-S-00	Solid	10/14/15 16:50	10/16/15 11:14
160-14321-5	L03-02-07-P-S-S-00	Solid	10/14/15 17:05	10/16/15 11:14
160-14321-6	L03-02-08-P-R-S-00	Solid	10/14/15 17:25	10/16/15 11:14
160-14321-7	L03-02-10-P-S-S-00	Solid	10/15/15 08:35	10/16/15 11:14
160-14321-8	L03-02-11-P-R-S-00	Solid	10/15/15 09:20	10/16/15 11:14
160-14321-9	L03-02-13-P-S-S-00	Solid	10/15/15 09:40	10/16/15 11:14
160-14321-10	L03-02-14-P-R-S-00	Solid	10/15/15 10:20	10/16/15 11:14
160-14321-11	L03-02-16-P-S-S-00	Solid	10/15/15 10:30	10/16/15 11:14
160-14321-12	L03-02-17-P-R-S-00	Solid	10/15/15 10:50	10/16/15 11:14
160-14321-13	L03-02-19-P-S-S-00	Solid	10/15/15 11:10	10/16/15 11:14
160-14321-14	L03-02-20-P-R-S-00	Solid	10/15/15 11:35	10/16/15 11:14
160-14321-15	L03-02-22-P-S-S-00	Solid	10/15/15 12:00	10/16/15 11:14
160-14321-16	L03-02-23-P-R-S-00	Solid	10/15/15 12:30	10/16/15 11:14
160-14321-17	L03-02-11-P-S-Q-00	Solid	10/15/15 09:20	10/16/15 11:14
160-14321-18	L03-02-19-P-R-Q-00	Solid	10/15/15 11:10	10/16/15 11:14

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-01-P-S-S-00

Lab Sample ID: 160-14321-1

Date Collected: 10/14/15 15:15

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.07		0.120	0.162		0.121	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Bismuth 212	1.57		0.528	0.553		0.471	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Bismuth 214	1.36		0.123	0.187		0.0666	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Lead 212	0.977		0.0881	0.154		0.0774	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Lead 214	1.38		0.107	0.179		0.0874	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Potassium 40	17.1		1.22	2.14		0.368	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Protactinium 231	0.344	U	0.254	0.257		1.12	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Radium 226	1.36		0.123	0.187	1.00	0.0666	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Thorium 232	1.07		0.120	0.162		0.121	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Thorium 234	0.875	U	0.320	0.333		0.899	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Uranium 235	0.00154	U	0.152	0.152		0.259	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Americium 241	-0.00449	U	0.0662	0.0662		0.112	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Protactinium 234m	7.30		3.12	3.21		6.18	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.80		0.732	0.762		0.897	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Tl-208	0.332		0.0490	0.0599		0.0370	pCi/g	10/19/15 11:09	11/09/15 20:31	1

Client Sample ID: L03-02-02-P-R-S-00

Lab Sample ID: 160-14321-2

Date Collected: 10/14/15 16:00

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.03		0.104	0.148		0.0853	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Bismuth 212	1.45		0.335	0.367		0.283	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Bismuth 214	1.09		0.0993	0.151		0.0659	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Lead 212	1.05		0.0847	0.160		0.0730	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Lead 214	1.22		0.101	0.162		0.0742	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Potassium 40	18.4		1.05	2.15		0.316	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Protactinium 231	0.148	U	0.403	0.403		0.685	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Radium 226	1.09		0.0993	0.151	1.00	0.0659	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Thorium 232	1.03		0.104	0.148		0.0853	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Thorium 234	0.915		0.277	0.293		0.815	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Uranium 235	0.0731	U	0.130	0.131		0.240	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Americium 241	0.00368	U	0.0621	0.0621		0.105	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Protactinium 234m	1.81	U	2.90	2.90		4.89	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.353		0.0459	0.0587		0.0329	pCi/g	10/19/15 11:09	11/09/15 19:05	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-04-P-S-S-00

Lab Sample ID: 160-14321-3

Date Collected: 10/14/15 16:15

Matrix: Solid

Date Received: 10/16/15 11:14

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	0.995		0.131	0.166		0.123	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Bismuth 212	1.47		0.406	0.434		0.343	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Bismuth 214	1.25		0.119	0.176		0.0695	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Lead 212	0.949		0.0807	0.147		0.0672	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Lead 214	1.23		0.103	0.164		0.0823	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Potassium 40	17.1		1.23	2.14		0.376	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Protactinium 231	0.505	U	0.202	0.210		1.24	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Radium 226	1.25		0.119	0.176	1.00	0.0695	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Thorium 232	0.995		0.131	0.166		0.123	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Thorium 234	1.32		0.525	0.543		0.818	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Uranium 235	0.112	U	0.150	0.151		0.248	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Americium 241	-0.0235	U	0.0590	0.0591		0.0987	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Protactinium 234m	4.98	U	2.62	2.66		5.82	pCi/g	10/19/15 11:09	11/09/15 19:03	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.323		0.0515	0.0614		0.0416	pCi/g	10/19/15 11:09	11/09/15 19:03	1

Client Sample ID: L03-02-05-P-R-S-00

Lab Sample ID: 160-14321-4

Date Collected: 10/14/15 16:50

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.40		0.166	0.217		0.114	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Bismuth 212	1.76		0.492	0.524		0.455	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Bismuth 214	1.56		0.126	0.204		0.0822	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Lead 212	1.26		0.101	0.193		0.0890	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Lead 214	1.57		0.111	0.198		0.0765	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Potassium 40	18.3		1.07	2.13		0.331	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Protactinium 231	0.461	U	0.256	0.261		1.25	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Radium 226	1.56		0.126	0.204	1.00	0.0822	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Thorium 232	1.40		0.166	0.217		0.114	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Thorium 234	1.51		0.551	0.573		0.866	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Uranium 235	0.0414	U	0.0926	0.0927		0.276	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Americium 241	0.00292	U	0.0667	0.0667		0.112	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Protactinium 234m	2.03	U	2.82	2.83		4.69	pCi/g	10/19/15 11:09	11/09/15 19:04	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.416		0.0559	0.0703		0.0447	pCi/g	10/19/15 11:09	11/09/15 19:04	1

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-07-P-S-S-00

Lab Sample ID: 160-14321-5

Date Collected: 10/14/15 17:05

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.09		0.156	0.192		0.110	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Bismuth 212	1.14		0.400	0.417		0.397	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Bismuth 214	1.17		0.106	0.161		0.0667	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Lead 212	1.06		0.0757	0.156		0.0615	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Lead 214	1.16		0.0949	0.153		0.0772	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Potassium 40	17.7		1.05	2.09		0.200	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Protactinium 231	-0.637	U	0.673	0.676		1.10	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Radium 226	1.17		0.106	0.161	1.00	0.0667	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Thorium 232	1.09		0.156	0.192		0.110	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Thorium 234	0.975		0.293	0.310		0.774	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Uranium 235	0.167	U	0.122	0.123		0.173	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Americium 241	-0.0238	U	0.0620	0.0621		0.103	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Protactinium 234m	0.363	U	2.41	2.41		4.33	pCi/g	10/19/15 11:09	11/09/15 19:05	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
TI-208	0.337		0.0480	0.0594		0.0369	pCi/g	10/19/15 11:09	11/09/15 19:05	1

Client Sample ID: L03-02-08-P-R-S-00

Lab Sample ID: 160-14321-6

Date Collected: 10/14/15 17:25

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.31		0.178	0.223		0.141	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Bismuth 212	1.54		0.612	0.633		0.541	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Bismuth 214	1.36		0.138	0.198		0.0746	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Lead 212	1.29		0.109	0.199		0.0910	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Lead 214	1.51		0.130	0.204		0.101	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Potassium 40	15.2		1.33	2.04		0.354	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Protactinium 231	0.377	U	0.266	0.269		1.44	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Radium 226	1.36		0.138	0.198	1.00	0.0746	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Thorium 232	1.31		0.178	0.223		0.141	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Thorium 234	1.07		0.369	0.386		1.06	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Uranium 235	0.199	U	0.197	0.198		0.247	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Americium 241	0.00962	U	0.0799	0.0799		0.135	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Protactinium 234m	2.63	U	4.50	4.51		7.61	pCi/g	10/19/15 11:09	11/09/15 19:06	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
TI-208	0.487		0.0728	0.0886		0.0508	pCi/g	10/19/15 11:09	11/09/15 19:06	1

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-10-P-S-S-00

Lab Sample ID: 160-14321-7

Date Collected: 10/15/15 08:35

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.28		0.174	0.216		0.0997	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Bismuth 212	1.76		0.457	0.491		0.364	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Bismuth 214	1.22		0.109	0.167		0.0673	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Lead 212	0.976		0.0833	0.152		0.0756	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Lead 214	1.30		0.0901	0.163		0.0686	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Potassium 40	20.4		1.14	2.35		0.338	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Protactinium 231	-0.559	U	0.713	0.715		1.18	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Radium 226	1.22		0.109	0.167	1.00	0.0673	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Thorium 232	1.28		0.174	0.216		0.0997	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Thorium 234	0.751	U	0.283	0.294		0.860	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Uranium 235	0.0678	U	0.135	0.135		0.238	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Americium 241	-0.0144	U	0.633	0.633		0.104	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Protactinium 234m	2.16	U	3.27	3.27		5.45	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			(2σ+/-)	(2σ+/-)						
Pb-210	1.66		0.688	0.715		0.824	pCi/g	10/19/15 11:09	11/09/15 20:31	1
Tl-208	0.370		0.0452	0.0591		0.0342	pCi/g	10/19/15 11:09	11/09/15 20:31	1

Client Sample ID: L03-02-11-P-R-S-00

Lab Sample ID: 160-14321-8

Date Collected: 10/15/15 09:20

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.20		0.130	0.178		0.114	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Bismuth 212	1.56		0.442	0.471		0.397	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Bismuth 214	1.27		0.105	0.169		0.0519	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Lead 212	1.20		0.0835	0.176		0.0645	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Lead 214	1.46		0.105	0.185		0.0762	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Potassium 40	15.4		1.08	1.90		0.367	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Protactinium 231	-0.176	U	0.154	0.155		0.221	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Radium 226	1.27		0.105	0.169	1.00	0.0519	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Thorium 232	1.20		0.130	0.178		0.114	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Thorium 234	1.32		0.535	0.553		0.845	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Uranium 235	0.125	U	0.152	0.153		0.236	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Americium 241	0.00223	U	0.0667	0.0667		0.113	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Protactinium 234m	-0.355	U	14.2	14.2		6.55	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			(2σ+/-)	(2σ+/-)						
Pb-210	1.77		0.722	0.752		0.876	pCi/g	10/19/15 11:09	11/09/15 20:32	1
Tl-208	0.401		0.0549	0.0688		0.0429	pCi/g	10/19/15 11:09	11/09/15 20:32	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-13-P-S-S-00

Lab Sample ID: 160-14321-9

Date Collected: 10/15/15 09:40

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.42		0.237	0.278		0.142	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Bismuth 212	2.01		0.520	0.561		0.388	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Bismuth 214	1.14		0.132	0.177		0.0877	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Lead 212	1.06		0.0971	0.168		0.0852	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Lead 214	1.29		0.121	0.181		0.100	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Potassium 40	20.1		1.49	2.54		0.450	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Protactinium 231	0.474	U	0.351	0.355		1.51	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Radium 226	1.14		0.132	0.177	1.00	0.0877	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Thorium 232	1.42		0.237	0.278		0.142	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Thorium 234	1.67		0.636	0.660		0.992	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Uranium 235	0.160	U	0.161	0.162		0.280	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Americium 241	0.0449	U	0.0762	0.0763		0.126	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Protactinium 234m	0.000	U	3.13	3.13		9.55	pCi/g	10/19/15 11:09	11/09/15 21:42	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.394		0.0610	0.0734		0.0449	pCi/g	10/19/15 11:09	11/09/15 21:42	1

Client Sample ID: L03-02-14-P-R-S-00

Lab Sample ID: 160-14321-10

Date Collected: 10/15/15 10:20

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.10		0.129	0.171		0.124	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Bismuth 212	1.48		0.394	0.422		0.353	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Bismuth 214	1.27		0.109	0.172		0.0657	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Lead 212	1.06		0.0829	0.160		0.0719	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Lead 214	1.42		0.0978	0.177		0.0802	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Potassium 40	18.6		1.15	2.22		0.382	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Protactinium 231	-0.707	U	0.750	0.754		1.23	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Radium 226	1.27		0.109	0.172	1.00	0.0657	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Thorium 232	1.10		0.129	0.171		0.124	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Thorium 234	1.52		0.565	0.587		0.884	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Uranium 235	0.0310	U	0.143	0.143		0.220	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Americium 241	0.0282	U	0.0649	0.0649		0.108	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Protactinium 234m	5.18		2.83	2.88		4.88	pCi/g	10/19/15 11:09	11/09/15 21:43	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.363		0.0446	0.0583		0.0321	pCi/g	10/19/15 11:09	11/09/15 21:43	1

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-16-P-S-S-00

Lab Sample ID: 160-14321-11

Date Collected: 10/15/15 10:30

Matrix: Solid

Date Received: 10/16/15 11:14

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		0.153	0.195		0.128	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Bismuth 212	1.65		0.446	0.478		0.385	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Bismuth 214	1.13		0.123	0.170		0.0794	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Lead 212	1.14		0.0899	0.173		0.0729	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Lead 214	1.23		0.121	0.176		0.0914	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Potassium 40	18.1		1.33	2.28		0.478	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Protactinium 231	0.653	U	0.379	0.386		1.15	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Radium 226	1.13		0.123	0.170	1.00	0.0794	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Thorium 232	1.19		0.153	0.195		0.128	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Thorium 234	0.862	U	0.326	0.339		0.978	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Uranium 235	0.289		0.159	0.162		0.198	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Americium 241	0.00390	U	0.0556	0.0556		0.0944	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Protactinium 234m	5.45	U	3.15	3.20		5.64	pCi/g	10/19/15 11:09	11/09/15 21:44	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.387		0.0586	0.0710		0.0449	pCi/g	10/19/15 11:09	11/09/15 21:44	1

Client Sample ID: L03-02-17-P-R-S-00

Lab Sample ID: 160-14321-12

Date Collected: 10/15/15 10:50

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.24		0.149	0.194		0.134	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Bismuth 212	1.57		0.360	0.394		0.307	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Bismuth 214	1.25		0.101	0.164		0.0620	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Lead 212	1.08		0.0977	0.171		0.0886	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Lead 214	1.42		0.0909	0.174		0.0768	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Potassium 40	19.5		1.08	2.24		0.367	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Protactinium 231	0.444	U	0.224	0.229		1.17	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Radium 226	1.25		0.101	0.164	1.00	0.0620	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Thorium 232	1.24		0.149	0.194		0.134	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Thorium 234	0.856		0.282	0.296		0.801	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Uranium 235	0.102	U	0.142	0.142		0.243	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Americium 241	0.0261	U	0.0627	0.0628		0.105	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Protactinium 234m	0.0231	U	3.02	3.02		5.32	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.372		0.0507	0.0635		0.0404	pCi/g	10/19/15 11:09	11/09/15 21:45	1

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-19-P-S-S-00

Lab Sample ID: 160-14321-13

Date Collected: 10/15/15 11:10

Matrix: Solid

Date Received: 10/16/15 11:14

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	0.997		0.118	0.156		0.0880	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Bismuth 212	1.42		0.393	0.420		0.340	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Bismuth 214	1.04		0.101	0.148		0.0682	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Lead 212	1.03		0.0764	0.154		0.0613	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Lead 214	1.20		0.0949	0.157		0.0726	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Potassium 40	19.1		1.15	2.26		0.309	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Protactinium 231	-0.540	U	0.637	0.639		1.05	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Radium 226	1.04		0.101	0.148	1.00	0.0682	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Thorium 232	0.997		0.118	0.156		0.0880	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Thorium 234	1.96		0.617	0.650		0.795	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Uranium 235	0.163	U	0.113	0.114		0.164	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Americium 241	0.0400	U	0.0549	0.0550		0.0907	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Protactinium 234m	0.859	U	3.05	3.05		5.34	pCi/g	10/19/15 11:09	11/09/15 21:45	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.313		0.0530	0.0622		0.0412	pCi/g	10/19/15 11:09	11/09/15 21:45	1

Client Sample ID: L03-02-20-P-R-S-00

Lab Sample ID: 160-14321-14

Date Collected: 10/15/15 11:35

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.31		0.152	0.203		0.119	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Bismuth 212	2.25		0.498	0.550		0.343	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Bismuth 214	1.33		0.134	0.193		0.0845	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Lead 212	1.19		0.0960	0.182		0.0836	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Lead 214	1.33		0.114	0.179		0.0776	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Potassium 40	14.9		1.26	1.97		0.550	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Protactinium 231	0.536	U	0.418	0.422		1.27	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Radium 226	1.33		0.134	0.193	1.00	0.0845	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Thorium 232	1.31		0.152	0.203		0.119	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Thorium 234	1.11		0.317	0.338		0.887	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Uranium 235	0.0326	U	0.169	0.169		0.284	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Americium 241	-0.0297	U	0.0661	0.0661		0.110	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Protactinium 234m	2.56	U	3.78	3.79		6.34	pCi/g	10/19/15 11:09	11/09/15 22:25	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.406		0.0549	0.0692		0.0410	pCi/g	10/19/15 11:09	11/09/15 22:25	1

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-22-P-S-S-00

Lab Sample ID: 160-14321-15

Date Collected: 10/15/15 12:00

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.06		0.118	0.160		0.0839	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Bismuth 212	1.37		0.440	0.462		0.406	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Bismuth 214	1.09		0.106	0.155		0.0687	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Lead 212	1.06		0.0906	0.164		0.0782	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Lead 214	1.23		0.0920	0.157		0.0728	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Potassium 40	21.6		1.24	2.53		0.387	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Protactinium 231	0.435	U	0.222	0.227		1.16	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Radium 226	1.09		0.106	0.155	1.00	0.0687	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Thorium 232	1.06		0.118	0.160		0.0839	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Thorium 234	1.16		0.309	0.332		0.889	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Uranium 235	0.111	U	0.146	0.147		0.249	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Americium 241	-0.0148	U	0.0685	0.0686		0.115	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Protactinium 234m	4.47	U	2.97	3.01		5.08	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
<i>Tl-208</i>			<i>0.0430</i>	<i>0.0562</i>		<i>0.0301</i>	<i>pCi/g</i>	<i>10/19/15 11:09</i>	<i>11/09/15 22:26</i>	<i>1</i>

Client Sample ID: L03-02-23-P-R-S-00

Lab Sample ID: 160-14321-16

Date Collected: 10/15/15 12:30

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.22		0.137	0.185		0.167	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Bismuth 212	1.05		0.396	0.411		0.530	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Bismuth 214	1.21		0.120	0.174		0.0699	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Lead 212	1.17		0.0935	0.178		0.0790	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Lead 214	1.21		0.113	0.169		0.0818	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Potassium 40	20.1		1.34	2.45		0.284	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Protactinium 231	0.568	U	0.278	0.285		1.18	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Radium 226	1.21		0.120	0.174	1.00	0.0699	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Thorium 232	1.22		0.137	0.185		0.167	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Thorium 234	1.35		0.584	0.601		0.919	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Uranium 235	0.0993	U	0.145	0.145		0.240	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Americium 241	-0.0000394	U	0.0632	0.0632		0.107	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Protactinium 234m	0.000	U	2.88	2.88		7.00	pCi/g	10/19/15 11:09	11/09/15 22:26	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
<i>Tl-208</i>			<i>0.0507</i>	<i>0.0616</i>		<i>0.0399</i>	<i>pCi/g</i>	<i>10/19/15 11:09</i>	<i>11/09/15 22:26</i>	<i>1</i>

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-14321-2

Client Sample ID: L03-02-11-P-S-Q-00

Lab Sample ID: 160-14321-17

Date Collected: 10/15/15 09:20

Matrix: Solid

Date Received: 10/16/15 11:14

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		0.133	0.181		0.0928	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Bismuth 212	1.40		0.394	0.419		0.368	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Bismuth 214	1.26		0.104	0.166		0.0689	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Lead 212	1.08		0.0824	0.163		0.0749	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Lead 214	1.51		0.0977	0.185		0.0811	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Potassium 40	17.4		1.03	2.03		0.361	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Protactinium 231	0.424	U	0.265	0.269		1.03	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Radium 226	1.26		0.104	0.166	1.00	0.0689	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Thorium 232	1.23		0.133	0.181		0.0928	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Thorium 234	1.45		0.532	0.553		0.838	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Uranium 235	0.191		0.117	0.119		0.173	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Americium 241	-0.0191	U	0.230	0.230		0.108	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Protactinium 234m	1.16	U	3.02	3.02		5.15	pCi/g	10/19/15 11:09	11/09/15 22:27	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.404		0.0464	0.0623		0.0339	pCi/g	10/19/15 11:09	11/09/15 22:27	1

Client Sample ID: L03-02-19-P-R-Q-00

Lab Sample ID: 160-14321-18

Date Collected: 10/15/15 11:10

Matrix: Solid

Date Received: 10/16/15 11:14

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	1.07		0.123	0.165		0.131	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Bismuth 212	1.62		0.548	0.573		0.488	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Bismuth 214	1.03		0.103	0.149		0.0695	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Lead 212	1.04		0.0924	0.163		0.0802	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Lead 214	1.26		0.105	0.168		0.0742	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Potassium 40	18.1		1.16	2.19		0.362	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Protactinium 231	-0.563	U	0.721	0.724		1.19	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Radium 226	1.03		0.103	0.149	1.00	0.0695	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Thorium 232	1.07		0.123	0.165		0.131	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Thorium 234	1.83		0.555	0.587		0.850	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Uranium 235	0.0904	U	0.150	0.150		0.249	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Americium 241	0.0213	U	0.0633	0.0634		0.106	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Protactinium 234m	2.45	U	2.96	2.97		4.92	pCi/g	10/19/15 11:09	11/09/15 22:28	1
Other Detected Radionuclides			Count	Total						
	Result	Qualifier	Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.370		0.0439	0.0583		0.0291	pCi/g	10/19/15 11:09	11/09/15 22:28	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-14321-2

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

Lab Sample ID: MB 160-217135/1-A
Matrix: Solid
Analysis Batch: 220955

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 217135

Analyte	MB MB		Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Actinium 228	0.0000	U	0.0112	0.0112		0.128	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Bismuth 212	0.0000	U	0.0862	0.0862		0.276	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Bismuth 214	-0.006454	U	0.0605	0.0605		0.0327	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Lead 212	0.004721	U	0.0125	0.0126		0.0259	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Lead 214	0.001061	U	0.0178	0.0178		0.0340	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Potassium 40	-0.09983	U	3.99	3.99		0.290	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Protactinium 231	0.0000	U	0.201	0.201		0.489	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Radium 226	-0.006454	U	0.0605	0.0605	1.00	0.0327	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Thorium 232	0.0000	U	0.0112	0.0112		0.128	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Thorium 234	0.04342	U	0.146	0.146		0.296	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Uranium 235	0.03739	U	0.0426	0.0427		0.0645	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Americium 241	0.0000	U	0.0126	0.0126		0.0221	pCi/g	10/19/15 11:09	11/09/15 20:28	1
Protactinium 234m	0.09967	U	1.15	1.15		2.40	pCi/g	10/19/15 11:09	11/09/15 20:28	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	10/19/15 11:09	11/09/15 20:28	1

Lab Sample ID: LCS 160-217135/2-A
Matrix: Solid
Analysis Batch: 220967

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 217135

Analyte	Spike Added	LCS Result	LCS Qual	Total	RL	MDC	Unit	%Rec	%Rec. Limits
				Uncert. (2σ+/-)					
Americium 241	101	97.26		10.1		0.466	pCi/g	97	87 - 116
Cesium 137	34.4	33.19		3.47		0.166	pCi/g	97	87 - 120
Cobalt 60	33.4	31.67		3.19		0.135	pCi/g	95	87 - 115

Lab Sample ID: 160-14321-1 DU
Matrix: Solid
Analysis Batch: 220955

Client Sample ID: L03-02-01-P-S-S-00
Prep Type: Total/NA
Prep Batch: 217135

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total	RL	MDC	Unit	RER	RER Limit
					Uncert. (2σ+/-)					
Actinium 228	1.07		1.114		0.196		0.116	pCi/g	0.11	1
Bismuth 212	1.57		1.160		0.461		0.424	pCi/g	0.40	1
Bismuth 214	1.36		1.099		0.166		0.0694	pCi/g	0.74	1
Lead 212	0.977		1.013		0.160		0.0761	pCi/g	0.11	1
Lead 214	1.38		1.289		0.181		0.0862	pCi/g	0.25	1
Potassium 40	17.1		16.37		2.18		0.550	pCi/g	0.18	1
Protactinium 231	0.344	U	0.5009	U	0.430		1.40	pCi/g	0.23	1
Radium 226	1.36		1.099		0.166	1.00	0.0694	pCi/g	0.74	1
Thorium 232	1.07		1.114		0.196		0.116	pCi/g	0.11	1
Thorium 234	0.875	U	1.244		0.599		0.926	pCi/g	0.40	1
Uranium 235	0.00154	U	0.1080	U	0.188		0.272	pCi/g	0.31	1
Americium 241	-0.00449	U	0.03338	U	0.0702		0.117	pCi/g	0.28	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-14321-2

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

Lab Sample ID: 160-14321-1 DU
Matrix: Solid
Analysis Batch: 220955

Client Sample ID: L03-02-01-P-S-S-00
Prep Type: Total/NA
Prep Batch: 217135

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	7.30		3.547	U	4.41		7.19	pCi/g	0.49	1

Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Tl-208	0.332		0.3589		0.0674		0.0430	pCi/g	0.21	1

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- 11

QC Association Summary

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

TestAmerica Job ID: 160-14321-2

Rad

Leach Batch: 216801

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14321-1	L03-02-01-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-1 DU	L03-02-01-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-2	L03-02-02-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-3	L03-02-04-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-4	L03-02-05-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-5	L03-02-07-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-6	L03-02-08-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-7	L03-02-10-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-8	L03-02-11-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-9	L03-02-13-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-10	L03-02-14-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-11	L03-02-16-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-12	L03-02-17-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-13	L03-02-19-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-14	L03-02-20-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-15	L03-02-22-P-S-S-00	Total/NA	Solid	Dry and Grind	
160-14321-16	L03-02-23-P-R-S-00	Total/NA	Solid	Dry and Grind	
160-14321-17	L03-02-11-P-S-Q-00	Total/NA	Solid	Dry and Grind	
160-14321-18	L03-02-19-P-R-Q-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 217135

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14321-1	L03-02-01-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-1 DU	L03-02-01-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-2	L03-02-02-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-3	L03-02-04-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-4	L03-02-05-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-5	L03-02-07-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-6	L03-02-08-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-7	L03-02-10-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-8	L03-02-11-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-9	L03-02-13-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-10	L03-02-14-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-11	L03-02-16-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-12	L03-02-17-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-13	L03-02-19-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-14	L03-02-20-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-15	L03-02-22-P-S-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-16	L03-02-23-P-R-S-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-17	L03-02-11-P-S-Q-00	Total/NA	Solid	Fill_Geo-21	216801
160-14321-18	L03-02-19-P-R-Q-00	Total/NA	Solid	Fill_Geo-21	216801
LCS 160-217135/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-217135/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	