

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: 160-10325-2

Client Project/Site: HDP

For:

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

Attn: Brian Miller



Authorized for release by:
2/27/2015 2:46:35 PM

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

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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: 160-10325-2

Job ID: 160-10325-2

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-10325-2

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

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

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

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

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

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

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

RECEIPT

The samples were received on 01/30/2015; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the coolers at receipt was 20.0 C.

SAMPLE PRETREATMENT

The samples were dried for 41 hours because they were very wet clay. L10-01-01-B-S-S-00 (160-10325-1), L10-01-02-B-R-S-00 (160-10325-2), L10-01-04-B-S-S-00 (160-10325-3), L10-01-05-B-R-S-00 (160-10325-4), L10-01-07-B-R-S-00 (160-10325-5), L10-01-08-B-E-S-00 (160-10325-6), L10-01-09-B-R-S-00 (160-10325-7), L10-01-10-B-E-S-00 (160-10325-8), L10-01-11-B-R-S-00 (160-10325-9), L10-01-12-B-E-S-00 (160-10325-10), L10-01-13-B-E-Q-00 (160-10325-12), L10-01-13-B-E-S-00 (160-10325-11), L10-01-14-B-E-S-00 (160-10325-13), L10-01-15-B-S-S-00 (160-10325-14), L10-01-16-B-R-S-00 (160-10325-15), L10-01-18-B-E-B-00 (160-10325-16)

RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)

Samples L10-01-01-B-S-S-00 (160-10325-1), L10-01-02-B-R-S-00 (160-10325-2), L10-01-04-B-S-S-00 (160-10325-3), L10-01-05-B-R-S-00 (160-10325-4), L10-01-07-B-R-S-00 (160-10325-5), L10-01-08-B-E-S-00 (160-10325-6), L10-01-09-B-R-S-00

Case Narrative

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

TestAmerica Job ID: 160-10325-2

Job ID: 160-10325-2 (Continued)

Laboratory: TestAmerica St. Louis (Continued)

(160-10325-7), L10-01-10-B-E-S-00 (160-10325-8), L10-01-11-B-R-S-00 (160-10325-9), L10-01-12-B-E-S-00 (160-10325-10), L10-01-13-B-E-S-00 (160-10325-11), L10-01-13-B-E-Q-00 (160-10325-12), L10-01-14-B-E-S-00 (160-10325-13), L10-01-15-B-S-S-00 (160-10325-14), L10-01-16-B-R-S-00 (160-10325-15) and L10-01-18-B-E-B-00 (160-10325-16) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA_01_R. The samples were leached on 02/02/2015, prepared on 02/03/2015 and analyzed on 02/24/2015.

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

Chain of Custody Record

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

Client Contact		Project Manager: Brian Miller		Site Contact: Ellen Jakub		Date: 01/30/15		COC No: 013015-FSS1						
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		1 of 2 COCs						
2800 Solway Road		Analysis Turnaround Time						Sampler:						
Knoxville, TN 37931		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS						For Lab Use Only:						
(865) 690-0501 Phone		TAT if different from Below _____						Walk-in Client:						
(865) 539-9868 FAX		<input type="checkbox"/> 2 weeks						Lab Sampling:						
Project Name: Hematite Decommissioning Project		<input checked="" type="checkbox"/> 1 week												
Site: Westinghouse Hematite, MO		<input type="checkbox"/> 2 days						Job / SDG No.:						
P O # 832953		<input type="checkbox"/> 1 day												
Sample Identification		Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Gamma Spec (Westinghouse Hematite library)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (with 21 day ingrowth)	Sample Specific Notes:	
L10-01-01-B-S-S-00		1/28/15	13:14	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-02-B-R-S-00		1/28/15	14:00	C	Soil	1	N	X	X	X			LSA 10-01	
L10-01-04-B-S-S-00		1/28/15	14:15	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-05-B-R-S-00		1/29/15	11:00	C	Soil	1	N	X	X	X			LSA 10-01	
L10-01-07-B-R-S-00		1/29/15	11:30	C	Soil	1	N	X	X	X			LSA 10-01	
L10-01-08-B-E-S-00		1/29/15	11:35	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-09-B-R-S-00		1/28/15	15:00	C	Soil	1	N	X	X	X			LSA 10-01	
L10-01-10-B-E-S-00		1/28/15	15:10	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-11-B-R-S-00		1/28/15	16:45	C	Soil	1	N	X	X	X			LSA 10-01	
L10-01-12-B-E-S-00		1/28/15	16:55	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-13-B-E-S-00		1/28/15	14:30	G	Soil	1	N	X	X	X			LSA 10-01	
L10-01-13-B-E-Q-00		1/28/15	14:30	G	Soil	1	N	X	X	X			LSA 10-01	
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														
Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) <input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months														
Special Instructions/QC Requirements & Comments: Dry and homogenize samples before analyses; potential for radiological contamination														
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____		Corr'd: _____		Therm ID No.:						
Relinquished by: <i>Brian Miller</i>		Company: Perma-Fix		Date/Time: 01/30/15 1730		Received by: <i>Gaudin</i>		Company: TestAmerica						
Relinquished by: <i>MA</i>		Company: PERMA-FIX		Date/Time: 1/30/15 1805		Received by: <i>MA</i>		Company: TestAmerica						
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:						
Hematite Decommissioning Project		Perma-Fix (for Westinghouse) Non-Proprietary Class 3				Procedure: HDP-PR-QA-006, Chain of Custody								
Revision: 3														

Chain of Custody Record

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

Client Contact		Project Manager: Brian Miller		Site Contact: Ellen Jakub		Date: 1/30/15		COC No: 013015-FSS1					
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		2 of 2 COCs					
2800 Solway Road		Analysis Turnaround Time						Sampler:					
Knoxville, TN 37931		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS						For Lab Use Only:					
(865) 690-0501 Phone		TAT if different from Below _____						Walk-in Client:					
(865) 539-9868 FAX		<input type="checkbox"/> 2 weeks						Lab Sampling:					
Project Name: Hematite Decommissioning Project		<input checked="" type="checkbox"/> 1 week											
Site: Westinghouse Hematite, MO		<input type="checkbox"/> 2 days						Job / SDG No.:					
P O # 832953		<input type="checkbox"/> 1 day											
Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Gamma Spec (Westinghouse Hematite library)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (post-21 day ingrowth)	Sample Specific Notes:	
L10-01-14-B-E-S-00	1/28/15	14:25	G	Soil	1	N		X	X	X		LSA 10-01	
L10-01-15-B-S-S-00	1/28/15	15:15	G	Soil	1	N		X	X	X		LSA 10-01	
L10-01-16-B-R-S-00	1/28/15	16:05	C	Soil	1	N		X	X	X		LSA 10-01	
L10-01-18-B-E-B-00	1/29/15	16:00	G	Soil	1	N		X	X	X		LSA 10-01 biased sample (4 K ncpm)	
N / A													
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4= HNO3; 5= NaOH; 6= Other None													
Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.						Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)							
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown						<input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months							
Special Instructions/QC Requirements & Comments: Dry and homogenize samples prior to analyses; potential for radiological contamination													
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No			Custody Seal No.:			Cooler Temp. (°C): Obs'd: _____			Corr'd: _____			Therm ID No.:	
Relinquished by: <i>Brian Miller</i>			Company: Perma-Fix			Date/Time: 01/30/15 1730			Received by: <i>Courier</i>			Company: TestAmerica Perma-Fix	
Relinquished by: <i>[Signature]</i>			Company: PERMA-FIX			Date/Time: 1/30/15 1805			Received by: <i>[Signature]</i>			Company: TestAmerica Perma-Fix	
Relinquished by:			Company:			Date/Time:			Received in Laboratory by:			Company:	
Hematite Decommissioning Project			Perma-Fix (for Westinghouse) Non-Proprietary Class 3			Procedure: HDP-PR-QA-006, Chain of Custody			Revision: 3				

Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-10325-2

Login Number: 10325

List Source: TestAmerica St. Louis

List Number: 1

Creator: Clarke, Jill C

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

Definitions/Glossary

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

TestAmerica Job ID: 160-10325-2

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: 160-10325-2

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: 160-10325-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10325-1	L10-01-01-B-S-S-00	Solid	01/28/15 13:14	01/30/15 18:05
160-10325-2	L10-01-02-B-R-S-00	Solid	01/28/15 14:00	01/30/15 18:05
160-10325-3	L10-01-04-B-S-S-00	Solid	01/28/15 14:15	01/30/15 18:05
160-10325-4	L10-01-05-B-R-S-00	Solid	01/28/15 11:00	01/30/15 18:05
160-10325-5	L10-01-07-B-R-S-00	Solid	01/28/15 11:30	01/30/15 18:05
160-10325-6	L10-01-08-B-E-S-00	Solid	01/28/15 11:35	01/30/15 18:05
160-10325-7	L10-01-09-B-R-S-00	Solid	01/28/15 15:00	01/30/15 18:05
160-10325-8	L10-01-10-B-E-S-00	Solid	01/28/15 15:10	01/30/15 18:05
160-10325-9	L10-01-11-B-R-S-00	Solid	01/28/15 16:45	01/30/15 18:05
160-10325-10	L10-01-12-B-E-S-00	Solid	01/28/15 16:55	01/30/15 18:05
160-10325-11	L10-01-13-B-E-S-00	Solid	01/28/15 14:30	01/30/15 18:05
160-10325-12	L10-01-13-B-E-Q-00	Solid	01/28/15 14:30	01/30/15 18:05
160-10325-13	L10-01-14-B-E-S-00	Solid	01/28/15 14:25	01/30/15 18:05
160-10325-14	L10-01-15-B-S-S-00	Solid	01/28/15 15:15	01/30/15 18:05
160-10325-15	L10-01-16-B-R-S-00	Solid	01/28/15 16:05	01/30/15 18:05
160-10325-16	L10-01-18-B-E-B-00	Solid	01/28/15 16:00	01/30/15 18:05

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

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

Lab Sample ID: 160-10325-1

Date Collected: 01/28/15 13:14

Matrix: Solid

Date Received: 01/30/15 18:05

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

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.673		0.133	0.150		0.175	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Bismuth 212	1.44		0.519	0.540		0.468	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Bismuth 214	1.01		0.133	0.170		0.0869	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Lead 212	0.854		0.0838	0.139		0.0698	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Lead 214	1.08		0.117	0.162		0.0780	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Potassium 40	16.7		1.48	2.26		0.506	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Protactinium 231	0.408	U	0.364	0.367		1.17	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Radium 226	1.01		0.133	0.170	1.00	0.0869	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Thorium 232	0.673		0.133	0.150		0.175	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Thorium 234	1.45		0.657	0.675		1.03	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Uranium 235	0.190	U	0.147	0.148		0.214	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Americium 241	-0.0269	U	0.0707	0.0708		0.119	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Protactinium 234m	1.93	U	3.51	3.51		6.00	pCi/g	02/03/15 10:44	02/24/15 17:52	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.250		0.0544	0.0603		0.0485	pCi/g	02/03/15 10:44	02/24/15 17:52	1

Client Sample ID: L10-01-02-B-R-S-00

Lab Sample ID: 160-10325-2

Date Collected: 01/28/15 14:00

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.20		0.139	0.185		0.112	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Bismuth 212	1.54		0.480	0.506		0.433	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Bismuth 214	1.27		0.122	0.179		0.0779	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Lead 212	1.24		0.0814	0.180		0.0653	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Lead 214	1.37		0.0922	0.169		0.0807	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Potassium 40	21.7		1.26	2.56		0.259	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Protactinium 231	-0.594	U	0.788	0.790		1.30	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Radium 226	1.27		0.122	0.179	1.00	0.0779	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Thorium 232	1.20		0.139	0.185		0.112	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Thorium 234	1.07		0.561	0.572		0.904	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Uranium 235	0.172	U	0.138	0.140		0.245	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Americium 241	0.0291	U	0.0640	0.0641		0.107	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Protactinium 234m	0.630	U	3.27	3.27		5.82	pCi/g	02/03/15 10:44	02/24/15 17:55	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.407		0.0548	0.0692		0.0396	pCi/g	02/03/15 10:44	02/24/15 17:55	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

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

Lab Sample ID: 160-10325-3

Date Collected: 01/28/15 14:15

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.25		0.174	0.216		0.0792	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Bismuth 212	1.24		0.482	0.499		0.455	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Bismuth 214	1.16		0.120	0.170		0.0754	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Lead 212	1.08		0.0821	0.162		0.0705	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Lead 214	1.24		0.0953	0.161		0.0719	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Potassium 40	19.1		1.31	2.35		0.262	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Protactinium 231	0.542	U	0.396	0.400		1.15	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Radium 226	1.16		0.120	0.170	1.00	0.0754	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Thorium 232	1.25		0.174	0.216		0.0792	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Thorium 234	1.68		0.515	0.544		0.771	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Uranium 235	0.235	U	0.149	0.151		0.252	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Americium 241	-0.0302	U	0.0701	0.0702		0.117	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Protactinium 234m	-0.183	U	3.46	3.46		6.22	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Other Detected										
Radionuclides	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Pb-210	0.919		0.514	0.525		0.750	pCi/g	02/03/15 10:44	02/24/15 18:32	1
Tl-208	0.370		0.0537	0.0660		0.0395	pCi/g	02/03/15 10:44	02/24/15 18:32	1

Client Sample ID: L10-01-05-B-R-S-00

Lab Sample ID: 160-10325-4

Date Collected: 01/28/15 11:00

Matrix: Solid

Date Received: 01/30/15 18:05

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		0.154	0.190		0.109	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Bismuth 212	1.25		0.420	0.440		0.356	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Bismuth 214	1.08		0.120	0.164		0.0682	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Lead 212	1.05		0.0917	0.164		0.0918	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Lead 214	1.18		0.113	0.167		0.0878	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Potassium 40	18.2		1.43	2.35		0.481	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Protactinium 231	0.347	U	0.313	0.316		1.47	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Radium 226	1.08		0.120	0.164	1.00	0.0682	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Thorium 232	1.09		0.154	0.190		0.109	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Thorium 234	1.02		0.549	0.559		0.878	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Uranium 235	0.140	U	0.189	0.190		0.319	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Americium 241	-0.0231	U	0.0747	0.0747		0.125	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Protactinium 234m	-1.66	U	4.35	4.35		7.50	pCi/g	02/03/15 10:44	02/24/15 18:33	1
Other Detected										
Radionuclides	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.395		0.0575	0.0706		0.0436	pCi/g	02/03/15 10:44	02/24/15 18:33	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-07-B-R-S-00

Lab Sample ID: 160-10325-5

Date Collected: 01/28/15 11:30

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.04		0.154	0.187		0.134	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Bismuth 212	0.271	U	0.419	0.420		0.697	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Bismuth 214	1.20		0.111	0.167		0.0696	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Lead 212	1.19		0.0787	0.173		0.0623	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Lead 214	1.35		0.0982	0.171		0.0879	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Potassium 40	19.2		1.20	2.30		0.331	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Protactinium 231	-0.637	U	0.778	0.781		1.28	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Radium 226	1.20		0.111	0.167	1.00	0.0696	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Thorium 232	1.04		0.154	0.187		0.134	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Thorium 234	1.50		0.718	0.735		0.933	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Uranium 235	0.153	U	0.161	0.161		0.253	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Americium 241	-0.00321	U	0.0636	0.0636		0.107	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Protactinium 234m	3.19	U	3.08	3.10		5.02	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Other Detected										
Radionuclides	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Pb-210	1.17		0.627	0.642		0.853	pCi/g	02/03/15 10:44	02/24/15 18:35	1
Tl-208	0.379		0.0583	0.0703		0.0457	pCi/g	02/03/15 10:44	02/24/15 18:35	1

Client Sample ID: L10-01-08-B-E-S-00

Lab Sample ID: 160-10325-6

Date Collected: 01/28/15 11:35

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.16		0.125	0.172		0.102	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Bismuth 212	1.32		0.391	0.414		0.357	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Bismuth 214	1.14		0.109	0.161		0.0713	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Lead 212	1.08		0.0802	0.161		0.0816	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Lead 214	1.33		0.103	0.172		0.0665	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Potassium 40	21.7		1.27	2.56		0.441	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Protactinium 231	0.431	U	0.236	0.241		1.24	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Radium 226	1.14		0.109	0.161	1.00	0.0713	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Thorium 232	1.16		0.125	0.172		0.102	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Thorium 234	0.905	U	0.373	0.385		1.11	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Uranium 235	0.165	U	0.137	0.138		0.188	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Americium 241	0.0172	U	0.0676	0.0676		0.113	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Protactinium 234m	-0.290	U	11.6	11.6		5.12	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Other Detected										
Radionuclides	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Pb-210	1.23		0.572	0.590		0.786	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Tl-208	0.350		0.0527	0.0640		0.0424	pCi/g	02/03/15 10:44	02/24/15 19:09	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-09-B-R-S-00

Lab Sample ID: 160-10325-7

Date Collected: 01/28/15 15:00

Matrix: Solid

Date Received: 01/30/15 18:05

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		0.129	0.169		0.0973	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Bismuth 212	1.63		0.688	0.708		0.611	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Bismuth 214	1.24		0.124	0.179		0.0792	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Lead 212	1.16		0.0850	0.172		0.0735	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Lead 214	1.35		0.104	0.174		0.0874	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Potassium 40	19.3		1.36	2.40		0.399	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Protactinium 231	-0.793	U	0.861	0.866		1.41	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Radium 226	1.24		0.124	0.179	1.00	0.0792	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Thorium 232	1.06		0.129	0.169		0.0973	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Thorium 234	1.38		0.542	0.561		0.841	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Uranium 235	0.207	U	0.180	0.181		0.232	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Americium 241	-0.0129	U	0.0698	0.0698		0.117	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Protactinium 234m	-0.296	U	3.44	3.44		6.16	pCi/g	02/03/15 10:44	02/24/15 19:06	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
TI-208	0.398		0.0657	0.0776		0.0497	pCi/g	02/03/15 10:44	02/24/15 19:06	1

Client Sample ID: L10-01-10-B-E-S-00

Lab Sample ID: 160-10325-8

Date Collected: 01/28/15 15:10

Matrix: Solid

Date Received: 01/30/15 18:05

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		0.167	0.206		0.115	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Bismuth 212	1.72		0.564	0.591		0.471	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Bismuth 214	1.21		0.152	0.197		0.103	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Lead 212	1.12		0.100	0.176		0.105	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Lead 214	1.28		0.125	0.182		0.101	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Potassium 40	14.4		1.61	2.18		1.73	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Protactinium 231	0.372	U	0.593	0.594		0.992	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Radium 226	1.21		0.152	0.197	1.00	0.103	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Thorium 232	1.19		0.167	0.206		0.115	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Thorium 234	1.21		0.660	0.672		1.06	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Uranium 235	0.0818	U	0.151	0.151		0.334	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Americium 241	0.0111	U	0.0781	0.0781		0.132	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Protactinium 234m	3.20	U	3.27	3.28		7.82	pCi/g	02/03/15 10:44	02/24/15 19:07	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
TI-208	0.418		0.0636	0.0770		0.0455	pCi/g	02/03/15 10:44	02/24/15 19:07	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-11-B-R-S-00

Lab Sample ID: 160-10325-9

Date Collected: 01/28/15 16:45

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.00		0.123	0.160		0.0989	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Bismuth 212	1.26		0.400	0.420		0.359	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Bismuth 214	1.03		0.112	0.155		0.0807	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Lead 212	0.991		0.0714	0.147		0.0596	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Lead 214	1.19		0.0932	0.155		0.0607	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Potassium 40	17.1		1.11	2.08		0.325	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Protactinium 231	0.318	U	0.173	0.176		1.12	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Radium 226	1.03		0.112	0.155	1.00	0.0807	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Thorium 232	1.00		0.123	0.160		0.0989	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Thorium 234	1.10		0.663	0.673		0.873	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Uranium 235	0.110	U	0.136	0.137		0.242	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Americium 241	0.0417	U	0.0611	0.0612		0.101	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Protactinium 234m	5.62		2.79	2.85		4.94	pCi/g	02/03/15 10:44	02/24/15 19:09	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.320		0.0490	0.0592		0.0393	pCi/g	02/03/15 10:44	02/24/15 19:09	1

Client Sample ID: L10-01-12-B-E-S-00

Lab Sample ID: 160-10325-10

Date Collected: 01/28/15 16:55

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.27		0.154	0.201		0.106	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Bismuth 212	1.05		0.359	0.376		0.484	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Bismuth 214	0.763		0.115	0.140		0.148	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Lead 212	1.20		0.0848	0.177		0.0805	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Lead 214	1.42		0.108	0.183		0.0850	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Potassium 40	20.9		1.27	2.48		0.408	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Protactinium 231	0.284	U	0.465	0.466		0.779	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Radium 226	0.763		0.115	0.140	1.00	0.148	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Thorium 232	1.27		0.154	0.201		0.106	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Thorium 234	0.689	U	0.333	0.341		0.943	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Uranium 235	0.200		0.115	0.116		0.178	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Americium 241	0.000222	U	0.0731	0.0731		0.123	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Protactinium 234m	2.26	U	3.42	3.43		5.77	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.368		0.0481	0.0614		0.0351	pCi/g	02/03/15 10:44	02/24/15 19:47	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-13-B-E-S-00

Lab Sample ID: 160-10325-11

Date Collected: 01/28/15 14:30

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.34		0.149	0.203		0.132	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Bismuth 212	1.61		0.453	0.483		0.414	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Bismuth 214	1.47		0.129	0.200		0.0692	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Lead 212	1.24		0.0858	0.182		0.0727	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Lead 214	1.45		0.102	0.182		0.0728	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Potassium 40	17.4		1.23	2.17		0.251	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Protactinium 231	0.362	U	0.352	0.354		1.31	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Radium 226	1.47		0.129	0.200	1.00	0.0692	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Thorium 232	1.34		0.149	0.203		0.132	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Thorium 234	1.44		0.590	0.609		0.926	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Uranium 235	0.0277	U	0.0828	0.0829		0.266	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Americium 241	0.0166	U	0.0587	0.0587		0.0986	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Protactinium 234m	0.757	U	3.63	3.63		6.36	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Other Detected										
			Count	Total						
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Radionuclides	Result	Qualifier			RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.22		0.662	0.677		0.885	pCi/g	02/03/15 10:44	02/24/15 19:44	1
Tl-208	0.492		0.0718	0.0881		0.0535	pCi/g	02/03/15 10:44	02/24/15 19:44	1

Client Sample ID: L10-01-13-B-E-Q-00

Lab Sample ID: 160-10325-12

Date Collected: 01/28/15 14:30

Matrix: Solid

Date Received: 01/30/15 18:05

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		0.177	0.227		0.130	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Bismuth 212	0.949		0.500	0.510		0.742	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Bismuth 214	1.40		0.164	0.219		0.121	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Lead 212	1.24		0.102	0.190		0.103	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Lead 214	1.65		0.127	0.214		0.102	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Potassium 40	18.7		1.41	2.38		0.338	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Protactinium 231	0.808	U	0.316	0.328		1.56	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Radium 226	1.40		0.164	0.219	1.00	0.121	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Thorium 232	1.40		0.177	0.227		0.130	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Thorium 234	0.997	U	0.630	0.638		1.02	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Uranium 235	0.185	U	0.184	0.185		0.300	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Americium 241	0.0352	U	0.0786	0.0787		0.131	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Protactinium 234m	1.21	U	4.05	4.05		7.08	pCi/g	02/03/15 10:44	02/24/15 19:45	1
Other Detected										
			Count	Total						
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Radionuclides	Result	Qualifier			RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.430		0.0592	0.0742		0.0421	pCi/g	02/03/15 10:44	02/24/15 19:45	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-14-B-E-S-00

Lab Sample ID: 160-10325-13

Date Collected: 01/28/15 14:25

Matrix: Solid

Date Received: 01/30/15 18:05

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		0.142	0.200		0.136	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Bismuth 212	1.93		0.498	0.537		0.424	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Bismuth 214	1.40		0.111	0.183		0.0740	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Lead 212	1.43		0.0846	0.203		0.0650	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Lead 214	1.69		0.113	0.209		0.0820	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Potassium 40	17.7		1.15	2.15		0.347	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Protactinium 231	0.683	U	0.270	0.280		1.34	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Radium 226	1.40		0.111	0.183	1.00	0.0740	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Thorium 232	1.37		0.142	0.200		0.136	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Thorium 234	1.26		0.585	0.600		0.935	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Uranium 235	0.158	U	0.163	0.164		0.272	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Americium 241	0.00903	U	0.0694	0.0694		0.117	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Protactinium 234m	0.191	U	3.56	3.56		6.33	pCi/g	02/03/15 10:44	02/24/15 19:47	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.246		0.0546	0.0603		0.0765	pCi/g	02/03/15 10:44	02/24/15 19:47	1

Client Sample ID: L10-01-15-B-S-S-00

Lab Sample ID: 160-10325-14

Date Collected: 01/28/15 15:15

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.24		0.139	0.189		0.0925	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Bismuth 212	1.43		0.397	0.423		0.376	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Bismuth 214	1.21		0.126	0.178		0.0903	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Lead 212	1.10		0.0848	0.166		0.0860	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Lead 214	1.37		0.130	0.193		0.0963	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Potassium 40	23.4		1.33	2.74		0.349	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Protactinium 231	0.438	U	0.341	0.345		1.27	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Radium 226	1.21		0.126	0.178	1.00	0.0903	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Thorium 232	1.24		0.139	0.189		0.0925	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Thorium 234	1.54		0.884	0.898		1.07	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Uranium 235	0.0498	U	0.162	0.162		0.286	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Americium 241	0.0173	U	0.0610	0.0610		0.102	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Protactinium 234m	1.38	U	3.35	3.35		5.79	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.19		0.689	0.703		0.913	pCi/g	02/03/15 10:44	02/24/15 20:24	1
Tl-208	0.380		0.0589	0.0709		0.0458	pCi/g	02/03/15 10:44	02/24/15 20:24	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-10325-2

Client Sample ID: L10-01-16-B-R-S-00

Lab Sample ID: 160-10325-15

Date Collected: 01/28/15 16:05

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.22		0.141	0.188		0.128	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Bismuth 212	1.52		0.450	0.477		0.383	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Bismuth 214	1.30		0.120	0.181		0.0673	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Lead 212	1.20		0.0830	0.176		0.0644	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Lead 214	1.35		0.113	0.180		0.0766	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Potassium 40	19.3		1.34	2.38		0.383	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Protactinium 231	0.394	U	0.213	0.218		1.33	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Radium 226	1.30		0.120	0.181	1.00	0.0673	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Thorium 232	1.22		0.141	0.188		0.128	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Thorium 234	1.50		0.552	0.573		0.852	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Uranium 235	0.0779	U	0.151	0.152		0.270	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Americium 241	0.0329	U	0.0627	0.0628		0.104	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Protactinium 234m	1.41	U	3.43	3.44		5.92	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Other Detected			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radionuclides	Result	Qualifier								
Other Detected	None						pCi/g	02/03/15 10:44	02/24/15 20:22	1
Radionuclide										
Pb-210	1.34		0.588	0.608		0.793	pCi/g	02/03/15 10:44	02/24/15 20:22	1

Client Sample ID: L10-01-18-B-E-B-00

Lab Sample ID: 160-10325-16

Date Collected: 01/28/15 16:00

Matrix: Solid

Date Received: 01/30/15 18:05

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	1.31		0.176	0.221		0.166	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Bismuth 212	1.22		0.455	0.473		0.425	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Bismuth 214	1.27		0.150	0.199		0.0989	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Lead 212	1.10		0.102	0.175		0.104	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Lead 214	1.40		0.130	0.195		0.125	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Potassium 40	17.0		1.49	2.29		0.536	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Protactinium 231	0.422	U	0.275	0.279		1.63	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Radium 226	1.27		0.150	0.199	1.00	0.0989	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Thorium 232	1.31		0.176	0.221		0.166	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Thorium 234	0.912	U	0.506	0.515		1.39	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Uranium 235	0.160	U	0.196	0.196		0.333	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Americium 241	0.0419	U	0.0716	0.0717		0.119	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Protactinium 234m	-0.0721	U	4.27	4.27		7.75	pCi/g	02/03/15 10:44	02/24/15 20:22	1
Other Detected			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radionuclides	Result	Qualifier								
Tl-208	0.394		0.0631	0.0752		0.0465	pCi/g	02/03/15 10:44	02/24/15 20:22	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-10325-2

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

Lab Sample ID: MB 160-171830/1-A

Matrix: Solid

Analysis Batch: 175638

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 171830

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.006522	U	0.0182	0.0182		0.0330	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Bismuth 212	-0.002785	U	0.0911	0.0911		0.166	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Bismuth 214	-0.005472	U	0.0409	0.0409		0.0404	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Lead 212	0.01444	U	0.0118	0.0119		0.0186	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Lead 214	-0.009184	U	0.0708	0.0708		0.0296	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Potassium 40	-0.08817	U	3.63	3.63		0.263	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Protactinium 231	0.002672	U	0.145	0.145		0.275	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Radium 226	-0.005472	U	0.0409	0.0409	1.00	0.0404	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Thorium 232	0.006522	U	0.0182	0.0182		0.0330	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Thorium 234	0.03967	U	0.126	0.126		0.247	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Uranium 235	0.007137	U	0.0190	0.0190		0.0583	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Americium 241	-0.001986	U	0.0111	0.0111		0.0199	pCi/g	02/03/15 10:44	02/24/15 17:54	1
Protactinium 234m	0.2341	U	0.422	0.423		2.51	pCi/g	02/03/15 10:44	02/24/15 17:54	1

Other Detected Radionuclides	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Other Detected Radionuclide	None						pCi/g	02/03/15 10:44	02/24/15 17:54	1

Lab Sample ID: LCS 160-171830/2-A

Matrix: Solid

Analysis Batch: 175534

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 171830

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	94.82		9.88		0.620	pCi/g	94	87 - 116
Cesium 137	35.0	33.11		3.48		0.201	pCi/g	95	87 - 120
Cobalt 60	36.6	34.89		3.53		0.130	pCi/g	95	87 - 115

Lab Sample ID: 160-10325-1 DU

Matrix: Solid

Analysis Batch: 175638

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

Prep Type: Total/NA

Prep Batch: 171830

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	0.673		0.9345		0.185		0.105	pCi/g	0.78	1
Bismuth 212	1.44		1.015		0.423		0.396	pCi/g	0.44	1
Bismuth 214	1.01		0.7404		0.130		0.110	pCi/g	0.90	1
Lead 212	0.854		0.8998		0.142		0.0775	pCi/g	0.16	1
Lead 214	1.08		1.115		0.161		0.0782	pCi/g	0.10	1
Potassium 40	16.7		17.37		2.24		0.598	pCi/g	0.14	1
Protactinium 231	0.408	U	0.3242	U	0.223		1.11	pCi/g	0.14	1
Radium 226	1.01		0.7404		0.130	1.00	0.110	pCi/g	0.90	1
Thorium 232	0.673		0.9345		0.185		0.105	pCi/g	0.78	1
Thorium 234	1.45		1.500		0.608		0.911	pCi/g	0.04	1
Uranium 235	0.190	U	0.2194	U	0.199		0.244	pCi/g	0.09	1
Americium 241	-0.0269	U	0.04646	U	0.0657		0.108	pCi/g	0.54	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-10325-2

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

Lab Sample ID: 160-10325-1 DU

Matrix: Solid

Analysis Batch: 175638

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

Prep Type: Total/NA

Prep Batch: 171830

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	1.93	U	0.7544	U	3.26		5.84	pCi/g	0.17	1

Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Tl-208	0.250		0.3112		0.0630		0.0407	pCi/g	0.50	1

QC Association Summary

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

TestAmerica Job ID: 160-10325-2

Rad

Leach Batch: 171530

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10325-1	L10-01-01-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10325-1 DU	L10-01-01-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10325-2	L10-01-02-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-3	L10-01-04-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10325-4	L10-01-05-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-5	L10-01-07-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-6	L10-01-08-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10325-7	L10-01-09-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-8	L10-01-10-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10325-9	L10-01-11-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-10	L10-01-12-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10325-11	L10-01-13-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10325-12	L10-01-13-B-E-Q-00	Total/NA	Solid	Dry and Grind	
160-10325-13	L10-01-14-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10325-14	L10-01-15-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10325-15	L10-01-16-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10325-16	L10-01-18-B-E-B-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 171830

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10325-1	L10-01-01-B-S-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-1 DU	L10-01-01-B-S-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-2	L10-01-02-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-3	L10-01-04-B-S-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-4	L10-01-05-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-5	L10-01-07-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-6	L10-01-08-B-E-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-7	L10-01-09-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-8	L10-01-10-B-E-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-9	L10-01-11-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-10	L10-01-12-B-E-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-11	L10-01-13-B-E-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-12	L10-01-13-B-E-Q-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-13	L10-01-14-B-E-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-14	L10-01-15-B-S-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-15	L10-01-16-B-R-S-00	Total/NA	Solid	Fill_Geo-21	171530
160-10325-16	L10-01-18-B-E-B-00	Total/NA	Solid	Fill_Geo-21	171530
LCS 160-171830/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-171830/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	

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