

# 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: 160-10296-1

Client Project/Site: HDP

For:

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

Attn: Brian Miller



Authorized for release by:  
2/5/2015 8:57:23 PM

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

[ivan.vania@testamericainc.com](mailto: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: 160-10296-1

**Job ID: 160-10296-1**

**Laboratory: TestAmerica St. Louis**

**Narrative**

### CASE NARRATIVE

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

**Project: HDP**

**Report Number: 160-10296-1**

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 01/28/2015; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the coolers at receipt was 20.0 C.

#### **TECHNETIUM-99 (ICPMS)**

Samples L10-03-10-B-E-B-00 (160-10296-1), L10-03-11-B-E-B-00 (160-10296-2) and L10-03-12-B-E-B-00 (160-10296-3) were analyzed for Technetium-99 (ICPMS) in accordance with EPA SW-846 Method 6020A. The samples were prepared on 01/30/2015 and analyzed on 02/02/2015.

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

#### **PERCENT SOLIDS**

Samples L10-03-10-B-E-B-00 (160-10296-1), L10-03-11-B-E-B-00 (160-10296-2) and L10-03-12-B-E-B-00 (160-10296-3) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 01/29/2015.

## Case Narrative

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

TestAmerica Job ID: 160-10296-1

### Job ID: 160-10296-1 (Continued)

#### Laboratory: TestAmerica St. Louis (Continued)

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

#### CESIUM-137 & OTHER GAMMA EMITTERS (GS)

Samples L10-03-10-B-E-B-00 (160-10296-1), L10-03-11-B-E-B-00 (160-10296-2) and L10-03-12-B-E-B-00 (160-10296-3) were analyzed for Cesium-137 & Other Gamma Emitters (GS) in accordance with DOE GA-01-R. The samples were leached on 01/28/2015, prepared on 01/30/2015 and analyzed on 02/03/2015 and 02/04/2015.

Batch 171231:

Radium-226 is reported in these samples at the client's request. Radium-226 is reported from the 609.31 keV line of bismuth-214. Because the samples have not had a 21-day ingrowth, the activity for radium-226 is an estimated value and may be biased low. This bias is caused by the disruption of secular equilibrium between radium-226 and bismuth-214 by the loss of radon-222 during sample preparation. (160-10296-3 DU), (LCS 160-171231/2-A), (MB 160-171231/1-A), L10-03-10-B-E-B-00 (160-10296-1), L10-03-11-B-E-B-00 (160-10296-2), L10-03-12-B-E-B-00 (160-10296-3)

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: 1/28/15		COC No: 012815-FSS1					
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		Page 1 of 1					
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 (Ra-226, Th-232, U-235, U-238)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (Ra-226; post-21 day ingrowth)	Sample Specific Notes:	
L10-03-10-B-E-B-00	1/27/15	10:40	G	Soil	1	N	X	X	X				LSA 10-03 (bias); (~5K ncpm)
L10-03-11-B-E-B-00	1/27/15	10:45	G	Soil	1	N	X	X	X				LSA 10-03 (bias); (~5K ncpm)
L10-03-12-B-E-B-00	1/27/15	10:50	G	Soil	1	N	X	X	X				LSA 10-03 (bias); (~5K ncpm)
N / A													
160-10296 Chain of Custody													
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4=HNO3, 5=NaOH, 6= Other None													
Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.						Sample Disposal ( A fee may be assessed if samples are retained longer than 1 month)							
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown						<input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months							
Special Instructions/QC Requirements & Comments: 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: _____ Cor'd: _____		Therm ID No.:							
Relinquished by: <i>Brian Miller</i>		Company: Perma-Fix		Date/Time: 1-28-15		Received by: <i>Mark Schaffner 904</i>		Company: TestAmerica		Date/Time: 1/28/15 12:10			
Relinquished by: <i>Mark Schaffner 904</i>		Company: <i>CROSSROADS</i>		Date/Time: 1/28/15 1338		Received by: <i>Jim Clarke</i>		Company: <i>TA SL</i>		Date/Time: 1-28-15 1338			
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:			
Hematite Decommissioning Project				Perma-Fix (for Westinghouse) Non-Proprietary Class 3				Procedure:HDP-PR-QA-006, Chain of Custody				Revision: 3	

## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-10296-1

Login Number: 10296

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.	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?	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: 160-10296-1

### 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: 160-10296-1

Method	Method Description	Protocol	Laboratory
6020A	Metals (ICP/MS), Tc-99	SW846	TAL SL
Moisture	Percent Moisture	EPA	TAL SL
6020A	Metals (ICP/MS), Tc-99 in Activity	SW846	TAL SL
GA-01-R	Cesium-137 & Other Gamma Emitters (GS)	DOE	TAL SL

### Protocol References:

DOE = U.S. Department of Energy

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

### 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: 160-10296-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10296-1	L10-03-10-B-E-B-00	Solid	01/27/15 10:40	01/28/15 13:38
160-10296-2	L10-03-11-B-E-B-00	Solid	01/27/15 10:45	01/28/15 13:38
160-10296-3	L10-03-12-B-E-B-00	Solid	01/27/15 10:50	01/28/15 13:38

# Client Sample Results

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

TestAmerica Job ID: 160-10296-1

**Client Sample ID: L10-03-10-B-E-B-00**

**Lab Sample ID: 160-10296-1**

**Date Collected: 01/27/15 10:40**

**Matrix: Solid**

**Date Received: 01/28/15 13:38**

**Percent Solids: 67.5**

## Method: 6020A - Metals (ICP/MS), Tc-99

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000085	0.000025	mg/Kg	☆	01/30/15 10:30	02/02/15 13:49	1

## Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	0.0721	U	0.0360	0.0366	1.69	0.289	pCi/g	01/30/15 10:30	02/02/15 13:49	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	88		30 - 110					01/30/15 10:30	02/02/15 13:49	1

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.46		0.206	0.254		0.177	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Americium 241	-0.0179	U	0.251	0.251		0.145	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Bismuth 212	1.33		0.643	0.658		0.611	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Bismuth 214	1.29		0.166	0.214		0.111	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Lead 212	1.22		0.103	0.188		0.102	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Lead 214	1.38		0.131	0.194		0.0842	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Potassium 40	18.4		1.48	2.40		0.356	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Protactinium 234m	4.50	U	3.72	3.75		7.91	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Protactinium 231	0.261	U	0.546	0.547		0.928	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Radium 226	1.29		0.166	0.214		0.111	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Thorium 234	2.10		0.465	0.514		1.22	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Uranium 235	0.469		0.198	0.204		0.257	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Thorium 232	1.46		0.206	0.254		0.177	pCi/g	01/30/15 08:56	02/03/15 10:36	1
Other Detected Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.435		0.0652	0.0793		0.0503	pCi/g	01/30/15 08:56	02/03/15 10:36	1

**Client Sample ID: L10-03-11-B-E-B-00**

**Lab Sample ID: 160-10296-2**

**Date Collected: 01/27/15 10:45**

**Matrix: Solid**

**Date Received: 01/28/15 13:38**

**Percent Solids: 63.3**

## Method: 6020A - Metals (ICP/MS), Tc-99

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.00011	0.000032	mg/Kg	☆	01/30/15 10:30	02/02/15 14:01	1

## Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	0.120	U	0.108	0.108	2.14	0.367	pCi/g	01/30/15 10:30	02/02/15 14:01	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	74		30 - 110					01/30/15 10:30	02/02/15 14:01	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10296-1

Client Sample ID: L10-03-11-B-E-B-00

Lab Sample ID: 160-10296-2

Date Collected: 01/27/15 10:45

Matrix: Solid

Date Received: 01/28/15 13:38

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.36		0.154	0.207		0.116	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Americium 241	-0.0114	U	0.0605	0.0605		0.102	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Bismuth 212	1.67		0.519	0.547		0.446	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Bismuth 214	1.32		0.127	0.187		0.0771	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Lead 212	1.23		0.0883	0.182		0.0777	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Lead 214	1.53		0.111	0.194		0.0832	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Potassium 40	18.9		1.34	2.35		0.395	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Protactinium 234m	3.99	U	3.68	3.70		5.84	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Protactinium 231	0.990		0.442	0.455		0.744	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Radium 226	1.32		0.127	0.187		0.0771	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Thorium 234	2.18		0.381	0.444		0.978	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Uranium 235	0.525		0.201	0.208		0.264	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Thorium 232	1.36		0.154	0.207		0.116	pCi/g	01/30/15 08:56	02/04/15 17:52	1
Other Detected										
Radionuclides	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Tl-208	0.470		0.0615	0.0785		0.0436	pCi/g	01/30/15 08:56	02/04/15 17:52	1

Client Sample ID: L10-03-12-B-E-B-00

Lab Sample ID: 160-10296-3

Date Collected: 01/27/15 10:50

Matrix: Solid

Date Received: 01/28/15 13:38

Percent Solids: 73.1

## Method: 6020A - Metals (ICP/MS), Tc-99

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000084	0.000025	mg/Kg	☆	01/30/15 10:30	02/02/15 14:05	1

## Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Technetium 99	0.0315	U	0.0451	0.0452	1.67	0.286	pCi/g	01/30/15 10:30	02/02/15 14:05	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	82		30 - 110					01/30/15 10:30	02/02/15 14:05	1

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.22		0.140	0.187		0.145	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Americium 241	-0.000560	U	0.0623	0.0623		0.106	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Bismuth 212	1.61		0.562	0.586		0.514	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Bismuth 214	1.00		0.121	0.160		0.0884	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Lead 212	1.37		0.0901	0.199		0.0736	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Lead 214	1.13		0.0951	0.151		0.0910	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Potassium 40	17.5		1.26	2.20		0.367	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Protactinium 234m	0.0780	U	3.28	3.28		5.91	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Protactinium 231	0.617	U	0.249	0.258		1.34	pCi/g	01/30/15 08:56	02/04/15 18:45	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10296-1

Client Sample ID: L10-03-12-B-E-B-00

Lab Sample ID: 160-10296-3

Date Collected: 01/27/15 10:50

Matrix: Solid

Date Received: 01/28/15 13:38

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS) (Continued)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Radium 226	1.00		0.121	0.160		0.0884	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Thorium 234	1.20		0.556	0.570		0.882	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Uranium 235	0.135	U	0.144	0.144		0.194	pCi/g	01/30/15 08:56	02/04/15 18:45	1
Thorium 232	1.22		0.140	0.187		0.145	pCi/g	01/30/15 08:56	02/04/15 18:45	1
<b>Other Detected</b>										
			Count	Total						
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Radionuclides	Result	Qualifier			RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.442		0.0556	0.0720		0.0383	pCi/g	01/30/15 08:56	02/04/15 18:45	1

# QC Sample Results

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

TestAmerica Job ID: 160-10296-1

## Method: 6020A - Metals (ICP/MS), Tc-99

Lab Sample ID: MB 160-171246/1-A  
Matrix: Solid  
Analysis Batch: 171825

Client Sample ID: Method Blank  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000052	0.000016	mg/Kg		01/30/15 10:30	02/02/15 13:42	1

Lab Sample ID: LCS 160-171246/2-A  
Matrix: Solid  
Analysis Batch: 171825

Client Sample ID: Lab Control Sample  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Technetium 99	0.00123	0.00129		mg/Kg		105	80 - 120

Lab Sample ID: 160-10296-1 MS  
Matrix: Solid  
Analysis Batch: 171825

Client Sample ID: L10-03-10-B-E-B-00  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Technetium 99	ND		0.00184	0.00185		mg/Kg	☼	101	75 - 125

Lab Sample ID: 160-10296-1 MSD  
Matrix: Solid  
Analysis Batch: 171825

Client Sample ID: L10-03-10-B-E-B-00  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Technetium 99	ND		0.00184	0.00199		mg/Kg	☼	108	75 - 125	7	30

## Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Lab Sample ID: MB 160-171246/1-A  
Matrix: Solid  
Analysis Batch: 171826

Client Sample ID: Method Blank  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	0.007975	U	0.00588	0.00592	1.04	0.177	pCi/g	01/30/15 10:30	02/02/15 13:42	1

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Re	97		30 - 110	01/30/15 10:30	02/02/15 13:42	1

Lab Sample ID: LCS 160-171246/2-A  
Matrix: Solid  
Analysis Batch: 171826

Client Sample ID: Lab Control Sample  
Prep Type: Total/NA  
Prep Batch: 171246

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Technetium 99	21.1	22.15		2.20	1.14	0.195	pCi/g	105	80 - 120

Carrier	LCS %Yield	LCS Qualifier	Limits
Re	88		30 - 110

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# QC Sample Results

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

TestAmerica Job ID: 160-10296-1

## Method: 6020A - Metals (ICP/MS), Tc-99 in Activity (Continued)

Lab Sample ID: 160-10296-1 MS

Matrix: Solid

Analysis Batch: 171826

Client Sample ID: L10-03-10-B-E-B-00

Prep Type: Total/NA

Prep Batch: 171246

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Technetium 99	0.0721	U	31.4	31.60		2.95	1.63	0.280	pCi/g	101	75 - 125
Carrier	MS %Yield	MS Qualifier	Limits								
Re	91		30 - 110								

Lab Sample ID: 160-10296-1 MSD

Matrix: Solid

Analysis Batch: 171826

Client Sample ID: L10-03-10-B-E-B-00

Prep Type: Total/NA

Prep Batch: 171246

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Technetium 99	0.0721	U	31.4	34.06		3.21	1.77	0.303	pCi/g	108	75 - 125	0.40	1
Carrier	MSD %Yield	MSD Qualifier	Limits										
Re	84		30 - 110										

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-171231/1-A

Matrix: Solid

Analysis Batch: 171843

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 171231

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.01987	U	0.0256	0.0257		0.0475	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Americium 241	0.003122	U	0.0121	0.0121		0.0215	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Bismuth 212	-0.05084	U	0.337	0.337		0.188	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Bismuth 214	0.003761	U	0.0190	0.0190		0.0367	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Lead 212	-0.006551	U	0.0564	0.0564		0.0254	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Lead 214	-0.008566	U	0.0781	0.0781		0.0321	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Potassium 40	0.09589	U	0.0868	0.0874		0.118	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Protactinium 234m	0.0000	U	0.241	0.241		0.888	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Protactinium 231	0.009766	U	0.0194	0.0194		0.346	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Radium 226	0.003761	U	0.0190	0.0190		0.0367	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Thorium 234	0.03156	U	0.128	0.128		0.248	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Uranium 235	0.003767	U	0.00829	0.00829		0.0737	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Thorium 232	0.01987	U	0.0256	0.0257		0.0475	pCi/g	01/30/15 08:56	02/03/15 10:35	1
Other Detected Radionuclides	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Other Detected Radionuclide	None						pCi/g	01/30/15 08:56	02/03/15 10:35	1

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# QC Sample Results

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

TestAmerica Job ID: 160-10296-1

## Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS) (Continued)

Lab Sample ID: LCS 160-171231/2-A

Matrix: Solid

Analysis Batch: 171844

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 171231

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	102.9		10.7		0.532	pCi/g	102	87 - 116
Cesium 137	35.0	35.43		3.71	0.200	0.182	pCi/g	101	87 - 120
Cobalt 60	36.9	36.79		3.71		0.111	pCi/g	100	87 - 115

Lab Sample ID: 160-10296-3 DU

Matrix: Solid

Analysis Batch: 172242

Client Sample ID: L10-03-12-B-E-B-00

Prep Type: Total/NA

Prep Batch: 171231

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	1.22		1.322		0.183		0.123	pCi/g	0.28	1
Americium 241	-0.00056	U	0.01495	U	0.0456		0.0767	pCi/g	0.14	1
	0									
Bismuth 212	1.61		1.279		0.452		0.415	pCi/g	0.31	1
Bismuth 214	1.00		1.009		0.145		0.0641	pCi/g	0.02	1
Lead 212	1.37		1.337		0.190		0.0570	pCi/g	0.1	1
Lead 214	1.13		1.201		0.158		0.0638	pCi/g	0.22	1
Potassium 40	17.5		17.95		2.15		0.300	pCi/g	0.09	1
Protactinium 234m	0.0780	U	0.8304	U	3.04		5.28	pCi/g	0.12	1
Protactinium 231	0.617	U	0.7809	U	0.326		1.24	pCi/g	0.28	1
Radium 226	1.00		1.009		0.145		0.0641	pCi/g	0.02	1
Thorium 234	1.20		0.8651		0.516		0.826	pCi/g	0.31	1
Uranium 235	0.135	U	0.1258	U	0.150		0.241	pCi/g	0.03	1
Thorium 232	1.22		1.322		0.183		0.123	pCi/g	0.28	1
<b>Total</b>										
Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Tl-208	0.442		0.4181		0.0716		0.0428	pCi/g	0.16	1

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# QC Association Summary

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

TestAmerica Job ID: 160-10296-1

## Metals

### Prep Batch: 171246

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	None	
160-10296-1 MS	L10-03-10-B-E-B-00	Total/NA	Solid	None	
160-10296-1 MSD	L10-03-10-B-E-B-00	Total/NA	Solid	None	
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	None	
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	None	
LCS 160-171246/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-171246/1-A	Method Blank	Total/NA	Solid	None	

### Analysis Batch: 171825

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	6020A	171246
160-10296-1 MS	L10-03-10-B-E-B-00	Total/NA	Solid	6020A	171246
160-10296-1 MSD	L10-03-10-B-E-B-00	Total/NA	Solid	6020A	171246
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	6020A	171246
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	6020A	171246
LCS 160-171246/2-A	Lab Control Sample	Total/NA	Solid	6020A	171246
MB 160-171246/1-A	Method Blank	Total/NA	Solid	6020A	171246

## General Chemistry

### Analysis Batch: 170994

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10294-A-21 DU	Duplicate	Total/NA	Solid	Moisture	
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	Moisture	
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	Moisture	
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	Moisture	

## Rad

### Leach Batch: 170938

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10296-3 DU	L10-03-12-B-E-B-00	Total/NA	Solid	Dry and Grind	

### Prep Batch: 171231

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	Fill_Geo-0	170938
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	Fill_Geo-0	170938
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	Fill_Geo-0	170938
160-10296-3 DU	L10-03-12-B-E-B-00	Total/NA	Solid	Fill_Geo-0	170938
LCS 160-171231/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-0	
MB 160-171231/1-A	Method Blank	Total/NA	Solid	Fill_Geo-0	

### Prep Batch: 171246

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-1	L10-03-10-B-E-B-00	Total/NA	Solid	None	
160-10296-1 MS	L10-03-10-B-E-B-00	Total/NA	Solid	None	
160-10296-1 MSD	L10-03-10-B-E-B-00	Total/NA	Solid	None	

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## QC Association Summary

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

TestAmerica Job ID: 160-10296-1

### Rad (Continued)

#### Prep Batch: 171246 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10296-2	L10-03-11-B-E-B-00	Total/NA	Solid	None	
160-10296-3	L10-03-12-B-E-B-00	Total/NA	Solid	None	
LCS 160-171246/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-171246/1-A	Method Blank	Total/NA	Solid	None	

## Tracer/Carrier Summary

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

TestAmerica Job ID: 160-10296-1

### Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Matrix: Solid

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	Re (30-110)	
160-10296-1	L10-03-10-B-E-B-00	88	
160-10296-1 MS	L10-03-10-B-E-B-00	91	
160-10296-1 MSD	L10-03-10-B-E-B-00	84	
160-10296-2	L10-03-11-B-E-B-00	74	
160-10296-3	L10-03-12-B-E-B-00	82	
LCS 160-171246/2-A	Lab Control Sample	88	
MB 160-171246/1-A	Method Blank	97	
<b>Tracer/Carrier Legend</b>			
Re = Re			