

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

## ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045  
Tel: (314)298-8566

TestAmerica Job ID: 160-11841-1

Client Project/Site: HDP

For:

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

Attn: Brian Miller

*Elizabeth M. Hoerchler*

Authorized for release by:

5/26/2015 5:10:37 PM

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*This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.*

*Results relate only to the items tested and the sample(s) as received by the laboratory.*

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# Case Narrative

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

TestAmerica Job ID: 160-11841-1

**Job ID: 160-11841-1**

**Laboratory: TestAmerica St. Louis**

## Narrative

### CASE NARRATIVE

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

**Project: HDP**

**Report Number: 160-11841-1**

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 05/14/2015; the samples arrived in good condition, properly preserved. The temperature of the coolers at receipt was 20.0° C.

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

Samples L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3) and L10-14-14-B-E-B-00 (160-11841-4) were analyzed for Technetium-99 (ICPMS) in accordance with EPA SW-846 Method 6020A. The samples were prepared on 05/18/2015 and analyzed on 05/19/2015.

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

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

Samples L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3) and L10-14-14-B-E-B-00 (160-11841-4) were analyzed for Technetium-99 (ICPMS) in accordance with EPA SW-846 Method 6020A. The samples were prepared on 05/18/2015 and analyzed on 05/19/2015.

## Case Narrative

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

TestAmerica Job ID: 160-11841-1

### Job ID: 160-11841-1 (Continued)

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

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

#### **PERCENT SOLIDS**

Samples L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3) and L10-14-14-B-E-B-00 (160-11841-4) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 05/16/2015.

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 L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3) and L10-14-14-B-E-B-00 (160-11841-4) were analyzed for Cesium-137 & Other Gamma Emitters (GS) in accordance with DOE GA-01-R. The samples were leached on 05/18/2015, and prepared and analyzed on 05/20/2015.

Prep batch: 191719

Insufficient volume was provided for the following sample to fill the client requested marn soil geometry: L10-13-14-B-E-B-00 (160-11841-1), L10-13-15-B-E-B-00 (160-11841-2), L10-14-13-B-E-B-00 (160-11841-3), L10-14-14-B-E-B-00 (160-11841-4) and (160-11841-A-1-A DU) Samples were put into a tuna can instead.

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

## Chain of Custody Record

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

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

**TestAmerica Laboratories, Inc.**

[illegible]

## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-11841-1

Login Number: 11841

List Number: 1

Creator: Daniels, Brian J

List Source: TestAmerica St. Louis

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

## Definitions/Glossary

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

TestAmerica Job ID: 160-11841-1

### Qualifiers

#### Metals

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

#### 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: 160-11841-1

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: 160-11841-1

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

## Detection Summary

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

TestAmerica Job ID: 160-11841-1

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

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

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Technetium 99	0.000031	J	0.000082	0.000025	mg/Kg	1		☼	6020A	Total/NA

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

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

No Detections.

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

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

No Detections.

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

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

No Detections.

This Detection Summary does not include radiochemical test results.

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# Client Sample Results

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

TestAmerica Job ID: 160-11841-1

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

**Date Collected: 05/14/15 14:15**

**Date Received: 05/14/15 16:54**

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

**Matrix: Solid**

**Percent Solids: 71.3**

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

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	0.000031	J	0.000082	0.000025	mg/Kg	☼	05/18/15 09:50	05/19/15 13:01	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	0.528		0.163	0.171	1.64	0.280	pCi/g	05/18/15 09:50	05/19/15 13:01	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	86		30 - 110					05/18/15 09:50	05/19/15 13:01	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	1.36		0.140	0.197		0.103	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Americium 241	0.0301	U	0.0585	0.0586		0.0971	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Bismuth 212	1.39		0.425	0.448		0.393	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Bismuth 214	0.673		0.0719	0.100		0.0650	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Lead 212	1.28		0.0610	0.177		0.0525	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Lead 214	0.812		0.0706	0.110		0.0621	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Potassium 40	17.9		0.807	2.00		0.344	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Protactinium 234m	1.58	U	2.32	2.33		3.86	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Protactinium 231	0.572	U	0.251	0.259		0.983	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Radium 226	0.673		0.0719	0.100		0.0650	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Thorium 234	1.31		0.530	0.548		0.840	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Uranium 235	1.68		0.144	0.223		0.180	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Thorium 232	1.36		0.140	0.197		0.103	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Other Detected Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.467		0.0460	0.0668		0.0333	pCi/g	05/20/15 14:46	05/20/15 17:43	1

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

**Date Collected: 05/14/15 14:25**

**Date Received: 05/14/15 16:54**

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

**Matrix: Solid**

**Percent Solids: 75.9**

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

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000076	0.000023	mg/Kg	☼	05/18/15 09:50	05/19/15 13:05	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	0.0548	U	0.0760	0.0761	1.52	0.260	pCi/g	05/18/15 09:50	05/19/15 13:05	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	87		30 - 110					05/18/15 09:50	05/19/15 13:05	1

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# Client Sample Results

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

TestAmerica Job ID: 160-11841-1

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

Lab Sample ID: 160-11841-2

Date Collected: 05/14/15 14:25

Matrix: Solid

Date Received: 05/14/15 16:54

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

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.43		0.153	0.211		0.145	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Americium 241	0.0253	U	0.0822	0.0822		0.117	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Bismuth 212	1.78		0.611	0.638		0.565	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Bismuth 214	1.04		0.111	0.155		0.0807	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Lead 212	1.30		0.0822	0.188		0.0834	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Lead 214	1.06		0.0871	0.141		0.0784	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Potassium 40	18.3		1.07	2.16		0.342	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Protactinium 234m	4.23	U	2.55	2.59		6.37	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Protactinium 231	0.491	U	0.266	0.271		1.45	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Radium 226	1.04		0.111	0.155		0.0807	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Thorium 234	1.23	U	1.02	1.03		1.28	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Uranium 235	-0.0000804	U	0.000466	0.000467		0.302	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Thorium 232	1.43		0.153	0.211		0.145	pCi/g	05/20/15 14:46	05/20/15 17:48	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Th-227	0.685		0.0997	0.134		0.0772	pCi/g	05/20/15 14:46	05/20/15 17:48	1
Tl-208	0.421		0.0503	0.0666		0.0420	pCi/g	05/20/15 14:46	05/20/15 17:48	1

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

Lab Sample ID: 160-11841-3

Date Collected: 05/14/15 14:30

Matrix: Solid

Date Received: 05/14/15 16:54

Percent Solids: 80.2

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

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000070	0.000021	mg/Kg	☼	05/18/15 09:50	05/19/15 13:09	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	0.286		0.0435	0.0509	1.40	0.240	pCi/g	05/18/15 09:50	05/19/15 13:09	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	89		30 - 110					05/18/15 09:50	05/19/15 13:09	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	1.27		0.123	0.179		0.127	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Americium 241	-0.00351	U	0.0778	0.0778		0.131	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Bismuth 212	1.60		0.527	0.552		0.471	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Bismuth 214	0.824		0.106	0.136		0.102	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Lead 212	1.22		0.0787	0.177		0.0829	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Lead 214	0.853		0.0861	0.124		0.104	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Potassium 40	20.4		1.07	2.35		0.443	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Protactinium 234m	2.08	U	3.44	3.44		6.00	pCi/g	05/20/15 14:46	05/20/15 17:43	1

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# Client Sample Results

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

TestAmerica Job ID: 160-11841-1

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

Lab Sample ID: 160-11841-3

Date Collected: 05/14/15 14:30

Matrix: Solid

Date Received: 05/14/15 16:54

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

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Protactinium 231	0.432	U	0.246	0.251		1.34	pCi/g	05/20/15 14:46	05/20/15 17:43	1
<b>Radium 226</b>	<b>0.824</b>		0.106	0.136		0.102	pCi/g	05/20/15 14:46	05/20/15 17:43	1
Thorium 234	1.20	U	0.912	0.921		1.23	pCi/g	05/20/15 14:46	05/20/15 17:43	1
<b>Uranium 235</b>	<b>0.187</b>		0.135	0.136		0.184	pCi/g	05/20/15 14:46	05/20/15 17:43	1
<b>Thorium 232</b>	<b>1.27</b>		0.123	0.179		0.127	pCi/g	05/20/15 14:46	05/20/15 17:43	1
<b>Other Detected Radionuclides</b>										
	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.416		0.0465	0.0635		0.0390	pCi/g	05/20/15 14:46	05/20/15 17:43	1

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

Lab Sample ID: 160-11841-4

Date Collected: 05/14/15 14:35

Matrix: Solid

Date Received: 05/14/15 16:54

Percent Solids: 78.5

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

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000070	0.000021	mg/Kg	☼	05/18/15 09:50	05/19/15 13:12	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
<b>Technetium 99</b>	<b>0.281</b>		0.0888	0.0925	1.40	0.240	pCi/g	05/18/15 09:50	05/19/15 13:12	1
<b>Carrier</b>										
	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	91		30 - 110					05/18/15 09:50	05/19/15 13:12	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
<b>Actinium 228</b>	<b>1.22</b>		0.117	0.171		0.107	pCi/g	05/20/15 14:46	05/20/15 20:44	1
Americium 241	0.0397	U	0.0691	0.0692		0.114	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Bismuth 212</b>	<b>1.40</b>		0.427	0.451		0.407	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Bismuth 214</b>	<b>0.804</b>		0.0844	0.119		0.0746	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Lead 212</b>	<b>1.29</b>		0.0666	0.179		0.0577	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Lead 214</b>	<b>1.00</b>		0.102	0.146		0.0846	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Potassium 40</b>	<b>21.8</b>		1.00	2.44		0.449	pCi/g	05/20/15 14:46	05/20/15 20:44	1
Protactinium 234m	3.45	U	2.44	2.46		3.81	pCi/g	05/20/15 14:46	05/20/15 20:44	1
Protactinium 231	0.850	U	0.364	0.375		1.12	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Radium 226</b>	<b>0.804</b>		0.0844	0.119		0.0746	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Thorium 234</b>	<b>1.24</b>		0.335	0.360		1.10	pCi/g	05/20/15 14:46	05/20/15 20:44	1
Uranium 235	0.0770	U	0.149	0.149		0.247	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Thorium 232</b>	<b>1.22</b>		0.117	0.171		0.107	pCi/g	05/20/15 14:46	05/20/15 20:44	1
<b>Other Detected Radionuclides</b>										
	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.420		0.0549	0.0701		0.0414	pCi/g	05/20/15 14:46	05/20/15 20:44	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-11841-1

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

Lab Sample ID: MB 160-191187/1-A

Matrix: Solid

Analysis Batch: 191454

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 191187

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000053	0.000016	mg/Kg		05/18/15 09:50	05/19/15 11:43	1

Lab Sample ID: LCS 160-191187/2-A

Matrix: Solid

Analysis Batch: 191454

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 191187

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Technetium 99	0.00124	0.00120		mg/Kg		97	80 - 120

Lab Sample ID: 160-11861-A-15-B MS

Matrix: Solid

Analysis Batch: 191454

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Prep Batch: 191187

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Technetium 99	0.000037	J	0.00155	0.00156		mg/Kg	☼	98	75 - 125

Lab Sample ID: 160-11861-A-15-C MSD

Matrix: Solid

Analysis Batch: 191454

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Prep Batch: 191187

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Technetium 99	0.000037	J	0.00156	0.00154		mg/Kg	☼	96	75 - 125	1	30

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

Lab Sample ID: MB 160-191187/1-A

Matrix: Solid

Analysis Batch: 191455

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 191187

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	0.009865	U	0.0446	0.0446	1.07	0.183	pCi/g	05/18/15 09:50	05/19/15 11:43	1

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Re	94		30 - 110	05/18/15 09:50	05/19/15 11:43	1

Lab Sample ID: LCS 160-191187/2-A

Matrix: Solid

Analysis Batch: 191455

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 191187

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Technetium 99	21.2	20.63		2.21	1.08	0.185	pCi/g	97	80 - 120

Carrier	LCS %Yield	LCS Qualifier	Limits
Re	93		30 - 110

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-11841-1

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

Lab Sample ID: 160-11861-A-15-B MS

Matrix: Solid

Analysis Batch: 191455

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Prep Batch: 191187

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Technetium 99	0.635		26.6	26.71		2.54	1.42	0.243	pCi/g	98	75 - 125
Carrier	MS %Yield	MS Qualifier	Limits								
Re	89		30 - 110								

Lab Sample ID: 160-11861-A-15-C MSD

Matrix: Solid

Analysis Batch: 191455

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Prep Batch: 191187

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	0.635		26.8	26.45		2.52	1.44	0.246	pCi/g	96	75 - 125	0.05	1
Carrier	MSD %Yield	MSD Qualifier	Limits										
Re	88		30 - 110										

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

Lab Sample ID: MB 160-191719/1-A

Matrix: Solid

Analysis Batch: 191651

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 191719

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.05668	U	0.0345	0.0350		0.0758	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Americium 241	0.0002267	U	0.0288	0.0288		0.0495	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Bismuth 212	0.1387	U	0.173	0.174		0.285	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Bismuth 214	-0.01474	U	0.0558	0.0558		0.0647	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Lead 212	-0.004958	U	0.0337	0.0337		0.0490	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Lead 214	0.006167	U	0.0336	0.0336		0.0624	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Potassium 40	-0.4771	U	1.54	1.54		0.496	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Protactinium 234m	0.5271	U	1.59	1.59		2.76	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Protactinium 231	0.07186	U	0.181	0.181		0.627	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Radium 226	-0.01474	U	0.0558	0.0558		0.0647	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Thorium 234	-0.06993	U	0.329	0.329		0.529	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Uranium 235	0.01890	U	0.0747	0.0747		0.111	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Thorium 232	0.05668	U	0.0345	0.0350		0.0758	pCi/g	05/20/15 14:46	05/20/15 17:47	1
Other Detected Radionuclides	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Other Detected Radionuclide	None						pCi/g	05/20/15 14:46	05/20/15 17:47	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-11841-1

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

Lab Sample ID: LCS 160-191719/2-A  
Matrix: Solid  
Analysis Batch: 191652

Client Sample ID: Lab Control Sample  
Prep Type: Total/NA  
Prep Batch: 191719

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	97.3	99.89		10.4		0.549	pCi/g	103	87 - 116
Cesium 137	30.4	30.50		3.19	0.200	0.141	pCi/g	100	87 - 120
Cobalt 60	19.7	19.57		1.98		0.0579	pCi/g	99	87 - 115

Lab Sample ID: 160-11841-1 DU  
Matrix: Solid  
Analysis Batch: 191652

Client Sample ID: L10-13-14-B-E-B-00  
Prep Type: Total/NA  
Prep Batch: 191719

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	1.36		1.382		0.206		0.138	pCi/g	0.07	1
Americium 241	0.0301	U	-0.02140	U	38.6		0.139	pCi/g	0	1
Bismuth 212	1.39		1.545		0.410		0.453	pCi/g	0.18	1
Bismuth 214	0.673		0.8606		0.149		0.0970	pCi/g	0.75	1
Lead 212	1.28		1.350		0.191		0.0661	pCi/g	0.18	1
Lead 214	0.812		0.8098		0.117		0.0868	pCi/g	0.01	1
Potassium 40	17.9		17.82		2.14		0.484	pCi/g	0.01	1
Protactinium 234m	1.58	U	-1.162	U	3.81		6.52	pCi/g	0.45	1
Protactinium 231	0.572	U	0.5670	U	0.310		1.34	pCi/g	0.01	1
Radium 226	0.673		0.8606		0.149		0.0970	pCi/g	0.75	1
Thorium 234	1.31		1.008	U	0.394		1.10	pCi/g	0.32	1
Uranium 235	1.68		1.955		0.308		0.269	pCi/g	0.52	1
Thorium 232	1.36		1.382		0.206		0.138	pCi/g	0.07	1
<b>Total</b>										
<b>Other Detected Radionuclides</b>	<b>Sample Result</b>	<b>Sample Qual</b>	<b>DU Result</b>	<b>DU Qual</b>	<b>Uncert. (2σ+/-)</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>RER</b>	<b>RER Limit</b>
Tl-208	0.467		0.4207		0.0674		0.0443	pCi/g	0.34	1

TestAmerica St. Louis



# QC Association Summary

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

TestAmerica Job ID: 160-11841-1

## Metals

### Prep Batch: 191187

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	None	
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	None	
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	None	
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	None	
160-11861-A-15-B MS	Matrix Spike	Total/NA	Solid	None	
160-11861-A-15-C MSD	Matrix Spike Duplicate	Total/NA	Solid	None	
LCS 160-191187/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-191187/1-A	Method Blank	Total/NA	Solid	None	

### Analysis Batch: 191454

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	6020A	191187
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	6020A	191187
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	6020A	191187
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	6020A	191187
160-11861-A-15-B MS	Matrix Spike	Total/NA	Solid	6020A	191187
160-11861-A-15-C MSD	Matrix Spike Duplicate	Total/NA	Solid	6020A	191187
LCS 160-191187/2-A	Lab Control Sample	Total/NA	Solid	6020A	191187
MB 160-191187/1-A	Method Blank	Total/NA	Solid	6020A	191187

## General Chemistry

### Analysis Batch: 190916

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

## Rad

### Prep Batch: 191187

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	None	
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	None	
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	None	
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	None	
160-11861-A-15-B MS	Matrix Spike	Total/NA	Solid	None	
160-11861-A-15-C MSD	Matrix Spike Duplicate	Total/NA	Solid	None	
LCS 160-191187/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-191187/1-A	Method Blank	Total/NA	Solid	None	

### Leach Batch: 191189

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

TestAmerica St. Louis

## QC Association Summary

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

TestAmerica Job ID: 160-11841-1

### Rad (Continued)

#### Prep Batch: 191719

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11841-1	L10-13-14-B-E-B-00	Total/NA	Solid	Fill_Geo-0	191189
160-11841-1 DU	L10-13-14-B-E-B-00	Total/NA	Solid	Fill_Geo-0	191189
160-11841-2	L10-13-15-B-E-B-00	Total/NA	Solid	Fill_Geo-0	191189
160-11841-3	L10-14-13-B-E-B-00	Total/NA	Solid	Fill_Geo-0	191189
160-11841-4	L10-14-14-B-E-B-00	Total/NA	Solid	Fill_Geo-0	191189
LCS 160-191719/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-0	
MB 160-191719/1-A	Method Blank	Total/NA	Solid	Fill_Geo-0	

## Tracer/Carrier Summary

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

TestAmerica Job ID: 160-11841-1

**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)
160-11841-1	L10-13-14-B-E-B-00	86
160-11841-2	L10-13-15-B-E-B-00	87
160-11841-3	L10-14-13-B-E-B-00	89
160-11841-4	L10-14-14-B-E-B-00	91
160-11861-A-15-B MS	Matrix Spike	89
160-11861-A-15-C MSD	Matrix Spike Duplicate	88
LCS 160-191187/2-A	Lab Control Sample	93
MB 160-191187/1-A	Method Blank	94

### Tracer/Carrier Legend

Re = Re