

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: 160-14366-2
Client Project/Site: HDP

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

Attn: Brian Miller



Authorized for release by:
11/17/2015 12:14:54 AM

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

LINKS

Review your project
results through
TotalAccess

Have a Question?



Visit us at:
www.testamericainc.com

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.

1
2
3
4
5
6
7
8
9
10
11



Table of Contents

Cover Page	1
Table of Contents	2
Case Narrative	3
Chain of Custody	4
Receipt Checklists	5
Definitions/Glossary	6
Method Summary	7
Sample Summary	8
Client Sample Results	9
QC Sample Results	10
QC Association Summary	12

Case Narrative

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

TestAmerica Job ID: 160-14366-2

Job ID: 160-14366-2

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-14366-2

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

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

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

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

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

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

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

RECEIPT

The samples were received on 10/20/2015 11:10 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 20.3° C.

RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)

Samples L03-02-25-P-S-B-00 (160-14366-1) and L03-02-26-P-S-B-00 (160-14366-2) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA_01_R. The samples were leached on 10/20/2015, prepared on 10/21/2015 and analyzed on 11/12/2015.

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

Earth City, MO 63045
phone 314.298.8566 fax

Regulatory Program: DW NPDES RCRA Other:

TestAmerica Laboratories, Inc.

Client Contact Perma-Fix Environmental Services 2800 Solway Road Knoxville, TN 37931 (865) 690-0501 Phone (865) 539-9868 FAX Project Name: Hematite Decommissioning Project Site: Westinghouse Hematite, MO P O # 832953		Project Manager: Brian Miller Tel/Fax: (314) 810-3333		Site Contact: Ellen Jakub Lab Contact: Ivan Vania		Date: 10/20/2015 Carrier: Courier		COC No: 102015-FSS1 1 of 1 COCs Sampler: For Lab Use Only: Walk-in Client: Lab Sampling: Job / SDG No.:				
		Analysis Turnaround Time <input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____ <input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day										
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 post-21 day ingrowth)	Sample Specific Notes:
L03-02-25-P-S-B-00	10/19/15	1545	G	Soil	1	N	X	X	X			Matt Cushman
L03-02-26-P-S-B-00	10/19/15	1535	G	Soil	1	N	X	X	X			Matt Cushman
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. <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: Potential for Radiological Contamination												
Custody Seals Intact: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____ Corr'd: _____		Therm ID No.:						
Relinquished by: <i>Brian Miller</i>		Company: Perma-Fix		Date/Time: 10-20-15/0905		Received by: <i>K. Miller</i>		Company: Cross Roads		Date/Time: 10-20-15 09:05		
Relinquished by: <i>K. Miller</i>		Company: Cross Roads		Date/Time: 10-20-15/1110		Received by: <i>Debra O'Brien</i>		Company: Abstracts		Date/Time: 10-20-15/1110		
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:		



Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-14366-2

Login Number: 14366

List Source: TestAmerica St. Louis

List Number: 1

Creator: Clarke, Jill C

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 <math><6\text{mm}</math> (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Definitions/Glossary

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

TestAmerica Job ID: 160-14366-2

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.
F	Duplicate RPD exceeds the control 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: 160-14366-2

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: 160-14366-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-14366-1	L03-02-25-P-S-B-00	Solid	10/19/15 15:45	10/20/15 11:10
160-14366-2	L03-02-26-P-S-B-00	Solid	10/19/15 15:35	10/20/15 11:10

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11

Client Sample Results

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

TestAmerica Job ID: 160-14366-2

Client Sample ID: L03-02-25-P-S-B-00

Lab Sample ID: 160-14366-1

Date Collected: 10/19/15 15:45

Matrix: Solid

Date Received: 10/20/15 11:10

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	0.978		0.177	0.203		0.114	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Bismuth 212	0.656		0.383	0.389		0.561	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Bismuth 214	1.01		0.119	0.159		0.0786	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Lead 212	0.936		0.109	0.163		0.101	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Lead 214	1.11		0.107	0.157		0.0830	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Potassium 40	18.5		1.40	2.35		0.326	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Protactinium 231	0.476	U	0.537	0.539		0.876	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Radium 226	1.01		0.119	0.159	1.00	0.0786	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Thorium 232	0.978		0.177	0.203		0.114	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Thorium 234	1.49		0.582	0.602		0.905	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Uranium 235	0.158	U	0.159	0.160		0.251	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Americium 241	0.0113	U	0.0662	0.0662		0.112	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Protactinium 234m	0.000	U	2.52	2.52		8.45	pCi/g	10/21/15 13:17	11/12/15 13:13	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.333		0.0555	0.0654		0.0415	pCi/g	10/21/15 13:17	11/12/15 13:13	1

Client Sample ID: L03-02-26-P-S-B-00

Lab Sample ID: 160-14366-2

Date Collected: 10/19/15 15:35

Matrix: Solid

Date Received: 10/20/15 11:10

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	0.935		0.101	0.139		0.0817	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Bismuth 212	1.38		0.343	0.372		0.277	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Bismuth 214	0.908		0.0903	0.131		0.0606	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Lead 212	0.809		0.0665	0.124		0.0575	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Lead 214	1.02		0.0738	0.129		0.0581	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Potassium 40	16.6		1.00	1.97		0.347	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Protactinium 231	0.532	U	0.282	0.288		0.908	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Radium 226	0.908		0.0903	0.131	1.00	0.0606	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Thorium 232	0.935		0.101	0.139		0.0817	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Thorium 234	1.12		0.466	0.480		0.735	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Uranium 235	0.133	U	0.101	0.102		0.160	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Americium 241	-0.0152	U	0.0543	0.0544		0.0910	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Protactinium 234m	1.28	U	2.18	2.18		3.83	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.82		0.623	0.658		0.727	pCi/g	10/21/15 13:17	11/12/15 13:38	1
Tl-208	0.260		0.0365	0.0454		0.0294	pCi/g	10/21/15 13:17	11/12/15 13:38	1

QC Sample Results

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

TestAmerica Job ID: 160-14366-2

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

Lab Sample ID: MB 160-217775/1-A
Matrix: Solid
Analysis Batch: 221606

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 217775

Analyte	MB MB		Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Actinium 228	0.0000	U	0.0276	0.0276		0.0576	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Bismuth 212	-0.01814	U	0.112	0.112		0.209	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Bismuth 214	-0.003437	U	0.0295	0.0295		0.0333	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Lead 212	0.006537	U	0.0114	0.0114		0.0209	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Lead 214	0.002047	U	0.0146	0.0146		0.0298	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Potassium 40	-0.01089	U	0.119	0.119		0.219	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Protactinium 231	0.01393	U	0.122	0.122		0.310	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Radium 226	-0.003437	U	0.0295	0.0295	1.00	0.0333	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Thorium 232	0.0000	U	0.0276	0.0276		0.0576	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Thorium 234	-0.01167	U	0.159	0.159		0.287	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Uranium 235	0.002861	U	0.0456	0.0456		0.0833	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Americium 241	0.01027	U	0.0133	0.0134		0.0220	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Protactinium 234m	0.06461	U	0.997	0.997		2.09	pCi/g	10/21/15 13:17	11/12/15 10:21	1
Other Detected Radionuclides	MB MB		Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Other Detected Radionuclide	None						pCi/g	10/21/15 13:17	11/12/15 10:21	1

Lab Sample ID: LCS 160-217775/2-A
Matrix: Solid
Analysis Batch: 221712

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 217775

Analyte	Spike Added	LCS Result	LCS Qual	Total	RL	MDC	Unit	%Rec	%Rec.
				Uncert. (2σ+/-)					Limits
Americium 241	101	102.2		10.6		0.606	pCi/g	101	87 - 116
Cesium 137	34.4	34.06		3.58		0.193	pCi/g	99	87 - 120
Cobalt 60	33.4	32.60		3.30		0.102	pCi/g	98	87 - 115

Lab Sample ID: 160-14346-A-1-F DU
Matrix: Solid
Analysis Batch: 221715

Client Sample ID: Duplicate
Prep Type: Total/NA
Prep Batch: 217775

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total	RL	MDC	Unit	RER	RER
					Uncert. (2σ+/-)					Limit
Actinium 228	1.03		0.9859		0.156		0.0902	pCi/g	0.13	1
Bismuth 212	1.18		1.289		0.381		0.297	pCi/g	0.14	1
Bismuth 214	0.972		0.8877		0.132		0.0692	pCi/g	0.30	1
Lead 212	0.908		0.9494		0.143		0.0611	pCi/g	0.15	1
Lead 214	1.14		1.105		0.145		0.0621	pCi/g	0.11	1
Potassium 40	17.2		17.06		2.06		0.449	pCi/g	0.03	1
Protactinium 231	-0.464	U	0.4920	U F	0.264		0.919	pCi/g	1.06	1
Radium 226	0.972		0.8877		0.132	1.00	0.0692	pCi/g	0.30	1
Thorium 232	1.03		0.9859		0.156		0.0902	pCi/g	0.13	1
Thorium 234	2.40		2.449		0.599		0.796	pCi/g	0.04	1
Uranium 235	0.602		0.6396		0.154		0.181	pCi/g	0.10	1
Americium 241	-0.00074	U	-0.00145	U	0.0575		0.0970	pCi/g	0.01	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-14366-2

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

Lab Sample ID: 160-14346-A-1-F DU
Matrix: Solid
Analysis Batch: 221715

Client Sample ID: Duplicate
Prep Type: Total/NA
Prep Batch: 217775

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER
										Limit
Protactinium 234m	3.85	U	4.001	U	1.78		5.04	pCi/g	0.03	1

Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER
										Limit
Tl-208	0.345		0.3137		0.0560		0.0368	pCi/g	0.27	1



QC Association Summary

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

TestAmerica Job ID: 160-14366-2

Rad

Leach Batch: 217185

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14346-A-1-F DU	Duplicate	Total/NA	Solid	Dry and Grind	

Leach Batch: 217466

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	Dry and Grind	
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 217775

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14346-A-1-F DU	Duplicate	Total/NA	Solid	Fill_Geo-21	217185
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	Fill_Geo-21	217466
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	Fill_Geo-21	217466
LCS 160-217775/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-217775/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	