RESUBMISSION
Gamma Spectroscopy
Case Narrative

Tidewater, Inc.
Phase 1 RI OU2 Great Kills Park – 2016-007

Work Order Number: 1810627

1. **This data is being resubmitted in order to accommodate a change in the gamma library.**

2. This report consists of analytical results and supporting documentation for 22 soil samples and seven sediment received by ALS on 10/30/2018.

3. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 11/05/2018 and stored for at least 29 days to allow ^{222}Rn to approach secular equilibrium with its parent, ^{226}Ra. The degree of ingrowth achieved prior to analysis is at least 99.48%. Conservatively assuming a radon emanation efficiency of approximately 50%, the effective radon progeny ingrowth for these samples would be greater than 99.74%.

4. The samples were analyzed for the presence of gamma emitting radionuclides according to the current revision of SOP713. The analyses were completed on 12/06/2018.

5. The analysis results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

6. Activity concentrations above the calculated MDC are reported in some instances where minimum nuclide identification criteria are not met. Such tentative identifications result when the software attempts to calculate net activity concentrations for analytes where either one or both of the following criteria are not satisfied: the ‘diagnostic’ peak for a nuclide must be identified above the critical level, or the minimum library peak abundance must be attained. Nuclides not meeting these requirements have been flagged with a “TI” qualifier.

7. In cases where there are no peaks found in the peak search routine, the software performs a net quantification. This indicates that nuclides are not detected or supported at any level above the reported MDC. Consequently, these nuclides are flagged with an “NQ” qualifier on the final reports. Please refer to the Technical Bulletin Addendum in section 5 of this report.

8. ALS has found there to be a significant low bias to ^{214}Pb and ^{214}Bi results when using a mixed nuclide gamma source for efficiency calibrations. The magnitude of this bias has been determined to be approximately 32% for ^{214}Bi, and 23% for ^{214}Pb. Therefore, any reported results for ^{214}Pb and ^{214}Bi are flagged with a "J" qualifier, indicating the activity values to be an estimated value. Results are reported without further qualification.

9. The gamma emission energy of ^{210}Pb falls below the minimum calibrated value of 59.54 keV at 46.5 keV. The reported activity should be considered an estimated value. Results are reported without further qualification. Therefore, any reported results for ^{210}Pb are flagged with a "J" qualifier, indicating the activity values to be an estimated value. Results are reported without further qualification.

10. Radium-226 quantification based on the 186.21 keV photon suffers from interference with the 185.72 keV photon emitted by ^{235}U. Due to the high abundance of this photon in ^{235}U emissions, even small amounts of ^{235}U may bias the ^{226}Ra results high. Thus, any measured activity for ^{226}Ra has been flagged with an "SI" qualifier, denoting spectral interference.

11. There are cases where the sample density is less or greater than the associated calibration standard density. Cases that exceed the limit of +/- 15% of the density of the calibration standard are flagged with a 'G', denoting a significant density difference between the sample and calibration standard. Consequently, the results may be biased high for the flagged results where sample density is less than the standard density, and low where sample density is greater than the standard density. If requested, ALS can perform a transmission spike in order to estimate a magnitude of this bias. The results are reported without further qualification.

12. Technical considerations made in the creation of the gamma spectroscopy library used in this analysis are detailed in the document "Technical Comments Regarding Gamma Spectroscopy Libraries" found in Section 5.

13. The requested MDC for/or ^{214}Bi and ^{214}Pb were not met for some samples. The reported activity exceeds the achieved MDC. The samples were counted for a maximum count time of 1000 minutes. The results are flagged with an "M3" flag on the final reports.

14. There are cases where the magnitude of negative activity is greater than the 2σ TPU. Under typical conditions, where background data is normally distributed and analyzed by paired observations, this event is likely to occur at least 2.5% of the time. Review of the data does not indicate a problem with the instrument or reporting systems and results are reported without further qualification.

15. No further problems were encountered with either the client samples or the associated quality control samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Pik Yee Yuen — 1/8/19

Pik Yee Yuen
Radiochemistry Primary Data Reviewer

Date

1/8/18

Radiochemistry Final Data Reviewer

Date

1

Section 1

CHAIN OF CUSTODY

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1810627
Client Name: Tidewater, Inc.
Client Project Name: Phase 1 RI OU2 Great Kills Park
Client Project Number: 2016-007
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
OU2-1-SE001	1810627-1		SEDIMEN	22-Oct-18	9:00
OU2-1-SE002	1810627-2		SEDIMEN	22-Oct-18	10:10
OU2-1-SE004	1810627-3		SEDIMEN	22-Oct-18	11:30
OU2-1-SE004-DUP	1810627-4		SEDIMEN	22-Oct-18	11:30
OU2-1-SE003	1810627-5		SEDIMEN	22-Oct-18	14:35
OU1-1-SE005	1810627-6		SEDIMEN	23-Oct-18	8:35
REF-1-SE001	1810627-7		SEDIMEN	23-Oct-18	9:10
OU2-1-SS007	1810627-8		SOIL	23-Oct-18	10:45
OU2-1-SS003	1810627-9		SOIL	23-Oct-18	11:05
OU2-1-SS001	1810627-10		SOIL	23-Oct-18	11:20
OU2-1-SS005	1810627-11		SOIL	23-Oct-18	11:45
OU2-1-SS005-DUP	1810627-12		SOIL	23-Oct-18	11:45
OU2-1-SS004	1810627-13		SOIL	24-Oct-18	9:15
OU2-1-SS006	1810627-14		SOIL	24-Oct-18	9:50
OU2-1-SS002	1810627-15		SOIL	24-Oct-18	10:45
OU2-1-SS008	1810627-16		SOIL	24-Oct-18	11:30
OU2-1-SU002-07	1810627-17		SOIL	25-Oct-18	11:10
OU2-1-SU004-10	1810627-18		SOIL	25-Oct-18	14:30
OU2-1-SU004-16	1810627-19		SOIL	25-Oct-18	15:10
OU2-1-SU004-29	1810627-20		SOIL	25-Oct-18	15:45
OU2-1-SU005-01	1810627-21		SOIL	26-Oct-18	9:20
OU2-1-SU005-01-DUP	1810627-22		SOIL	26-Oct-18	9:20
OU2-1-SU005-14	1810627-23		SOIL	26-Oct-18	11:00
OU2-1-SU006-10	1810627-24		SOIL	26-Oct-18	14:45
OU2-1-SU006-13	1810627-25		SOIL	26-Oct-18	15:30
OU2-1-SU008-03	1810627-26		SOIL	26-Oct-18	16:35
OU2-1-SU001-08	1810627-27		SOIL	29-Oct-18	10:10
OU2-1-SU003-09	1810627-28		SOIL	29-Oct-18	11:35
OU2-1-SU007-08	1810627-29		SOIL	29-Oct-18	12:45

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #: 1810627

TURNAROUND TIME		SAMPLER	John C Schroeder	PAGE	1 of 3
PROJECT NAME	GKP Phase I RI OU2	SITE ID		DISPOSAL	BY LAB or RETURN
PROJECT No.	2016-007	EDD FORMAT	contact Ryan Wensink	PARAMETER/METHOD REQUEST FOR ANALYSIS	
		PURCHASE ORDER		A	Uranium-238
COMPANY NAME	Tidewater	BILL TO COMPANY	Tidewater	B	Radium-226 (EPA 901.1m)
SEND REPORT TO	Ryan Wensink (Tidewater)	INVOICE ATTN TO	Ryan Wensink	C	Thorium-232
ADDRESS	Devon Chicoine (AECOM)	ADDRESS	3761 Attucks Drive	D	
CITY / STATE / ZIP	devon.chicoine@aecom.com	CITY / STATE / ZIP	Powell OH 43065	E	
PHONE	703-966-5484	PHONE	614-389-6251	F	
FAX	Colleen Scott	FAX		G	
E-MAIL	colleen.scott@aecom.com	E-MAIL	ryan.wensink@tideh2o.net	H	
				I	
				J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
1	OU2-1-SE001	sediment	102218	0900	1			X	X	X								
2	OU2-1-SE002	sediment	102218	1010	1			X	X	X								
3	OU2-1-SE004	sediment	102218	1130	3		MS/MSD	X	X	X								
4	OU2-1-SE004-DUP	sediment	102218	1130	1		duplicate	X	X	X								
5	OU2-1-SE003	sediment	102218	1435	1			X	X	X								
6	OU1-1-SE005	sediment	102318	0835	1			X	X	X								
7	REF-1-SE001	sediment	102318	0910	1			X	X	X								
8	OU2-1-SS007	soil	102318	1045	1			X	X	X								
9	OU2-1-SS003	soil	102318	1105	1			X	X	X								
10	OU2-1-SS001	soil	102318	1120	1			X	X	X								
11	OU2-1-SS005	soil	102318	1145	1			X	X	X								
12	OU2-1-SS005-DUP	soil	102318	1145	1		duplicate	X	X	X								

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES

6 of 624

REPORT LEVEL / QC REQUIRED	
	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		John C Schroeder	10/29/18	1800
RECEIVED BY	Fed Ex	Fed Ex	10/29/18	1800
RELINQUISHED BY		FEDEX	10.30.18	0851
RECEIVED BY		KELI-JEAN SMITH	10.30.18	0851
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

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Chain-of-Custody

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ALS WORKORDER #
1810627

TURNAROUND TIME		SAMPLER	John C Schroeder	PAGE	2 of 3
SITE ID				DISPOSAL	BY LAB or RETURN

PROJECT NAME	GKP Phase I RI OU2	EDD FORMAT	contact Ryan Wensink	PARAMETER/METHOD REQUEST FOR ANALYSIS	
PROJECT No.	2016-067	PURCHASE ORDER		A	Uranium-238
COMPANY NAME	Tidewater	BILL TO COMPANY	Tidewater	B	Radium-226 } EPA 901.1m
SEND REPORT TO	Ryan Wensink (Tidewater)	INVOICE ATTN TO	Ryan Wensink	C	Thorium-232
ADDRESS	Devon Chicoine (AECOM)	ADDRESS	3761 Attucks Drive	D	
CITY / STATE / ZIP	devon.chicoine@aecom.com	CITY / STATE / ZIP	Powell OH 43065	E	
PHONE	703-966-5484	PHONE	614-389-6251	F	
FAX	Colleen Scott	FAX		G	
E-MAIL	colleen.scott@aecom.com	E-MAIL	ryan.wensink@tideh2o.net	H	
				I	
				J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
13	OU2-1-SS004	soil	102418	0915	1			X	X	X								
14	OU2-1-SS006	soil	102418	0950	3		MS/MSD	X	X	X								
15	OU2-1-SS002	soil	102418	1045	1			X	X	X								
16	OU2-1-SS008	soil	102418	1130	1			X	X	X								
17	OU2-1-SU002-07	soil	102518	1110	1			X	X	X								
18	OU2-1-SU004-10	soil	102518	1430	1			X	X	X								
19	OU2-1-SU004-16	soil	102518	1510	1			X	X	X								
20	OU2-1-SU004-29	soil	102518	1545	1			X	X	X								
21	OU2-1-SU005-01	soil	102618	0920	1			X	X	X								
22	OU2-1-SU005-01-DUP	soil	102618	0920	1		duplicate	X	X	X								
23	OU2-1-SU005-14	soil	102618	1100	1			X	X	X								
24	OU2-1-SU006-10	soil	102618	1445	1			X	X	X								

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NOTES	REPORT LEVEL / QC REQUIRED
7 of 624	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

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RELINQUISHED BY		FEDEX	10.30.18	0851
RECEIVED BY		KELI-JEAN SMITH	10.30.18	0851
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

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ALS WORKORDER #
1810027

TURNAROUND TIME		SAMPLER	John C Schroeder	PAGE	3 of 3
PROJECT NAME	GKP Phase 1 RI OU2	SITE ID		DISPOSAL	BY LAB or RETURN
PROJECT No.	2016-007	EDD FORMAT	contact Ryan Wensink	PARAMETER/METHOD REQUEST FOR ANALYSIS	
		PURCHASE ORDER		A	Uranium-238 } EPA 901.1m
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FAX	Colleen Scott	FAX		G	
E-MAIL	colleen.scott@aecom.com	E-MAIL	ryan.wensink@tideh20.net	H	
				I	
				J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
25	OU2-1-SU006-13	soil	102618	1530	1			X	X	X								
26	OU2-1-SU008-03	soil	102618	1635	1			X	X	X								
27	OU2-1-SU001-08	soil	102918	1010	1			X	X	X								
28	OU2-1-SU003-09	soil	102918	1135	1			X	X	X								
29	OU2-1-SU007-08	soil	102918	1245	1			X	X	X								

10/29/18

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
	Summary (Standard QC)
	LEVEL II (Standard QC)
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8 of 624

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

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RELINQUISHED BY		FEDEX	10.30.18	0851
RECEIVED BY		KELI-JEAN SMITH	10.30.18	0851
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TIDEWATER Workorder No: 1810627

Project Manager: LRS Initials: LR Date: 10-30-18

1.	Are airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
2.	Are custody seals on **shipping** containers intact?	NONE	YES	NO
3.	Are custody seals on **sample** containers intact?	NONE	YES	NO
4.	Is there a COC (chain-of-custody) present?		YES	NO
5.	Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)		YES	NO
6.	Are short-hold samples present?		YES	NO
7.	Are all samples within holding times for the requested analyses?		YES	NO
8.	Were all sample containers received intact? (not broken or leaking)		YES	NO
9.	Is there sufficient sample for the requested analyses?		YES	NO
10.	Are all samples in the proper containers for the requested analyses?		YES	NO
11.	Are all aqueous samples preserved correctly, if required? (excluding volatiles)	N/A	YES	NO
12.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
13.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)	N/A	YES	NO
14.	Were the samples shipped on ice?		YES	NO
15.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1							
Temperature (°C):	1.4B							
No. of custody seals on cooler:	2							
DOT Survey/ Acceptance Information — External µR/hr reading:	10							
Background µR/hr reading:	10							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: **Please provide details here for any NO responses to gray-shaded boxes above, or any other issues noted:**

All client bottle ID's vs ALS lab ID's double-checked by: LR

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 10/31/18

Form 201r26.xls
(06/29/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

1810627

FedEx®

ORIGIN ID:LDJA (614) 389-6251
RYAN WENSINK
TIDEWATER
6625 SELNICK DR STE A

ELKRIDGE, MD 21075
UNITED STATES US

SHIP DATE: 29OCT18
ACTWGT: 58.60 LB
CAD: 6997897/SSFO1922
DIMS: 26x14x14 IN

BILL THIRD PARTY

10-2

TO SAMPLE RECEIVING
ALS ENVIRONMENTAL
225 COMMERCE DR

FORT COLLINS CO 80524

(800) 443-1511 REF:
INV:
PO: DEPT:

FedEx Express

TRK# 0201 7834 9646 8949

TUE - 30 OCT 10:30A
PRIORITY OVERNIGHT

AHS
80524
CO-US DEN

NA FTCA

R1616

Section 2

2

SAMPLE RESULTS SUMMARY

Due to the nature of gamma spectroscopy data, a summary report is not provided.

Please refer to the individual sample results in Section 4.

Section 3

QC RESULTS SUMMARY 3

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-1MB
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 182694d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.072 +/- 0.048	0.075		NA	U
13966-02-4	Be-7	-0.063 +/- 0.084	0.146		NA	U
14913-49-6	Bi-212	0.015 +/- 0.092	0.156		NA	U
14733-03-0	Bi-214	0.056 +/- 0.029	0.048	0.2	NA	NQ,J
14694-69-0	Ir-192	0.0014 +/- 0.0088	0.0148		NA	U
13966-00-2	K-40	0.11 +/- 0.36	0.61		NA	U
13966-32-0	Na-22	0.001 +/- 0.014	0.025		NA	U
15100-28-4	Pa-234	0.006 +/- 0.063	0.108		NA	U
14255-04-0	Pb-210	0.8 +/- 3.4	5.6		NA	U,J
15092-94-1	Pb-212	0.007 +/- 0.028	0.046		NA	U
15067-28-4	Pb-214	0.005 +/- 0.051	0.085	0.2	NA	U,J
15623-45-7	Ra-223	0.019 +/- 0.072	0.118		NA	U
13233-32-4	Ra-224	-0.05 +/- 0.19	0.32		NA	U
13982-63-3	Ra-226	-0.19 +/- 0.38	0.64		NA	U,SI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

DL - Decision Level

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-1MB
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 182694d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
15262-20-1	Ra-228	0.072 +/- 0.048	0.075		NA	U
13967-63-0	Sc-46	0.003 +/- 0.012	0.020		NA	U
15064-65-0	TL-201	0.061 +/- 0.034	0.052		NA	NQ
14913-50-9	Tl-208	0.011 +/- 0.012	0.019		NA	U
13966-01-3	TL-210	-0.001 +/- 0.011	0.019		NA	U
15117-96-1	U-235	0.052 +/- 0.053	0.086		NA	U
7440-61-1	U-238	0.06 +/- 0.34	0.57		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
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Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-2MB

Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181830d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.088 +/- 0.068	0.138		NA	U
13966-02-4	Be-7	-0.09 +/- 0.11	0.19		NA	U
14913-49-6	Bi-212	-0.01 +/- 0.14	0.24		NA	U
14733-03-0	Bi-214	0.041 +/- 0.064	0.133	0.2	NA	U,J
14694-69-0	Ir-192	-0.001 +/- 0.012	0.021		NA	U
13966-00-2	K-40	0.14 +/- 0.55	0.92		NA	U
13966-32-0	Na-22	0.008 +/- 0.018	0.030		NA	U
15100-28-4	Pa-234	-0.034 +/- 0.080	0.141		NA	U
14255-04-0	Pb-210	-0.12 +/- 0.67	1.12		NA	U,J
15092-94-1	Pb-212	0.004 +/- 0.050	0.083		NA	U
15067-28-4	Pb-214	0.001 +/- 0.070	0.117	0.2	NA	U,J
15623-45-7	Ra-223	-0.05 +/- 0.15	0.26		NA	U
13233-32-4	Ra-224	-0.15 +/- 0.25	0.42		NA	U
13982-63-3	Ra-226	-0.05 +/- 0.56	0.94		NA	U,SI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

DL - Decision Level

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-2MB
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181830d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
15262-20-1	Ra-228	0.088 +/- 0.068	0.138		NA	U
13967-63-0	Sc-46	0.003 +/- 0.017	0.028		NA	U
15064-65-0	TL-201	0.001 +/- 0.021	0.035		NA	U
14913-50-9	Tl-208	0.033 +/- 0.018	0.028		NA	NQ
13966-01-3	TL-210	-0.009 +/- 0.017	0.030		NA	U
15117-96-1	U-235	0.15 +/- 0.12	0.19		NA	U
7440-61-1	U-238	0.32 +/- 0.43	0.71		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

DL - Decision Level

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-1LCS

Library: ANALYTICAL.LI

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 26-Nov-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181752d09

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
14596-10-2	Am-241	471 +/- 55	2	469.1	100	85 - 115	P
10198-40-0	Co-60	187 +/- 22	1	187.7	99.4	85 - 115	P
10045-97-3	Cs-137	181 +/- 21	1	177.9	102	85 - 115	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Lab ID: GS181103-2LCS

Library: ANALYTICAL.LI

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 03-Nov-18
Date Prepared: 03-Nov-18
Date Analyzed: 27-Nov-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181935d10

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
14596-10-2	Am-241	473 +/- 56	4	469.1	101	85 - 115	P
10198-40-0	Co-60	188 +/- 22	1	187.6	99.9	85 - 115	P
10045-97-3	Cs-137	184 +/- 22	1	177.9	104	85 - 115	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3DUP
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181952d08

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14331-83-0	Ac-228	0.39 +/- 0.14	0.24		0.39 +/- 0.17	0.27	TI	0.024	2.13
13966-02-4	Be-7	-0.06 +/- 0.59	1.05	U	-0.04 +/- 0.54	0.99	U	0.0233	2.13
14913-49-6	Bi-212	0.38 +/- 0.32	0.50	U	0.03 +/- 0.36	0.64	U	0.736	2.13
14733-03-0	Bi-214	0.31 +/- 0.12	0.18	TI,J	0.35 +/- 0.14	0.19	TI,J	0.246	2.13
14694-69-0	Ir-192	0.027 +/- 0.062	0.106	U	-0.006 +/- 0.056	0.100	U	0.394	2.13
13966-00-2	K-40	7.8 +/- 1.5	1.2		7.1 +/- 1.5	1.0		0.35	2.13
13966-32-0	Na-22	0.015 +/- 0.042	0.074	U	-0.037 +/- 0.049	0.103	U	0.811	2.13
15100-28-4	Pa-234	-0.16 +/- 0.19	0.38	U	0.03 +/- 0.23	0.41	U	0.653	2.13
14255-04-0	Pb-210	-48 +/- 50	92	U,J	0.8 +/- 1.3	2.2	U,J	0.979	2.13
15092-94-1	Pb-212	0.351 +/- 0.098	0.121		0.42 +/- 0.12	0.14		0.427	2.13
15067-28-4	Pb-214	0.34 +/- 0.11	0.20	J	0.37 +/- 0.12	0.19	J	0.163	2.13
15623-45-7	Ra-223	0.10 +/- 0.21	0.36	U	0.14 +/- 0.22	0.37	U	0.152	2.13
13233-32-4	Ra-224	1.93 +/- 0.77	1.04	NQ	1.7 +/- 1.3	2.0	U	0.173	2.13
13982-63-3	Ra-226	0.06 +/- 0.76	1.31	U,SI	0.54 +/- 0.69	1.12	U,SI	0.465	2.13
15262-20-1	Ra-228	0.39 +/- 0.14	0.24		0.39 +/- 0.17	0.27	TI	0.024	2.13
13967-63-0	Sc-46	-0.049 +/- 0.063	0.120	U	0.009 +/- 0.063	0.114	U	0.661	2.13
15064-65-0	TL-201	2200 +/- 3700	6100	U	-50 +/- 890	1550	U	0.602	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3DUP
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181952d08

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14913-50-9	Tl-208	0.138 +/- 0.054	0.072		0.090 +/- 0.063	0.096	U	0.579	2.13
13966-01-3	TL-210	0.012 +/- 0.037	0.064	U	0.037 +/- 0.043	0.069	U	0.436	2.13
15117-96-1	U-235	-0.03 +/- 0.22	0.39	U	-0.20 +/- 0.22	0.41	U	0.561	2.13
7440-61-1	U-238	-0.13 +/- 0.81	1.41	U	0.25 +/- 0.57	0.95	U	0.38	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 152 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182672d03

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14331-83-0	Ac-228	1.64 +/- 0.21	0.18	G	1.71 +/- 0.23	0.24	G	0.221	2.13
13966-02-4	Be-7	0.03 +/- 0.26	0.43	U,G	-0.05 +/- 0.28	0.48	U,G	0.231	2.13
14913-49-6	Bi-212	1.07 +/- 0.22	0.27	G	1.11 +/- 0.27	0.34	G,TI	0.122	2.13
14733-03-0	Bi-214	1.49 +/- 0.19	0.14	G,J	1.44 +/- 0.19	0.16	G,J	0.161	2.13
14694-69-0	Ir-192	-0.007 +/- 0.024	0.040	U,G	0.012 +/- 0.025	0.042	U,G	0.558	2.13
13966-00-2	K-40	7.5 +/- 1.1	0.8	G	8.0 +/- 1.2	1.0	G	0.258	2.13
13966-32-0	Na-22	0.001 +/- 0.021	0.036	U,G	-0.016 +/- 0.031	0.053	U,G	0.461	2.13
15100-28-4	Pa-234	0.066 +/- 0.088	0.151	U,G	0 +/- 0.11	0.20	U,G	0.468	2.13
14255-04-0	Pb-210	8 +/- 57	95	U,G,J	4 +/- 11	18	U,G,J	0.0678	2.13
15092-94-1	Pb-212	1.89 +/- 0.24	0.11	G	2.05 +/- 0.25	0.10	G	0.464	2.13
15067-28-4	Pb-214	1.53 +/- 0.20	0.13	G,J	1.55 +/- 0.21	0.14	G,J	0.0589	2.13
15623-45-7	Ra-223	0.44 +/- 0.11	0.18	G	0.40 +/- 0.11	0.18	G	0.244	2.13
13233-32-4	Ra-224	2.1 +/- 3.0	0.7	G	1.5 +/- 5.0	1.3	G	0.107	2.13
13982-63-3	Ra-226	2.63 +/- 0.78	1.16	G,SI	2.95 +/- 0.92	1.37	G,SI	0.265	2.13
15262-20-1	Ra-228	1.64 +/- 0.21	0.18	G	1.71 +/- 0.23	0.24	G	0.221	2.13
13967-63-0	Sc-46	-0.011 +/- 0.024	0.042	U,G	-0.006 +/- 0.034	0.058	U,G	0.119	2.13
15064-65-0	TL-201	700 +/- 5800	9600	U,G	-200 +/- 1700	2900	U,G	0.145	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

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Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 152 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182672d03

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14913-50-9	Tl-208	0.553 +/- 0.075	0.052	G	0.583 +/- 0.088	0.088	G	0.258	2.13
13966-01-3	TL-210	0.061 +/- 0.019	0.027	G	0.071 +/- 0.023	0.032	G	0.336	2.13
15117-96-1	U-235	0.27 +/- 0.16	0.25	G,TI	0.15 +/- 0.14	0.23	U,G	0.579	2.13
7440-61-1	U-238	2.43 +/- 0.77	1.16	G	2.26 +/- 0.65	0.94	G,TI	0.175	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 161 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182032d07

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14331-83-0	Ac-228	2.37 +/- 0.30	0.18	G	2.32 +/- 0.30	0.23	G	0.129	2.13
13966-02-4	Be-7	-0.06 +/- 0.29	0.48	U,G	0.01 +/- 0.29	0.49	U,G	0.177	2.13
14913-49-6	Bi-212	1.24 +/- 0.62	1.23	G	1.38 +/- 0.36	0.54	G	0.201	2.13
14733-03-0	Bi-214	2.23 +/- 0.28	0.14	G,J	2.41 +/- 0.32	0.27	M3,G,J	0.408	2.13
14694-69-0	Ir-192	0.007 +/- 0.031	0.052	U,G	-0.006 +/- 0.026	0.044	U,G	0.301	2.13
13966-00-2	K-40	12.3 +/- 1.6	0.9	G	10.9 +/- 1.5	0.9	G	0.646	2.13
13966-32-0	Na-22	-0.001 +/- 0.024	0.040	U,G	0.024 +/- 0.035	0.056	U,G	0.587	2.13
15100-28-4	Pa-234	0.082 +/- 0.055	0.141	U,G	0.08 +/- 0.11	0.18	U,G	0.0268	2.13
14255-04-0	Pb-210	12 +/- 27	44	U,G,J	-21 +/- 87	145	U,G,J	0.364	2.13
15092-94-1	Pb-212	2.89 +/- 0.35	0.09	G	2.72 +/- 0.33	0.11	G	0.353	2.13
15067-28-4	Pb-214	2.83 +/- 0.34	0.12	G,J	2.47 +/- 0.30	0.13	G,J	0.776	2.13
15623-45-7	Ra-223	0.75 +/- 0.15	0.21	G	0.74 +/- 0.17	0.22	G,TI	0.0667	2.13
13233-32-4	Ra-224	1.8 +/- 3.3	0.7	G	2.7 +/- 4.1	1.0	G	0.175	2.13
13982-63-3	Ra-226	4.26 +/- 0.83	1.04	G,SI	4.98 +/- 0.99	1.25	G,SI	0.561	2.13
15262-20-1	Ra-228	2.37 +/- 0.30	0.18	G	2.32 +/- 0.30	0.23	G	0.129	2.13
13967-63-0	Sc-46	0.003 +/- 0.028	0.047	U,G	0.023 +/- 0.030	0.049	U,G	0.488	2.13
15064-65-0	TL-201	540 +/- 860	1410	U,G	-200 +/- 1300	2200	U,G	0.5	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 161 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182032d07

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
14913-50-9	Tl-208	0.79 +/- 0.10	0.05	G	0.77 +/- 0.11	0.08	G	0.129	2.13
13966-01-3	TL-210	0.083 +/- 0.023	0.032	G,TI	0.116 +/- 0.028	0.035	G,TI	0.912	2.13
15117-96-1	U-235	0.22 +/- 0.14	0.23	U,G	0.16 +/- 0.16	0.27	U,G	0.28	2.13
7440-61-1	U-238	3.88 +/- 0.85	1.13	G,TI	4.3 +/- 1.0	1.4	G,TI	0.304	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *GSS1810627-2*

Section 4

INDIVIDUAL SAMPLE RESULTS

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE001
Lab ID: 1810627-1
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 155 minutes
Report Basis: Dry Weight

Final Aliquot: 225 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182668d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.65 +/- 0.17	0.34		NA	
13966-02-4	Be-7	0.04 +/- 0.47	0.82		NA	U
14913-49-6	Bi-212	0.47 +/- 0.35	0.55		NA	U
14733-03-0	Bi-214	0.61 +/- 0.15	0.20	0.2	NA	J
14694-69-0	Ir-192	0 +/- 0.040	0.068		NA	U
13966-00-2	K-40	11.6 +/- 1.9	1.1		NA	
13966-32-0	Na-22	0.003 +/- 0.057	0.100		NA	U
15100-28-4	Pa-234	-0.09 +/- 0.20	0.36		NA	U
14255-04-0	Pb-210	3 +/- 17	29		NA	U,J
15092-94-1	Pb-212	0.77 +/- 0.13	0.11		NA	
15067-28-4	Pb-214	0.61 +/- 0.12	0.15	0.2	NA	J
15623-45-7	Ra-223	0.08 +/- 0.17	0.28		NA	U
13233-32-4	Ra-224	0.4 +/- 5.6	1.5		NA	U
13982-63-3	Ra-226	1.40 +/- 0.97	1.54		NA	U,SI
15262-20-1	Ra-228	0.65 +/- 0.17	0.34		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE001
Lab ID: 1810627-1
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 155 minutes
Report Basis: Dry Weight

Final Aliquot: 225 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182668d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.046 +/- 0.062	0.115		NA	U
15064-65-0	TL-201	-2000 +/- 2500	4300		NA	U
14913-50-9	TI-208	0.223 +/- 0.065	0.083		NA	
13966-01-3	TL-210	0.025 +/- 0.039	0.065		NA	U
15117-96-1	U-235	-0.01 +/- 0.21	0.35		NA	U
7440-61-1	U-238	0.80 +/- 0.74	1.20		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE002
Lab ID: 1810627-2
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 400 minutes
Report Basis: Dry Weight

Final Aliquot: 160 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182685d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.84 +/- 0.15	0.19		NA	G
13966-02-4	Be-7	0.08 +/- 0.40	0.68		NA	U,G
14913-49-6	Bi-212	0.48 +/- 0.32	0.50		NA	U,G
14733-03-0	Bi-214	0.81 +/- 0.14	0.19	0.2	NA	G,J
14694-69-0	Ir-192	-0.007 +/- 0.035	0.060		NA	U,G
13966-00-2	K-40	10.5 +/- 1.6	1.0		NA	G
13966-32-0	Na-22	-0.018 +/- 0.044	0.077		NA	U,G
15100-28-4	Pa-234	0.06 +/- 0.12	0.26		NA	U,G
14255-04-0	Pb-210	9.0 +/- 9.7	15.8		NA	U,G,J
15092-94-1	Pb-212	1.06 +/- 0.15	0.09		NA	G
15067-28-4	Pb-214	0.84 +/- 0.13	0.14	0.2	NA	G,J
15623-45-7	Ra-223	0.25 +/- 0.15	0.24		NA	G,TI
13233-32-4	Ra-224	1.0 +/- 3.6	0.9		NA	G
13982-63-3	Ra-226	1.39 +/- 0.74	1.16		NA	G,SI
15262-20-1	Ra-228	0.84 +/- 0.15	0.19		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE002
Lab ID: 1810627-2
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 400 minutes
Report Basis: Dry Weight

Final Aliquot: 160 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182685d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.021 +/- 0.045	0.075		NA	U,G
15064-65-0	TL-201	1100 +/- 1500	2500		NA	U,G
14913-50-9	TI-208	0.272 +/- 0.059	0.071		NA	G
13966-01-3	TL-210	0.047 +/- 0.031	0.048		NA	U,G
15117-96-1	U-235	0.10 +/- 0.16	0.26		NA	U,G
7440-61-1	U-238	1.21 +/- 0.71	1.13		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 209 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181897d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.39 +/- 0.14	0.24		NA	
13966-02-4	Be-7	-0.06 +/- 0.59	1.05		NA	U
14913-49-6	Bi-212	0.38 +/- 0.32	0.50		NA	U
14733-03-0	Bi-214	0.31 +/- 0.12	0.18	0.2	NA	TI,J
14694-69-0	Ir-192	0.027 +/- 0.062	0.106		NA	U
13966-00-2	K-40	7.8 +/- 1.5	1.2		NA	
13966-32-0	Na-22	0.015 +/- 0.042	0.074		NA	U
15100-28-4	Pa-234	-0.16 +/- 0.19	0.38		NA	U
14255-04-0	Pb-210	-48 +/- 50	92		NA	U,J
15092-94-1	Pb-212	0.351 +/- 0.098	0.121		NA	
15067-28-4	Pb-214	0.34 +/- 0.11	0.20	0.2	NA	J
15623-45-7	Ra-223	0.10 +/- 0.21	0.36		NA	U
13233-32-4	Ra-224	1.93 +/- 0.77	1.04		NA	NQ
13982-63-3	Ra-226	0.06 +/- 0.76	1.31		NA	U,SI
15262-20-1	Ra-228	0.39 +/- 0.14	0.24		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 209 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181897d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.049 +/- 0.063	0.120		NA	U
15064-65-0	TL-201	2200 +/- 3700	6100		NA	U
14913-50-9	TI-208	0.138 +/- 0.054	0.072		NA	
13966-01-3	TL-210	0.012 +/- 0.037	0.064		NA	U
15117-96-1	U-235	-0.03 +/- 0.22	0.39		NA	U
7440-61-1	U-238	-0.13 +/- 0.81	1.41		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3DUP
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181952d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.39 +/- 0.17	0.27		NA	TI
13966-02-4	Be-7	-0.04 +/- 0.54	0.99		NA	U
14913-49-6	Bi-212	0.03 +/- 0.36	0.64		NA	U
14733-03-0	Bi-214	0.35 +/- 0.14	0.19	0.2	NA	TI,J
14694-69-0	Ir-192	-0.006 +/- 0.056	0.100		NA	U
13966-00-2	K-40	7.1 +/- 1.5	1.0		NA	
13966-32-0	Na-22	-0.037 +/- 0.049	0.103		NA	U
15100-28-4	Pa-234	0.03 +/- 0.23	0.41		NA	U
14255-04-0	Pb-210	0.8 +/- 1.3	2.2		NA	U,J
15092-94-1	Pb-212	0.42 +/- 0.12	0.14		NA	
15067-28-4	Pb-214	0.37 +/- 0.12	0.19	0.2	NA	J
15623-45-7	Ra-223	0.14 +/- 0.22	0.37		NA	U
13233-32-4	Ra-224	1.7 +/- 1.3	2.0		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004
Lab ID: 1810627-3DUP
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181952d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.54 +/- 0.69	1.12		NA	U,SI
15262-20-1	Ra-228	0.39 +/- 0.17	0.27		NA	TI
13967-63-0	Sc-46	0.009 +/- 0.063	0.114		NA	U
15064-65-0	TL-201	-50 +/- 890	1550		NA	U
14913-50-9	TI-208	0.090 +/- 0.063	0.096		NA	U
13966-01-3	TL-210	0.037 +/- 0.043	0.069		NA	U
15117-96-1	U-235	-0.20 +/- 0.22	0.41		NA	U
7440-61-1	U-238	0.25 +/- 0.57	0.95		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004-DUP
Lab ID: 1810627-4
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 217 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181815d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.31 +/- 0.12	0.26		NA	
13966-02-4	Be-7	-0.09 +/- 0.48	0.87		NA	U
14913-49-6	Bi-212	0.42 +/- 0.36	0.56		NA	U
14733-03-0	Bi-214	0.29 +/- 0.12	0.18	0.2	NA	TI,J
14694-69-0	Ir-192	-0.016 +/- 0.047	0.084		NA	U
13966-00-2	K-40	7.9 +/- 1.5	0.9		NA	
13966-32-0	Na-22	-0.008 +/- 0.049	0.092		NA	U
15100-28-4	Pa-234	0.05 +/- 0.19	0.34		NA	U
14255-04-0	Pb-210	0.22 +/- 0.92	1.56		NA	U,J
15092-94-1	Pb-212	0.41 +/- 0.11	0.13		NA	
15067-28-4	Pb-214	0.46 +/- 0.11	0.15	0.2	NA	J
15623-45-7	Ra-223	0.04 +/- 0.22	0.37		NA	U
13233-32-4	Ra-224	0.5 +/- 1.1	1.8		NA	U
13982-63-3	Ra-226	0.8 +/- 1.0	1.7		NA	U,SI
15262-20-1	Ra-228	0.31 +/- 0.12	0.26		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE004-DUP
Lab ID: 1810627-4
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 217 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181815d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.040 +/- 0.050	0.082		NA	U
15064-65-0	TL-201	640 +/- 740	1200		NA	U
14913-50-9	TI-208	0.164 +/- 0.065	0.089		NA	
13966-01-3	TL-210	0.029 +/- 0.040	0.065		NA	U
15117-96-1	U-235	-0.06 +/- 0.18	0.32		NA	U
7440-61-1	U-238	0.27 +/- 0.46	0.77		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE003
Lab ID: 1810627-5
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 214 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182187d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.47 +/- 0.14	0.26		NA	
13966-02-4	Be-7	0.09 +/- 0.50	0.87		NA	U
14913-49-6	Bi-212	0.20 +/- 0.31	0.51		NA	U
14733-03-0	Bi-214	0.48 +/- 0.13	0.18	0.2	NA	TI,J
14694-69-0	Ir-192	0.013 +/- 0.048	0.081		NA	U
13966-00-2	K-40	8.3 +/- 1.5	1.1		NA	
13966-32-0	Na-22	-0.011 +/- 0.048	0.087		NA	U
15100-28-4	Pa-234	-0.21 +/- 0.17	0.34		NA	U
14255-04-0	Pb-210	10 +/- 100	180		NA	U,J
15092-94-1	Pb-212	0.67 +/- 0.13	0.14		NA	
15067-28-4	Pb-214	0.56 +/- 0.12	0.16	0.2	NA	J
15623-45-7	Ra-223	0.29 +/- 0.20	0.32		NA	U
13233-32-4	Ra-224	0.2 +/- 5.6	1.5		NA	U
13982-63-3	Ra-226	1.13 +/- 0.86	1.37		NA	U,SI
15262-20-1	Ra-228	0.47 +/- 0.14	0.26		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SE003
Lab ID: 1810627-5
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 22-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 214 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182187d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.006 +/- 0.049	0.086		NA	U
15064-65-0	TL-201	2300 +/- 6000	10000		NA	U
14913-50-9	TI-208	0.171 +/- 0.057	0.074		NA	
13966-01-3	TL-210	0.058 +/- 0.033	0.048		NA	TI
15117-96-1	U-235	0.01 +/- 0.22	0.38		NA	U
7440-61-1	U-238	-0.06 +/- 0.90	1.53		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU1-1-SE005
Lab ID: 1810627-6
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 60 minutes
Report Basis: Dry Weight

Final Aliquot: 254 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181992d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.24 +/- 0.11	0.21		NA	G
13966-02-4	Be-7	0.17 +/- 0.35	0.59		NA	U,G
14913-49-6	Bi-212	0.25 +/- 0.18	0.28		NA	U,G
14733-03-0	Bi-214	0.29 +/- 0.11	0.17	0.2	NA	G,TI,J
14694-69-0	Ir-192	0.009 +/- 0.041	0.069		NA	U,G
13966-00-2	K-40	8.1 +/- 1.3	0.9		NA	G
13966-32-0	Na-22	0.019 +/- 0.035	0.058		NA	U,G
15100-28-4	Pa-234	-0.01 +/- 0.14	0.25		NA	U,G
14255-04-0	Pb-210	-2.4 +/- 6.4	11.1		NA	U,G,J
15092-94-1	Pb-212	0.426 +/- 0.095	0.108		NA	G
15067-28-4	Pb-214	0.343 +/- 0.097	0.157	0.2	NA	G,J
15623-45-7	Ra-223	0.18 +/- 0.17	0.28		NA	U,G
13233-32-4	Ra-224	0.62 +/- 0.67	1.10		NA	U,G
13982-63-3	Ra-226	0.33 +/- 0.77	1.29		NA	U,G,SI
15262-20-1	Ra-228	0.24 +/- 0.11	0.21		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU1-1-SE005
Lab ID: 1810627-6
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 60 minutes
Report Basis: Dry Weight

Final Aliquot: 254 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181992d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.026 +/- 0.043	0.071		NA	U,G
15064-65-0	TL-201	200 +/- 1400	2300		NA	U,G
14913-50-9	TI-208	0.075 +/- 0.043	0.066		NA	G
13966-01-3	TL-210	0.016 +/- 0.030	0.050		NA	U,G
15117-96-1	U-235	0.03 +/- 0.19	0.32		NA	U,G
7440-61-1	U-238	0.10 +/- 0.51	0.86		NA	U,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: REF-1-SE001
Lab ID: 1810627-7
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 171 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182018d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.49 +/- 0.13	0.26		NA	G
13966-02-4	Be-7	0.04 +/- 0.40	0.68		NA	U,G
14913-49-6	Bi-212	0.29 +/- 0.37	0.61		NA	U,G
14733-03-0	Bi-214	0.51 +/- 0.12	0.19	0.2	NA	G,J
14694-69-0	Ir-192	0 +/- 0.037	0.063		NA	U,G
13966-00-2	K-40	7.3 +/- 1.3	1.1		NA	G
13966-32-0	Na-22	0.003 +/- 0.036	0.063		NA	U,G
15100-28-4	Pa-234	-0.06 +/- 0.15	0.27		NA	U,G
14255-04-0	Pb-210	12 +/- 57	95		NA	U,G,J
15092-94-1	Pb-212	0.64 +/- 0.12	0.12		NA	G
15067-28-4	Pb-214	0.49 +/- 0.10	0.14	0.2	NA	G,J
15623-45-7	Ra-223	0.22 +/- 0.19	0.30		NA	U,G
13233-32-4	Ra-224	0.9 +/- 4.9	1.3		NA	U,G
13982-63-3	Ra-226	1.13 +/- 0.94	1.51		NA	U,G,SI
15262-20-1	Ra-228	0.49 +/- 0.13	0.26		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: REF-1-SE001
Lab ID: 1810627-7
Library: TIDEWATER_G

Sample Matrix: SEDIMENT
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-1
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 171 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182018d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.051 +/- 0.047	0.087		NA	U,G
15064-65-0	TL-201	3000 +/- 2500	3900		NA	U,G
14913-50-9	TI-208	0.146 +/- 0.061	0.092		NA	G
13966-01-3	TL-210	0.040 +/- 0.032	0.050		NA	U,G
15117-96-1	U-235	0.13 +/- 0.15	0.25		NA	U,G
7440-61-1	U-238	0.47 +/- 0.88	1.46		NA	U,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS007
Lab ID: 1810627-8
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 258 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182154d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.26 +/- 0.16	0.30		NA	U,G
13966-02-4	Be-7	-0.19 +/- 0.52	0.95		NA	U,G
14913-49-6	Bi-212	0.25 +/- 0.32	0.52		NA	U,G
14733-03-0	Bi-214	0.33 +/- 0.13	0.17	0.2	NA	G,TI,J
14694-69-0	Ir-192	-0.005 +/- 0.047	0.084		NA	U,G
13966-00-2	K-40	7.2 +/- 1.5	1.3		NA	G
13966-32-0	Na-22	0.015 +/- 0.051	0.090		NA	U,G
15100-28-4	Pa-234	0.01 +/- 0.17	0.32		NA	U,G
14255-04-0	Pb-210	-42 +/- 39	73		NA	U,G,J
15092-94-1	Pb-212	0.261 +/- 0.097	0.133		NA	G
15067-28-4	Pb-214	0.25 +/- 0.12	0.18	0.2	NA	G,J
15623-45-7	Ra-223	-0.02 +/- 0.19	0.33		NA	U,G
13233-32-4	Ra-224	2.0 +/- 1.2	1.7		NA	G,NQ
13982-63-3	Ra-226	0.9 +/- 1.0	1.6		NA	U,G,SI
15262-20-1	Ra-228	0.26 +/- 0.16	0.30		NA	U,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS007
Lab ID: 1810627-8
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 258 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182154d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.004 +/- 0.047	0.086		NA	U,G
15064-65-0	TL-201	500 +/- 2600	4500		NA	U,G
14913-50-9	TI-208	0.142 +/- 0.059	0.078		NA	G
13966-01-3	TL-210	0.003 +/- 0.035	0.064		NA	U,G
15117-96-1	U-235	0.05 +/- 0.18	0.31		NA	U,G
7440-61-1	U-238	0.35 +/- 0.67	1.13		NA	U,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS003
Lab ID: 1810627-9
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 241 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181953d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.34 +/- 0.16	0.26		NA	TI
13966-02-4	Be-7	0.08 +/- 0.48	0.85		NA	U
14913-49-6	Bi-212	0.36 +/- 0.40	0.65		NA	U
14733-03-0	Bi-214	0.27 +/- 0.13	0.19	0.2	NA	TI,J
14694-69-0	Ir-192	-0.014 +/- 0.049	0.089		NA	U
13966-00-2	K-40	7.0 +/- 1.4	0.9		NA	
13966-32-0	Na-22	-0.008 +/- 0.054	0.101		NA	U
15100-28-4	Pa-234	-0.14 +/- 0.21	0.42		NA	U
14255-04-0	Pb-210	1.1 +/- 1.0	1.7		NA	U,J
15092-94-1	Pb-212	0.369 +/- 0.097	0.110		NA	
15067-28-4	Pb-214	0.37 +/- 0.10	0.14	0.2	NA	J
15623-45-7	Ra-223	0 +/- 0.19	0.33		NA	U
13233-32-4	Ra-224	0.6 +/- 6.1	1.6		NA	U
13982-63-3	Ra-226	0.85 +/- 0.95	1.55		NA	U,SI
15262-20-1	Ra-228	0.34 +/- 0.16	0.26		NA	TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS003
Lab ID: 1810627-9
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 75 minutes
Report Basis: Dry Weight

Final Aliquot: 241 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181953d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.013 +/- 0.062	0.110		NA	U
15064-65-0	TL-201	30 +/- 660	1140		NA	U
14913-50-9	TI-208	0.099 +/- 0.058	0.084		NA	
13966-01-3	TL-210	0.033 +/- 0.039	0.063		NA	U
15117-96-1	U-235	0.14 +/- 0.19	0.31		NA	U
7440-61-1	U-238	0.52 +/- 0.48	0.78		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS001
Lab ID: 1810627-10
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 60 minutes
Report Basis: Dry Weight

Final Aliquot: 273 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181993d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.23 +/- 0.12	0.20		NA	G,TI
13966-02-4	Be-7	0.12 +/- 0.32	0.55		NA	U,G
14913-49-6	Bi-212	0.21 +/- 0.21	0.35		NA	U,G
14733-03-0	Bi-214	0.193 +/- 0.094	0.151	0.2	NA	G,TI,J
14694-69-0	Ir-192	-0.035 +/- 0.035	0.064		NA	U,G
13966-00-2	K-40	8.2 +/- 1.3	0.8		NA	G
13966-32-0	Na-22	-0.016 +/- 0.035	0.065		NA	U,G
15100-28-4	Pa-234	0.02 +/- 0.15	0.25		NA	U,G
14255-04-0	Pb-210	-1.2 +/- 6.1	10.4		NA	U,G,J
15092-94-1	Pb-212	0.280 +/- 0.077	0.101		NA	G
15067-28-4	Pb-214	0.24 +/- 0.10	0.15	0.2	NA	G,J
15623-45-7	Ra-223	0.15 +/- 0.15	0.25		NA	U,G
13233-32-4	Ra-224	0.35 +/- 0.61	1.02		NA	U,G
13982-63-3	Ra-226	0.15 +/- 0.62	1.04		NA	U,G,SI
15262-20-1	Ra-228	0.23 +/- 0.12	0.20		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS001
Lab ID: 1810627-10
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 60 minutes
Report Basis: Dry Weight

Final Aliquot: 273 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181993d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.019 +/- 0.037	0.062		NA	U,G
15064-65-0	TL-201	-1800 +/- 1300	2300		NA	U,G
14913-50-9	TI-208	0.055 +/- 0.034	0.053		NA	G
13966-01-3	TL-210	-0.002 +/- 0.026	0.046		NA	U,G
15117-96-1	U-235	-0.04 +/- 0.19	0.32		NA	U,G
7440-61-1	U-238	0.03 +/- 0.62	1.05		NA	U,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS005
Lab ID: 1810627-11
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 400 minutes
Report Basis: Dry Weight

Final Aliquot: 211 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182669d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.69 +/- 0.14	0.24		NA	
13966-02-4	Be-7	0.27 +/- 0.30	0.49		NA	U
14913-49-6	Bi-212	0.37 +/- 0.21	0.31		NA	
14733-03-0	Bi-214	0.70 +/- 0.12	0.14	0.2	NA	TI,J
14694-69-0	Ir-192	0.004 +/- 0.027	0.046		NA	U
13966-00-2	K-40	9.5 +/- 1.4	0.9		NA	
13966-32-0	Na-22	-0.007 +/- 0.035	0.060		NA	U
15100-28-4	Pa-234	-0.11 +/- 0.14	0.24		NA	U
14255-04-0	Pb-210	8 +/- 11	19		NA	U,J
15092-94-1	Pb-212	0.96 +/- 0.13	0.08		NA	
15067-28-4	Pb-214	0.80 +/- 0.12	0.13	0.2	NA	J
15623-45-7	Ra-223	0.24 +/- 0.16	0.26		NA	U
13233-32-4	Ra-224	0.7 +/- 4.1	1.1		NA	U
13982-63-3	Ra-226	1.44 +/- 0.74	1.17		NA	
15262-20-1	Ra-228	0.69 +/- 0.14	0.24		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS005
Lab ID: 1810627-11
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 400 minutes
Report Basis: Dry Weight

Final Aliquot: 211 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182669d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.017 +/- 0.036	0.063		NA	U
15064-65-0	TL-201	-500 +/- 1500	2600		NA	U
14913-50-9	TI-208	0.261 +/- 0.055	0.070		NA	
13966-01-3	TL-210	0.044 +/- 0.025	0.038		NA	TI
15117-96-1	U-235	0.05 +/- 0.14	0.23		NA	U
7440-61-1	U-238	1.04 +/- 0.57	0.89		NA	TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS005-DUP
Lab ID: 1810627-12
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 202 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181899d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.67 +/- 0.13	0.17		NA	
13966-02-4	Be-7	0.01 +/- 0.34	0.58		NA	U
14913-49-6	Bi-212	0.63 +/- 0.23	0.31		NA	TI
14733-03-0	Bi-214	0.68 +/- 0.12	0.13	0.2	NA	TI,J
14694-69-0	Ir-192	-0.006 +/- 0.038	0.065		NA	U
13966-00-2	K-40	9.5 +/- 1.4	0.8		NA	
13966-32-0	Na-22	-0.010 +/- 0.030	0.053		NA	U
15100-28-4	Pa-234	0.07 +/- 0.12	0.20		NA	U
14255-04-0	Pb-210	5 +/- 30	51		NA	U,J
15092-94-1	Pb-212	0.87 +/- 0.12	0.08		NA	
15067-28-4	Pb-214	0.92 +/- 0.13	0.13	0.2	NA	J
15623-45-7	Ra-223	0.22 +/- 0.13	0.20		NA	TI
13233-32-4	Ra-224	0.4 +/- 3.4	0.8		NA	U
13982-63-3	Ra-226	1.35 +/- 0.62	0.96		NA	SI
15262-20-1	Ra-228	0.67 +/- 0.13	0.17		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS005-DUP
Lab ID: 1810627-12
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 23-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 202 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181899d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.012 +/- 0.032	0.055		NA	U
15064-65-0	TL-201	0 +/- 2000	3400		NA	U
14913-50-9	TI-208	0.253 +/- 0.048	0.050		NA	
13966-01-3	TL-210	0.029 +/- 0.020	0.031		NA	U
15117-96-1	U-235	0.10 +/- 0.13	0.23		NA	U
7440-61-1	U-238	0.72 +/- 0.68	1.11		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS004
Lab ID: 1810627-13
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 186 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182189d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.78 +/- 0.14	0.21		NA	
13966-02-4	Be-7	0.13 +/- 0.37	0.62		NA	U
14913-49-6	Bi-212	0.45 +/- 0.25	0.37		NA	TI
14733-03-0	Bi-214	0.71 +/- 0.12	0.15	0.2	NA	J
14694-69-0	Ir-192	0.005 +/- 0.033	0.055		NA	U
13966-00-2	K-40	7.7 +/- 1.2	0.9		NA	
13966-32-0	Na-22	-0.013 +/- 0.032	0.057		NA	U
15100-28-4	Pa-234	0.059 +/- 0.082	0.170		NA	U
14255-04-0	Pb-210	7 +/- 80	135		NA	U,J
15092-94-1	Pb-212	0.90 +/- 0.14	0.11		NA	
15067-28-4	Pb-214	0.73 +/- 0.12	0.13	0.2	NA	J
15623-45-7	Ra-223	0.29 +/- 0.15	0.24		NA	TI
13233-32-4	Ra-224	0.9 +/- 3.8	0.9		NA	
13982-63-3	Ra-226	0.91 +/- 0.75	1.21		NA	U
15262-20-1	Ra-228	0.78 +/- 0.14	0.21		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS004
Lab ID: 1810627-13
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 186 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182189d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.025 +/- 0.035	0.063		NA	U
15064-65-0	TL-201	300 +/- 2900	4900		NA	U
14913-50-9	TI-208	0.266 +/- 0.056	0.065		NA	
13966-01-3	TL-210	0.011 +/- 0.027	0.046		NA	U
15117-96-1	U-235	-0.05 +/- 0.17	0.29		NA	U
7440-61-1	U-238	0.7 +/- 4.8	1.3		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 155 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182195d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.64 +/- 0.21	0.18		NA	G
13966-02-4	Be-7	0.03 +/- 0.26	0.43		NA	U,G
14913-49-6	Bi-212	1.07 +/- 0.22	0.27		NA	G
14733-03-0	Bi-214	1.49 +/- 0.19	0.14	0.2	NA	G,J
14694-69-0	Ir-192	-0.007 +/- 0.024	0.040		NA	U,G
13966-00-2	K-40	7.5 +/- 1.1	0.8		NA	G
13966-32-0	Na-22	0.001 +/- 0.021	0.036		NA	U,G
15100-28-4	Pa-234	0.066 +/- 0.088	0.151		NA	U,G
14255-04-0	Pb-210	8 +/- 57	95		NA	U,G,J
15092-94-1	Pb-212	1.89 +/- 0.24	0.11		NA	G
15067-28-4	Pb-214	1.53 +/- 0.20	0.13	0.2	NA	G,J
15623-45-7	Ra-223	0.44 +/- 0.11	0.18		NA	G
13233-32-4	Ra-224	2.1 +/- 3.0	0.7		NA	G
13982-63-3	Ra-226	2.63 +/- 0.78	1.16		NA	G,SI
15262-20-1	Ra-228	1.64 +/- 0.21	0.18		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 155 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182195d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.011 +/- 0.024	0.042		NA	U,G
15064-65-0	TL-201	700 +/- 5800	9600		NA	U,G
14913-50-9	TI-208	0.553 +/- 0.075	0.052		NA	G
13966-01-3	TL-210	0.061 +/- 0.019	0.027		NA	G
15117-96-1	U-235	0.27 +/- 0.16	0.25		NA	G,TI
7440-61-1	U-238	2.43 +/- 0.77	1.16		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 152 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182672d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.71 +/- 0.23	0.24		NA	G
13966-02-4	Be-7	-0.05 +/- 0.28	0.48		NA	U,G
14913-49-6	Bi-212	1.11 +/- 0.27	0.34		NA	G,TI
14733-03-0	Bi-214	1.44 +/- 0.19	0.16	0.2	NA	G,J
14694-69-0	Ir-192	0.012 +/- 0.025	0.042		NA	U,G
13966-00-2	K-40	8.0 +/- 1.2	1.0		NA	G
13966-32-0	Na-22	-0.016 +/- 0.031	0.053		NA	U,G
15100-28-4	Pa-234	0 +/- 0.11	0.20		NA	U,G
14255-04-0	Pb-210	4 +/- 11	18		NA	U,G,J
15092-94-1	Pb-212	2.05 +/- 0.25	0.10		NA	G
15067-28-4	Pb-214	1.55 +/- 0.21	0.14	0.2	NA	G,J
15623-45-7	Ra-223	0.40 +/- 0.11	0.18		NA	G
13233-32-4	Ra-224	1.5 +/- 5.0	1.3		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS006
Lab ID: 1810627-14DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 152 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182672d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.95 +/- 0.92	1.37		NA	G,SI
15262-20-1	Ra-228	1.71 +/- 0.23	0.24		NA	G
13967-63-0	Sc-46	-0.006 +/- 0.034	0.058		NA	U,G
15064-65-0	TL-201	-200 +/- 1700	2900		NA	U,G
14913-50-9	TI-208	0.583 +/- 0.088	0.088		NA	G
13966-01-3	TL-210	0.071 +/- 0.023	0.032		NA	G
15117-96-1	U-235	0.15 +/- 0.14	0.23		NA	U,G
7440-61-1	U-238	2.26 +/- 0.65	0.94		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS002
Lab ID: 1810627-15
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 180 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181997d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.72 +/- 0.15	0.23		NA	G
13966-02-4	Be-7	0.09 +/- 0.39	0.65		NA	U,G
14913-49-6	Bi-212	0.51 +/- 0.26	0.40		NA	G,TI
14733-03-0	Bi-214	0.76 +/- 0.15	0.19	0.2	NA	G,J
14694-69-0	Ir-192	0.011 +/- 0.040	0.068		NA	U,G
13966-00-2	K-40	9.3 +/- 1.4	0.8		NA	G
13966-32-0	Na-22	0.005 +/- 0.037	0.064		NA	U,G
15100-28-4	Pa-234	0.04 +/- 0.15	0.26		NA	U,G
14255-04-0	Pb-210	5.5 +/- 5.7	9.2		NA	U,G,J
15092-94-1	Pb-212	0.91 +/- 0.14	0.12		NA	G
15067-28-4	Pb-214	1.02 +/- 0.16	0.18	0.2	NA	G,J
15623-45-7	Ra-223	0.21 +/- 0.20	0.33		NA	U,G
13233-32-4	Ra-224	1.89 +/- 0.84	1.28		NA	G
13982-63-3	Ra-226	1.14 +/- 0.88	1.42		NA	U,G,SI
15262-20-1	Ra-228	0.72 +/- 0.15	0.23		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS002
Lab ID: 1810627-15
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 180 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181997d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.012 +/- 0.044	0.077		NA	U,G
15064-65-0	TL-201	900 +/- 1400	2300		NA	U,G
14913-50-9	TI-208	0.235 +/- 0.056	0.068		NA	G
13966-01-3	TL-210	0.045 +/- 0.030	0.047		NA	U,G
15117-96-1	U-235	0.12 +/- 0.23	0.39		NA	U,G
7440-61-1	U-238	1.36 +/- 0.76	1.26		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS008
Lab ID: 1810627-16
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 82.9 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182000d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.66 +/- 0.15	0.28		NA	G
13966-02-4	Be-7	0.04 +/- 0.26	0.44		NA	U,G
14913-49-6	Bi-212	0.64 +/- 0.21	0.31		NA	G
14733-03-0	Bi-214	1.83 +/- 0.25	0.24	0.2	NA	M3,G,J
14694-69-0	Ir-192	0.009 +/- 0.027	0.045		NA	U,G
13966-00-2	K-40	7.2 +/- 1.1	1.1		NA	G
13966-32-0	Na-22	-0.015 +/- 0.026	0.044		NA	U,G
15100-28-4	Pa-234	-0.08 +/- 0.11	0.19		NA	U,G
14255-04-0	Pb-210	9.0 +/- 4.1	6.4		NA	G,NQ,J
15092-94-1	Pb-212	0.78 +/- 0.13	0.14		NA	G
15067-28-4	Pb-214	2.10 +/- 0.29	0.23	0.2	NA	M3,G,J
15623-45-7	Ra-223	0.18 +/- 0.21	0.34		NA	U,G
13233-32-4	Ra-224	0.5 +/- 5.8	1.5		NA	U,G
13982-63-3	Ra-226	3.6 +/- 1.2	1.8		NA	G,SI
15262-20-1	Ra-228	0.66 +/- 0.15	0.28		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SS008
Lab ID: 1810627-16
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 24-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 82.9 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182000d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.016 +/- 0.030	0.050		NA	U,G
15064-65-0	TL-201	3400 +/- 1700	2600		NA	G,NQ
14913-50-9	TI-208	0.189 +/- 0.058	0.089		NA	G
13966-01-3	TL-210	0.035 +/- 0.016	0.025		NA	G
15117-96-1	U-235	0.25 +/- 0.22	0.47		NA	U,G
7440-61-1	U-238	3.10 +/- 0.91	1.35		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU002-07
Lab ID: 1810627-17
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 213 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181902d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.85 +/- 0.18	0.22		NA	
13966-02-4	Be-7	-0.31 +/- 0.49	0.88		NA	U
14913-49-6	Bi-212	0.59 +/- 0.27	0.37		NA	TI
14733-03-0	Bi-214	0.82 +/- 0.15	0.16	0.2	NA	J
14694-69-0	Ir-192	0.015 +/- 0.059	0.101		NA	U
13966-00-2	K-40	9.4 +/- 1.6	1.1		NA	
13966-32-0	Na-22	-0.024 +/- 0.043	0.082		NA	U
15100-28-4	Pa-234	-0.06 +/- 0.18	0.34		NA	U
14255-04-0	Pb-210	6 +/- 49	84		NA	U,J
15092-94-1	Pb-212	1.02 +/- 0.15	0.10		NA	
15067-28-4	Pb-214	1.05 +/- 0.17	0.17	0.2	NA	J
15623-45-7	Ra-223	0.28 +/- 0.17	0.25		NA	TI
13233-32-4	Ra-224	0.5 +/- 5.8	1.5		NA	U
13982-63-3	Ra-226	0.94 +/- 0.71	1.13		NA	U,SI
15262-20-1	Ra-228	0.85 +/- 0.18	0.22		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU002-07
Lab ID: 1810627-17
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 213 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181902d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.007 +/- 0.055	0.097		NA	U
15064-65-0	TL-201	-400 +/- 2200	3800		NA	U
14913-50-9	TI-208	0.237 +/- 0.059	0.067		NA	
13966-01-3	TL-210	0.004 +/- 0.037	0.065		NA	U
15117-96-1	U-235	0.03 +/- 0.22	0.37		NA	U
7440-61-1	U-238	1.4 +/- 1.0	1.7		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-10
Lab ID: 1810627-18
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 182 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182159d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.88 +/- 0.17	0.29		NA	G
13966-02-4	Be-7	-0.12 +/- 0.39	0.68		NA	U,G
14913-49-6	Bi-212	0.38 +/- 0.28	0.43		NA	U,G
14733-03-0	Bi-214	0.97 +/- 0.15	0.15	0.2	NA	G,J
14694-69-0	Ir-192	0.024 +/- 0.038	0.063		NA	U,G
13966-00-2	K-40	5.6 +/- 1.1	1.1		NA	G
13966-32-0	Na-22	0.014 +/- 0.031	0.053		NA	U,G
15100-28-4	Pa-234	-0.02 +/- 0.16	0.27		NA	U,G
14255-04-0	Pb-210	14 +/- 33	54		NA	U,G,J
15092-94-1	Pb-212	1.13 +/- 0.17	0.13		NA	G
15067-28-4	Pb-214	1.09 +/- 0.17	0.17	0.2	NA	G,J
15623-45-7	Ra-223	0.37 +/- 0.22	0.34		NA	G,TI
13233-32-4	Ra-224	1.3 +/- 5.7	1.4		NA	U,G
13982-63-3	Ra-226	2.88 +/- 0.99	1.45		NA	G,SI
15262-20-1	Ra-228	0.88 +/- 0.17	0.29		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-10
Lab ID: 1810627-18
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 182 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182159d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.028 +/- 0.040	0.066		NA	U,G
15064-65-0	TL-201	800 +/- 1700	2900		NA	U,G
14913-50-9	TI-208	0.337 +/- 0.072	0.084		NA	G
13966-01-3	TL-210	0.012 +/- 0.031	0.052		NA	U,G
15117-96-1	U-235	0.15 +/- 0.16	0.26		NA	U,G
7440-61-1	U-238	2.14 +/- 0.86	1.30		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-16
Lab ID: 1810627-19
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 160 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181905d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.35 +/- 0.18	0.15		NA	G
13966-02-4	Be-7	-0.25 +/- 0.25	0.42		NA	U,G
14913-49-6	Bi-212	0.84 +/- 0.19	0.24		NA	G
14733-03-0	Bi-214	1.26 +/- 0.17	0.13	0.2	NA	G,J
14694-69-0	Ir-192	-0.005 +/- 0.026	0.044		NA	U,G
13966-00-2	K-40	7.7 +/- 1.1	0.8		NA	G
13966-32-0	Na-22	0.001 +/- 0.021	0.035		NA	U,G
15100-28-4	Pa-234	0.086 +/- 0.076	0.134		NA	U,G
14255-04-0	Pb-210	9 +/- 22	36		NA	U,G,J
15092-94-1	Pb-212	1.65 +/- 0.20	0.08		NA	G
15067-28-4	Pb-214	1.74 +/- 0.22	0.12	0.2	NA	G,J
15623-45-7	Ra-223	0.341 +/- 0.097	0.163		NA	G
13233-32-4	Ra-224	0.4 +/- 2.6	0.6		NA	U,G
13982-63-3	Ra-226	2.52 +/- 0.68	0.97		NA	G,SI
15262-20-1	Ra-228	1.35 +/- 0.18	0.15		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-16
Lab ID: 1810627-19
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 160 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181905d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.006 +/- 0.024	0.041		NA	U,G
15064-65-0	TL-201	1000 +/- 1500	2400		NA	U,G
14913-50-9	TI-208	0.422 +/- 0.060	0.046		NA	G
13966-01-3	TL-210	0.045 +/- 0.015	0.022		NA	G,TI
15117-96-1	U-235	0.14 +/- 0.11	0.18		NA	U,G
7440-61-1	U-238	1.1 +/- 4.4	1.0		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-29
Lab ID: 1810627-20
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181816d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.86 +/- 0.15	0.21		NA	
13966-02-4	Be-7	0.21 +/- 0.32	0.52		NA	U
14913-49-6	Bi-212	0.64 +/- 0.27	0.38		NA	TI
14733-03-0	Bi-214	0.82 +/- 0.13	0.13	0.2	NA	J
14694-69-0	Ir-192	0.027 +/- 0.032	0.052		NA	U
13966-00-2	K-40	11.1 +/- 1.6	0.8		NA	
13966-32-0	Na-22	0.013 +/- 0.031	0.053		NA	U
15100-28-4	Pa-234	0.062 +/- 0.095	0.217		NA	U
14255-04-0	Pb-210	0.75 +/- 0.84	1.38		NA	U,J
15092-94-1	Pb-212	1.08 +/- 0.15	0.09		NA	
15067-28-4	Pb-214	0.90 +/- 0.14	0.12	0.2	NA	J
15623-45-7	Ra-223	0.27 +/- 0.21	0.33		NA	U
13233-32-4	Ra-224	1.0 +/- 4.4	1.1		NA	U
13982-63-3	Ra-226	1.43 +/- 0.63	0.95		NA	SI
15262-20-1	Ra-228	0.86 +/- 0.15	0.21		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU004-29
Lab ID: 1810627-20
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 04-Dec-18

Prep Batch: GS181103-1
QCBatchID: GS181103-1-2
Run ID: GS181103-1B
Count Time: 300 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181816d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.007 +/- 0.036	0.064		NA	U
15064-65-0	TL-201	-20 +/- 310	520		NA	U
14913-50-9	TI-208	0.321 +/- 0.062	0.068		NA	
13966-01-3	TL-210	0.032 +/- 0.024	0.038		NA	U
15117-96-1	U-235	-0.06 +/- 0.15	0.26		NA	U
7440-61-1	U-238	1.00 +/- 0.50	0.82		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-01
Lab ID: 1810627-21
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 234 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181957d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.49 +/- 0.15	0.28		NA	
13966-02-4	Be-7	0.03 +/- 0.41	0.71		NA	U
14913-49-6	Bi-212	0.40 +/- 0.38	0.61		NA	U
14733-03-0	Bi-214	0.63 +/- 0.14	0.16	0.2	NA	J
14694-69-0	Ir-192	0.002 +/- 0.042	0.073		NA	U
13966-00-2	K-40	9.1 +/- 1.5	0.9		NA	
13966-32-0	Na-22	0.003 +/- 0.042	0.075		NA	U
15100-28-4	Pa-234	0.04 +/- 0.17	0.31		NA	U
14255-04-0	Pb-210	0.82 +/- 0.69	1.09		NA	U,J
15092-94-1	Pb-212	0.76 +/- 0.13	0.10		NA	
15067-28-4	Pb-214	0.66 +/- 0.12	0.13	0.2	NA	J
15623-45-7	Ra-223	0.24 +/- 0.16	0.25		NA	U
13233-32-4	Ra-224	0.9 +/- 5.1	1.3		NA	U
13982-63-3	Ra-226	0.99 +/- 0.79	1.26		NA	U,SI
15262-20-1	Ra-228	0.49 +/- 0.15	0.28		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-01
Lab ID: 1810627-21
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 234 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181957d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0 +/- 0.049	0.087		NA	U
15064-65-0	TL-201	60 +/- 390	650		NA	U
14913-50-9	TI-208	0.253 +/- 0.068	0.081		NA	
13966-01-3	TL-210	0.028 +/- 0.025	0.039		NA	U
15117-96-1	U-235	0 +/- 0.18	0.31		NA	U
7440-61-1	U-238	1.00 +/- 0.51	0.77		NA	TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-01-DUP
Lab ID: 1810627-22
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 210 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182002d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.70 +/- 0.13	0.18		NA	
13966-02-4	Be-7	-0.23 +/- 0.33	0.58		NA	U
14913-49-6	Bi-212	0.66 +/- 0.26	0.38		NA	
14733-03-0	Bi-214	0.79 +/- 0.14	0.16	0.2	NA	J
14694-69-0	Ir-192	-0.010 +/- 0.034	0.058		NA	U
13966-00-2	K-40	9.7 +/- 1.4	0.8		NA	
13966-32-0	Na-22	0.017 +/- 0.033	0.055		NA	U
15100-28-4	Pa-234	0.12 +/- 0.13	0.22		NA	U
14255-04-0	Pb-210	2.2 +/- 6.5	10.8		NA	U,J
15092-94-1	Pb-212	0.93 +/- 0.14	0.10		NA	
15067-28-4	Pb-214	0.91 +/- 0.14	0.15	0.2	NA	J
15623-45-7	Ra-223	0.28 +/- 0.16	0.25		NA	TI
13233-32-4	Ra-224	0.9 +/- 5.1	1.3		NA	U
13982-63-3	Ra-226	1.53 +/- 0.80	1.24		NA	SI
15262-20-1	Ra-228	0.70 +/- 0.13	0.18		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-01-DUP
Lab ID: 1810627-22
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 210 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182002d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.025 +/- 0.035	0.063		NA	U
15064-65-0	TL-201	110 +/- 990	1650		NA	U
14913-50-9	TI-208	0.240 +/- 0.050	0.059		NA	
13966-01-3	TL-210	-0.024 +/- 0.028	0.049		NA	U
15117-96-1	U-235	0.05 +/- 0.18	0.30		NA	U
7440-61-1	U-238	0.86 +/- 0.65	1.04		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-14
Lab ID: 1810627-23
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 169 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182023d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.32 +/- 0.18	0.20		NA	G
13966-02-4	Be-7	-0.11 +/- 0.26	0.44		NA	U,G
14913-49-6	Bi-212	0.67 +/- 0.29	0.46		NA	G
14733-03-0	Bi-214	1.36 +/- 0.18	0.16	0.2	NA	G,J
14694-69-0	Ir-192	-0.001 +/- 0.023	0.039		NA	U,G
13966-00-2	K-40	7.9 +/- 1.1	0.9		NA	G
13966-32-0	Na-22	-0.012 +/- 0.021	0.036		NA	U,G
15100-28-4	Pa-234	0.075 +/- 0.089	0.146		NA	U,G
14255-04-0	Pb-210	40 +/- 37	60		NA	U,G,J
15092-94-1	Pb-212	1.54 +/- 0.20	0.10		NA	G
15067-28-4	Pb-214	1.43 +/- 0.18	0.12	0.2	NA	G,J
15623-45-7	Ra-223	0.36 +/- 0.11	0.19		NA	G
13233-32-4	Ra-224	1.4 +/- 3.1	0.7		NA	G
13982-63-3	Ra-226	2.70 +/- 0.77	1.11		NA	G,SI
15262-20-1	Ra-228	1.32 +/- 0.18	0.20		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU005-14
Lab ID: 1810627-23
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 169 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182023d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.024 +/- 0.026	0.045		NA	U,G
15064-65-0	TL-201	500 +/- 1800	3100		NA	U,G
14913-50-9	TI-208	0.448 +/- 0.073	0.077		NA	G
13966-01-3	TL-210	0.046 +/- 0.022	0.033		NA	G,TI
15117-96-1	U-235	0.15 +/- 0.12	0.19		NA	U,G
7440-61-1	U-238	2.58 +/- 0.82	1.23		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU006-10
Lab ID: 1810627-24
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 135 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181959d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.07 +/- 0.16	0.19		NA	G
13966-02-4	Be-7	0.18 +/- 0.24	0.39		NA	U,G
14913-49-6	Bi-212	0.71 +/- 0.18	0.24		NA	G
14733-03-0	Bi-214	1.03 +/- 0.19	0.41	0.2	NA	M3,G,J
14694-69-0	Ir-192	0.004 +/- 0.024	0.040		NA	U,G
13966-00-2	K-40	5.51 +/- 0.90	0.87		NA	G
13966-32-0	Na-22	0.003 +/- 0.022	0.037		NA	U,G
15100-28-4	Pa-234	0.011 +/- 0.090	0.162		NA	U,G
14255-04-0	Pb-210	0.84 +/- 0.79	1.29		NA	U,G,J
15092-94-1	Pb-212	1.19 +/- 0.16	0.10		NA	G
15067-28-4	Pb-214	1.20 +/- 0.16	0.12	0.2	NA	G,J
15623-45-7	Ra-223	0.277 +/- 0.089	0.181		NA	G
13233-32-4	Ra-224	1.3 +/- 2.8	0.6		NA	G
13982-63-3	Ra-226	2.48 +/- 0.66	0.93		NA	G,SI
15262-20-1	Ra-228	1.07 +/- 0.16	0.19		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU006-10
Lab ID: 1810627-24
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 135 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181959d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.021 +/- 0.027	0.048		NA	U,G
15064-65-0	TL-201	-420 +/- 390	650		NA	U,G
14913-50-9	TI-208	0.353 +/- 0.064	0.077		NA	G
13966-01-3	TL-210	0.045 +/- 0.019	0.027		NA	G,TI
15117-96-1	U-235	0.151 +/- 0.088	0.139		NA	G,NQ
7440-61-1	U-238	1.68 +/- 0.39	0.63		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU006-13
Lab ID: 1810627-25
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 121 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181821d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.15 +/- 0.17	0.23		NA	G
13966-02-4	Be-7	0.08 +/- 0.29	0.49		NA	U,G
14913-49-6	Bi-212	0.71 +/- 0.21	0.28		NA	G,TI
14733-03-0	Bi-214	1.23 +/- 0.21	0.29	0.2	NA	M3,G,J
14694-69-0	Ir-192	0.030 +/- 0.029	0.047		NA	U,G
13966-00-2	K-40	6.2 +/- 1.1	1.1		NA	G
13966-32-0	Na-22	-0.004 +/- 0.028	0.048		NA	U,G
15100-28-4	Pa-234	0.051 +/- 0.043	0.086		NA	U,G
14255-04-0	Pb-210	1.2 +/- 1.1	1.8		NA	U,G,J
15092-94-1	Pb-212	1.43 +/- 0.19	0.12		NA	G
15067-28-4	Pb-214	1.46 +/- 0.20	0.16	0.2	NA	G,J
15623-45-7	Ra-223	0.21 +/- 0.14	0.27		NA	U,G
13233-32-4	Ra-224	1.2 +/- 4.0	1.0		NA	G
13982-63-3	Ra-226	2.62 +/- 0.85	1.27		NA	G,SI
15262-20-1	Ra-228	1.15 +/- 0.17	0.23		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU006-13
Lab ID: 1810627-25
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 121 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181821d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.007 +/- 0.032	0.054		NA	U,G
15064-65-0	TL-201	460 +/- 430	690		NA	U,G
14913-50-9	TI-208	0.403 +/- 0.075	0.089		NA	G
13966-01-3	TL-210	0.045 +/- 0.022	0.032		NA	G
15117-96-1	U-235	0.10 +/- 0.11	0.19		NA	U,G
7440-61-1	U-238	2.11 +/- 0.47	0.74		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU008-03
Lab ID: 1810627-26
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 156 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182683d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.85 +/- 0.14	0.22		NA	G
13966-02-4	Be-7	0.20 +/- 0.25	0.40		NA	U,G
14913-49-6	Bi-212	0.62 +/- 0.20	0.28		NA	G,TI
14733-03-0	Bi-214	1.00 +/- 0.19	0.32	0.2	NA	M3,G,J
14694-69-0	Ir-192	0.008 +/- 0.022	0.037		NA	U,G
13966-00-2	K-40	5.99 +/- 0.97	0.93		NA	G
13966-32-0	Na-22	0.002 +/- 0.026	0.044		NA	U,G
15100-28-4	Pa-234	-0.01 +/- 0.11	0.19		NA	U,G
14255-04-0	Pb-210	-3.5 +/- 9.1	15.2		NA	U,G,J
15092-94-1	Pb-212	1.10 +/- 0.14	0.09		NA	G
15067-28-4	Pb-214	1.03 +/- 0.15	0.13	0.2	NA	G,J
15623-45-7	Ra-223	0.33 +/- 0.13	0.19		NA	G,TI
13233-32-4	Ra-224	0.9 +/- 4.4	1.2		NA	U,G
13982-63-3	Ra-226	1.59 +/- 0.80	1.27		NA	G,SI
15262-20-1	Ra-228	0.85 +/- 0.14	0.22		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU008-03
Lab ID: 1810627-26
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 26-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 156 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182683d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.002 +/- 0.030	0.051		NA	U,G
15064-65-0	TL-201	-400 +/- 1300	2100		NA	U,G
14913-50-9	TI-208	0.329 +/- 0.064	0.083		NA	G
13966-01-3	TL-210	0.014 +/- 0.017	0.028		NA	U,G
15117-96-1	U-235	0.01 +/- 0.11	0.18		NA	U,G
7440-61-1	U-238	1.70 +/- 0.61	0.94		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU001-08
Lab ID: 1810627-27
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 236 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182192d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.70 +/- 0.15	0.22		NA	
13966-02-4	Be-7	0.05 +/- 0.47	0.81		NA	U
14913-49-6	Bi-212	0.52 +/- 0.29	0.41		NA	TI
14733-03-0	Bi-214	0.69 +/- 0.14	0.16	0.2	NA	J
14694-69-0	Ir-192	0.005 +/- 0.040	0.069		NA	U
13966-00-2	K-40	10.2 +/- 1.6	0.9		NA	
13966-32-0	Na-22	-0.015 +/- 0.047	0.085		NA	U
15100-28-4	Pa-234	-0.13 +/- 0.17	0.33		NA	U
14255-04-0	Pb-210	40 +/- 110	180		NA	U,J
15092-94-1	Pb-212	1.02 +/- 0.16	0.12		NA	
15067-28-4	Pb-214	0.69 +/- 0.12	0.15	0.2	NA	J
15623-45-7	Ra-223	0.30 +/- 0.22	0.36		NA	U
13233-32-4	Ra-224	0.9 +/- 5.0	1.2		NA	U
13982-63-3	Ra-226	0.65 +/- 0.74	1.21		NA	U,SI
15262-20-1	Ra-228	0.70 +/- 0.15	0.22		NA	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU001-08
Lab ID: 1810627-27
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 05-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 120 minutes
Report Basis: Dry Weight

Final Aliquot: 236 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182192d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.015 +/- 0.046	0.080		NA	U
15064-65-0	TL-201	-800 +/- 1500	2500		NA	U
14913-50-9	TI-208	0.274 +/- 0.062	0.062		NA	
13966-01-3	TL-210	0.038 +/- 0.037	0.060		NA	U
15117-96-1	U-235	0.21 +/- 0.23	0.37		NA	U
7440-61-1	U-238	0.46 +/- 0.70	1.16		NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU003-09
Lab ID: 1810627-28
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 172 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182732d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.48 +/- 0.19	0.13		NA	G
13966-02-4	Be-7	0.03 +/- 0.26	0.44		NA	U,G
14913-49-6	Bi-212	0.81 +/- 0.20	0.25		NA	G,TI
14733-03-0	Bi-214	1.54 +/- 0.20	0.14	0.2	NA	G,J
14694-69-0	Ir-192	-0.015 +/- 0.023	0.038		NA	U,G
13966-00-2	K-40	15.5 +/- 2.0	0.8		NA	G
13966-32-0	Na-22	0.010 +/- 0.030	0.051		NA	U,G
15100-28-4	Pa-234	-0.04 +/- 0.12	0.20		NA	U,G
14255-04-0	Pb-210	2.2 +/- 6.7	11.0		NA	U,G,J
15092-94-1	Pb-212	1.88 +/- 0.23	0.07		NA	G
15067-28-4	Pb-214	1.77 +/- 0.22	0.12	0.2	NA	G,J
15623-45-7	Ra-223	0.46 +/- 0.12	0.19		NA	G
13233-32-4	Ra-224	1.8 +/- 2.9	0.7		NA	G
13982-63-3	Ra-226	2.58 +/- 0.65	0.91		NA	G,SI
15262-20-1	Ra-228	1.48 +/- 0.19	0.13		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU003-09
Lab ID: 1810627-28
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 172 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182732d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	-0.014 +/- 0.028	0.049		NA	U,G
15064-65-0	TL-201	820 +/- 400	620		NA	G,NQ
14913-50-9	TI-208	0.499 +/- 0.072	0.061		NA	G
13966-01-3	TL-210	0.065 +/- 0.024	0.035		NA	G,TI
15117-96-1	U-235	0.17 +/- 0.15	0.25		NA	U,G
7440-61-1	U-238	1.80 +/- 0.57	0.85		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 149 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181914d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	2.37 +/- 0.30	0.18		NA	G
13966-02-4	Be-7	-0.06 +/- 0.29	0.48		NA	U,G
14913-49-6	Bi-212	1.24 +/- 0.62	1.23		NA	G
14733-03-0	Bi-214	2.23 +/- 0.28	0.14	0.2	NA	G,J
14694-69-0	Ir-192	0.007 +/- 0.031	0.052		NA	U,G
13966-00-2	K-40	12.3 +/- 1.6	0.9		NA	G
13966-32-0	Na-22	-0.001 +/- 0.024	0.040		NA	U,G
15100-28-4	Pa-234	0.082 +/- 0.055	0.141		NA	U,G
14255-04-0	Pb-210	12 +/- 27	44		NA	U,G,J
15092-94-1	Pb-212	2.89 +/- 0.35	0.09		NA	G
15067-28-4	Pb-214	2.83 +/- 0.34	0.12	0.2	NA	G,J
15623-45-7	Ra-223	0.75 +/- 0.15	0.21		NA	G
13233-32-4	Ra-224	1.8 +/- 3.3	0.7		NA	G
13982-63-3	Ra-226	4.26 +/- 0.83	1.04		NA	G,SI
15262-20-1	Ra-228	2.37 +/- 0.30	0.18		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 149 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181914d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13967-63-0	Sc-46	0.003 +/- 0.028	0.047		NA	U,G
15064-65-0	TL-201	540 +/- 860	1410		NA	U,G
14913-50-9	TI-208	0.79 +/- 0.10	0.05		NA	G
13966-01-3	TL-210	0.083 +/- 0.023	0.032		NA	G,TI
15117-96-1	U-235	0.22 +/- 0.14	0.23		NA	U,G
7440-61-1	U-238	3.88 +/- 0.85	1.13		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 161 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182032d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	2.32 +/- 0.30	0.23		NA	G
13966-02-4	Be-7	0.01 +/- 0.29	0.49		NA	U,G
14913-49-6	Bi-212	1.38 +/- 0.36	0.54		NA	G
14733-03-0	Bi-214	2.41 +/- 0.32	0.27	0.2	NA	M3,G,J
14694-69-0	Ir-192	-0.006 +/- 0.026	0.044		NA	U,G
13966-00-2	K-40	10.9 +/- 1.5	0.9		NA	G
13966-32-0	Na-22	0.024 +/- 0.035	0.056		NA	U,G
15100-28-4	Pa-234	0.08 +/- 0.11	0.18		NA	U,G
14255-04-0	Pb-210	-21 +/- 87	145		NA	U,G,J
15092-94-1	Pb-212	2.72 +/- 0.33	0.11		NA	G
15067-28-4	Pb-214	2.47 +/- 0.30	0.13	0.2	NA	G,J
15623-45-7	Ra-223	0.74 +/- 0.17	0.22		NA	G,TI
13233-32-4	Ra-224	2.7 +/- 4.1	1.0		NA	G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: *GSS1810627-2*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1810627
Client Name: Tidewater, Inc.
ClientProject ID: Phase 1 RI OU2 Great Kills Park 2016-007

Field ID: OU2-1-SU007-08
Lab ID: 1810627-29DUP
Library: TIDEWATER_G

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Oct-18
Date Prepared: 03-Nov-18
Date Analyzed: 06-Dec-18

Prep Batch: GS181103-2
QCBatchID: GS181103-2-1
Run ID: GS181103-2B
Count Time: 1000 minutes
Report Basis: Dry Weight

Final Aliquot: 161 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 182032d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	4.98 +/- 0.99	1.25		NA	G,SI
15262-20-1	Ra-228	2.32 +/- 0.30	0.23		NA	G
13967-63-0	Sc-46	0.023 +/- 0.030	0.049		NA	U,G
15064-65-0	TL-201	-200 +/- 1300	2200		NA	U,G
14913-50-9	Tl-208	0.77 +/- 0.11	0.08		NA	G
13966-01-3	TL-210	0.116 +/- 0.028	0.035		NA	G,TI
15117-96-1	U-235	0.16 +/- 0.16	0.27		NA	U,G
7440-61-1	U-238	4.3 +/- 1.0	1.4		NA	G,TI

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: *GSS1810627-2*

Section 5

RAW DATA

182668D03.SPC Analyzed by

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

****

Geo 17/26

Sample ID: 1810627-1 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:05
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 9300 Sec
Sample Size . . . . . 2.25E+002 g	Real Time . . . . . 9460 Sec
Collection Efficiency 1.0000	Spc. File 182668D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.37 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.79 + 0.012*En + 1.05E-03*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.36	129.10	23	30	24	139	0.52	a	NET< CL
2	74.83	151.99	129	59	45	343	1.18	a	
3	77.00	156.31	159	55	40	294	0.99	b	
4	92.87	187.95	118	58	44	334	1.17	a	
5	185.85	373.42	144	57	43	270	1.52	a	
6	198.57	398.78	68	67	53	346	1.94	a	Wide Pk
7	209.18	419.94	57	48	37	241	1.40	a	
8	238.57	478.57	577	63	33	204	1.25	a	
9	241.59	484.59	110	52	39	255	1.56	b	
10	277.38	555.98	24	31	24	126	0.96	a	NET< CL
11	295.13	591.39	224	47	30	156	1.55	a	
12	299.70	600.50	69	49	38	209	1.91	b	
13	338.14	677.16	101	41	30	154	1.45	a	
14	351.78	704.38	297	48	27	128	1.55	a	
15	463.01	926.22	53	38	29	130	2.22	a	
16	511.07	1022.08	254	52	34	155	2.79	a	Wide Pk
17	583.12	1165.78	178	36	20	76	1.72	a	
18	609.32	1218.05	248	48	30	140	2.07	a	
19	911.47	1820.70	121	34	21	71	2.62	a	
20	968.62	1934.68	57	26	18	57	1.91	a	
21	1119.89	2236.39	37	34	26	90	3.61	a	

182668D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	1460.72	2916.20	479	47	15	30	3.30	a
23	1764.84	3522.78	32	20	14	23	4.48	a

182668D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET031128.BKG (112818-3 LONG BKG CAL)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.36	23	30	24	8	38	31	NET<CL
3	77.00	159	55	40	149	61	46	
4	92.87	118	58	44	68	63	50	
5	185.85	144	57	43	96	66	51	
6	198.57	68	67	53	33	74	60	NET<CL
8	238.57	577	63	33	541	66	39	
9	241.59	110	52	39	100	59	45	
11	295.13	224	47	30	205	51	35	
13	338.14	101	41	30	96	45	33	
14	351.78	297	48	27	258	52	34	
16	511.07	254	52	34	14	65	53	NET<CL
17	583.12	178	36	20	158	42	28	
18	609.32	248	48	30	223	51	34	
19	911.47	121	34	21	111	38	26	
22	1460.72	479	47	15	454	49	20	
23	1764.84	32	20	14	25	22	16	

182668D03.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

****

Geo 17/26

Sample ID: 1810627-1 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:05
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 9300 Sec
Sample Size . . . . . 2.25e+002 g	Real Time . . . . . 9460 Sec
Collection Efficiency 1.0000	Spectrum File 182668D03.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-8.15E+01 +1.04E+02*L +-4.49E+01*L^2 +6.40E+00*L^3] 11/01/2018
Eff.=10^[-2.02E-01 +-3.44E-01*L +-1.27E-01*L^2 +7.29E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		7.95E-01 +- 7.35E-01	1.20E+00	5.84E-01	3.92E+13
Ra-226	186.10		1.40E+00 +- 9.55E-01	1.54E+00	7.50E-01	1.40E+07
Pb-212	Average:x		7.74E-01 +- 9.39E-02	. . . .	. . . .	5.04E+04
	238.63		7.69E-01 +- 9.43E-02	1.14E-01	5.53E-02	5.04E+04
	300.09		1.45E+00 +- 1.02E+00	1.64E+00	7.90E-01	5.04E+04
Pb-214	Average:x		6.09E-01 +- 9.71E-02	. . . .	. . . .	1.40E+07
	295.21		7.50E-01 +- 1.88E-01	2.67E-01	1.29E-01	1.40E+07
	351.92		5.58E-01 +- 1.13E-01	1.53E-01	7.37E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		6.49E-01 +- 1.53E-01	. . . .	. . . .	5.04E+04
	338.40		6.09E-01 +- 2.85E-01	4.39E-01	2.11E-01	5.04E+04
	911.07		6.94E-01 +- 2.34E-01	3.36E-01	1.59E-01	5.04E+04
	968.90		6.21E-01 +- 2.86E-01	4.14E-01	1.92E-01	5.04E+04
Tl-208	583.14		2.24E-01 +- 5.96E-02	8.25E-02	3.93E-02	5.04E+04
Bi-214	Average:x		6.08E-01 +- 1.32E-01	. . . .	. . . .	1.40E+07
	609.31		6.21E-01 +- 1.42E-01	1.98E-01	9.52E-02	1.40E+07
	1120.29		5.33E-01 +- 4.96E-01	8.02E-01	3.81E-01	1.40E+07
	1764.49		5.38E-01 +- 4.72E-01	7.52E-01	3.47E-01	1.40E+07
K-40	1460.75		1.16E+01 +- 1.25E+00	1.08E+00	5.06E-01	1.12E+13
Ra-224	241.00		3.99E-01 +- 5.61E+00	1.48E+00	7.17E-01	5.04E+04
Pb-210	46.52	N	3.42E+00 +- 1.74E+01	2.94E+01	1.42E+01	1.79E+05

182668D03.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Tl-201	70.82	N-	1.98E+03	+- 2.45E+03	4.27E+03B	2.07E+03	7.35E+01
U-235	143.76	N-	1.39E-02	+- 2.07E-01	3.54E-01	1.71E-01	3.33E+10
Ra-223	269.39	N	8.13E-02	+- 1.69E-01	2.84E-01	1.35E-01	2.87E+08
Ir-192	316.49	N	0.00E+00	+- 3.96E-02	6.84E-02	3.25E-02	1.78E+03
Be-7	477.56	N	3.59E-02	+- 4.73E-01	8.20E-01	3.87E-01	1.28E+03
Bi-212	727.17	N	4.70E-01	+- 3.50E-01	5.52E-01	2.59E-01	5.04E+04
Tl-210	795.00	N	2.52E-02	+- 3.92E-02	6.52E-02	3.05E-02	1.40E+07
Sc-46	889.26	N-	4.58E-02	+- 6.21E-02	1.15E-01	5.40E-02	2.01E+03
Pa-234	946.00	N-	8.84E-02	+- 1.97E-01	3.63E-01	1.69E-01	3.95E+13
Na-22	1274.54	N	3.33E-03	+- 5.68E-02	9.97E-02	4.64E-02	2.28E+04

MEASURED TOTAL: 2.11E+01 +- 2.76E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.36	129.10	8	38	31	139	0.52	Deleted
2	74.83	151.99	129	59	45	343	1.18	Unknown
3	77.00	156.31	149	61	46	294	0.99	Unknown
6	198.57	398.78	33	74	60	346	1.94	Deleted
7	209.18	419.94	57	48	37	241	1.40	Unknown
9	241.59	484.59	100	59	45	255	1.56	SPLIT
10	277.38	555.98	24	31	24	126	0.96	Deleted
15	463.01	926.22	53	38	29	130	2.22	Unknown
16	511.07	1022.08	14	65	53	155	2.79	Deleted

c:\SEEKER\BIN\182668d03.res Analysis Results Saved.

182685D04.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-2 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:14
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 24000 Sec
Sample Size . . . . . 1.60E+002 g	Real Time . . . . . 24264 Sec
Collection Efficiency 1.0000	Spc. File 182685D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.47 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.19	129.04	84	65	52	539	0.83	a	
2	74.88	152.35	335	81	59	648	0.99	a	
3	77.01	156.60	565	86	59	648	0.90	b	
4	84.00	170.56	106	76	61	625	1.16	a	
5	87.10	176.75	239	72	54	536	0.98	b	
6	89.92	182.36	140	70	54	536	0.97	c	
7	92.65	187.82	439	99	74	804	1.45	d	
8	99.24	200.96	49	63	50	470	0.93	a	NET< CL
9	105.63	213.73	43	55	44	387	0.88	a	NET< CL
10	115.40	233.21	49	77	62	615	1.39	a	NET< CL
11	130.15	262.65	124	132	107	1163	2.57	a	Wide Pk
12	143.76	289.82	67	55	44	383	0.74	a	
13	185.88	373.87	346	73	51	518	1.16	a	
14	209.27	420.55	104	62	48	461	1.12	a	
15	238.60	479.08	1447	94	46	411	1.20	a	
16	241.52	484.92	307	71	50	470	1.37	b	
17	270.11	541.96	97	58	45	368	1.39	a	
18	277.28	556.28	37	35	27	186	0.67	a	
19	295.25	592.13	467	68	43	348	1.29	a	
20	300.33	602.27	83	51	39	305	1.08	b	
21	327.95	657.40	25	33	26	171	0.70	a	NET< CL

182685D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	338.24	677.92	264	57	39	280	1.33	a	
23	351.88	705.14	725	70	37	270	1.19	a	
24	463.17	927.23	90	45	34	219	1.49	a	
25	510.94	1022.57	642	78	49	344	2.69	a	Wide Pk
26	558.85	1118.18	52	32	24	130	0.94	a	
27	583.18	1166.74	370	52	28	166	1.36	a	
28	600.21	1200.71	49	52	41	303	1.83	a	
29	609.39	1219.03	535	66	38	256	1.83	a	
30	661.58	1323.20	48	41	32	185	1.68	a	
31	663.10	1326.22	-1	27	22	111	0.96	b	NET< CL
32	694.38	1388.64	49	43	33	193	1.79	a	
33	727.30	1454.35	68	45	35	196	2.49	a	
34	768.48	1536.53	54	29	21	100	1.21	a	
35	794.99	1589.43	53	34	26	126	1.76	a	
36	860.85	1720.86	36	28	21	95	1.44	a	
37	911.37	1821.67	254	44	25	118	1.91	a	
38	969.11	1936.91	91	36	26	132	1.70	a	
39	1120.36	2238.74	92	34	23	105	1.87	a	
40	1238.77	2475.05	54	32	24	100	2.12	a	
41	1460.95	2918.44	765	60	19	56	2.62	a	
42	1765.00	3525.21	86	28	17	43	3.07	a	

182685D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET041128.BKG (112818-4 LONG BKG CAL)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.19	84	65	52	11	96	78	NET<CL
4	84.00	106	76	61	79	94	76	
7	92.65	439	99	74	212	122	97	
12	143.76	67	55	44	43	70	56	NET<CL
13	185.88	346	73	51	182	95	75	
15	238.60	1447	94	46	1403	102	57	
19	295.25	467	68	43	435	84	60	
23	351.88	725	70	37	674	87	57	
25	510.94	642	78	49	120	121	98	
26	558.85	52	32	24	-13	56	46	NET<CL
27	583.18	370	52	28	351	65	44	
28	600.21	49	52	41	17	72	59	NET<CL
29	609.39	535	66	38	489	84	58	
32	694.38	49	43	33	22	62	50	NET<CL
41	1460.95	765	60	19	709	67	33	

182685D04.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-2 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:14
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 24000 Sec
Sample Size . . . . . 1.60e+002 g	Real Time . . . . . 24264 Sec
Collection Efficiency 1.0000	Spectrum File 182685D04.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-7.41E+01 +9.43E+01*L +-4.05E+01*L^2 +5.76E+00*L^3] 09/25/2018
Eff.=10^[-8.67E+00 +8.41E+00*L +-3.13E+00*L^2 +3.49E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
U-238	92.60		1.21E+00	+- 6.95E-01	1.13E+00	5.55E-01	3.92E+13
Pa-234	Average:x		6.09E-02	+- 1.16E-01	. . . .	. . . .	3.95E+13
	131.28		1.47E-01	+- 1.57E-01	2.57E-01	1.27E-01	3.95E+13
	946.00	N	-4.36E-02	+- 1.73E-01	3.02E-01	1.44E-01	3.95E+13
U-235	143.76	N	9.65E-02	+- 1.57E-01	2.60E-01	1.27E-01	3.33E+10
Ra-226	186.10		1.39E+00	+- 7.23E-01	1.16E+00	5.70E-01	1.40E+07
Pb-212	Average:x		1.06E+00	+- 7.69E-02	. . . .	. . . .	5.04E+04
	238.63		1.06E+00	+- 7.75E-02	8.88E-02	4.34E-02	5.04E+04
	300.09		1.01E+00	+- 6.20E-01	9.86E-01	4.77E-01	5.04E+04
Ra-223	269.39		2.49E-01	+- 1.49E-01	2.37E-01	1.15E-01	2.87E+08
Tl-208	Average:x		2.72E-01	+- 4.94E-02	. . . .	. . . .	5.04E+04
	277.36		2.07E-01	+- 1.98E-01	3.21E-01	1.53E-01	5.04E+04
	583.14		2.76E-01	+- 5.11E-02	7.09E-02	3.44E-02	5.04E+04
	860.47		2.72E-01	+- 6.57E-01	8.83E-01	4.30E-01	5.04E+04
Pb-214	Average:x		8.38E-01	+- 8.99E-02	. . . .	. . . .	1.40E+07
	295.21		8.70E-01	+- 1.69E-01	2.46E-01	1.21E-01	1.40E+07
	351.92		8.25E-01	+- 1.06E-01	1.44E-01	7.01E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	. . . .	1.40E+07
Ac-228	Average:x		8.36E-01	+- 1.09E-01	. . . .	. . . .	5.04E+04
	338.40		9.50E-01	+- 2.06E-01	2.90E-01	1.40E-01	5.04E+04
	911.07		8.99E-01	+- 1.56E-01	1.88E-01	8.93E-02	5.04E+04

182685D04.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	968.90		5.65E-01 +- 2.27E-01	3.35E-01	1.59E-01	5.04E+04
Bi-214	Average:x		8.06E-01 +- 1.08E-01	. . . .	. . . .	1.40E+07
	609.31		7.57E-01 +- 1.30E-01	1.85E-01	9.06E-02	1.40E+07
	768.36		9.67E-01 +- 5.21E-01	7.89E-01	3.70E-01	1.40E+07
	1120.29		7.64E-01 +- 2.84E-01	4.10E-01	1.94E-01	1.40E+07
	1238.11		1.24E+00 +- 7.46E-01	1.16E+00	5.47E-01	1.40E+07
	1764.49		1.05E+00 +- 3.42E-01	4.54E-01	2.11E-01	1.40E+07
Bi-212	727.17		4.78E-01 +- 3.17E-01	5.04E-01	2.43E-01	5.04E+04
Tl-210	Average:x		4.71E-02 +- 3.04E-02	. . . .	. . . .	1.40E+07
	795.00		4.71E-02 +- 3.04E-02	4.77E-02	2.27E-02	1.40E+07
	860.00		2.80E-02 +- 2.35E+00	6.17E-01	2.90E-01	1.40E+07
K-40	1460.75		1.05E+01 +- 9.81E-01	1.01E+00	4.83E-01	1.12E+13
Ra-224	241.00		9.64E-01 +- 3.64E+00	8.74E-01	4.25E-01	5.04E+04
Pb-210	46.52	N	9.02E+00 +- 9.61E+00	1.57E+01	7.68E+00	1.79E+05
Tl-201	70.82	N	1.14E+03 +- 1.53E+03	2.52E+03B	1.23E+03	7.35E+01
Ir-192	316.49	N-	6.97E-03 +- 3.50E-02	5.98E-02	2.90E-02	1.78E+03
Be-7	477.56	N	7.60E-02 +- 4.02E-01	6.81E-01	3.28E-01	1.28E+03
Sc-46	889.26	N	2.12E-02 +- 4.45E-02	7.48E-02	3.55E-02	2.01E+03
Na-22	1274.54	N-	1.79E-02 +- 4.35E-02	7.73E-02	3.67E-02	2.28E+04

MEASURED TOTAL: 1.16E+03 +- 1.54E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.19	129.04	11	96	78	539	0.83	Deleted
2	74.88	152.35	335	81	59	648	0.99	Unknown
3	77.01	156.60	565	86	59	648	0.90	Unknown
4	84.00	170.56	79	94	76	625	1.16	Unknown
5	87.10	176.75	239	72	54	536	0.98	Unknown
6	89.92	182.36	140	70	54	536	0.97	Unknown
8	99.24	200.96	49	63	50	470	0.93	Deleted
9	105.63	213.73	43	55	44	387	0.88	Deleted
10	115.40	233.21	49	77	62	615	1.39	Deleted
14	209.27	420.55	104	62	48	461	1.12	Unknown
16	241.52	484.92	307	71	50	470	1.37	SPLIT
21	327.95	657.40	25	33	26	171	0.70	Deleted
24	463.17	927.23	90	45	34	219	1.49	Unknown
25	510.94	1022.57	120	121	98	344	2.69	Unknown
26	558.85	1118.18	-13	56	46	130	0.94	Deleted
28	600.21	1200.71	17	72	59	303	1.83	Deleted
30	661.58	1323.20	48	41	32	185	1.68	Unknown
31	663.10	1326.22	-1	27	22	111	0.96	Deleted

182685D04.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
32	694.38	1388.64	22	62	50	193	1.79	Deleted
36	860.85	1720.86	36	28	21	95	1.44	SPLIT

c:\SEEKER\BIN\182685d04.res Analysis Results Saved.

181897D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-3 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:20
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 5400 Sec
Sample Size . . . . . 2.09E+002 g	Real Time . . . . . 5409 Sec
Collection Efficiency 1.0000	Spc. File 181897D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.61 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	77.18	155.40	53	26	18	79	0.43	a
2	185.76	372.32	29	29	22	102	0.89	a
3	198.41	397.58	24	21	15	56	0.50	a
4	209.12	418.98	22	27	21	90	0.90	a
5	238.51	477.69	180	39	23	110	0.88	a
6	277.55	555.67	28	31	24	93	1.37	a
7	295.25	591.05	49	26	18	65	0.80	a
8	337.99	676.43	43	28	20	81	1.15	a
9	351.81	704.02	127	33	20	74	1.30	a
10	510.92	1021.87	126	39	26	94	2.10	a
11	583.01	1165.89	77	25	15	42	1.66	a
12	609.14	1218.09	98	30	18	66	1.48	a
13	661.70	1323.09	68	24	14	41	1.28	a
14	911.16	1821.43	55	20	11	28	1.39	a
15	969.09	1937.17	26	15	10	22	1.12	a
16	1461.04	2919.93	273	36	11	22	2.34	a
17	1765.37	3527.88	14	11	6	9	1.31	a

181897D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET051128.BKG (112818-5 LONG BKG CAL)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	185.76	29	29	22	3	33	27	NET<CL
3	198.41	24	21	15	0	25	21	NET<CL
5	238.51	180	39	23	162	41	27	
7	295.25	49	26	18	42	28	21	
8	337.99	43	28	20	38	30	23	
9	351.81	127	33	20	111	35	23	
10	510.92	126	39	26	-30	45	38	NET<CL
11	583.01	77	25	15	69	27	17	
12	609.14	98	30	18	81	33	23	
14	911.16	55	20	11	49	21	13	
15	969.09	26	15	10	24	18	12	
16	1461.04	273	36	11	234	37	17	
17	1765.37	14	11	6	10	12	8	

181897D05.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 1810627-3 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:20
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 5400 Sec
Sample Size . . . . . 2.09e+002 g	Real Time . . . . . 5409 Sec
Collection Efficiency 1.0000	Spectrum File 181897D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)

Efficiency File: (D05)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018

Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.10	N	6.33E-02 +- 7.59E-01	1.31E+00	6.22E-01	1.40E+07
Pb-212	238.63		3.51E-01 +- 8.92E-02	1.21E-01	5.78E-02	5.04E+04
Tl-208	Average:x		1.38E-01 +- 5.16E-02	. . . .	. . . .	5.04E+04
	277.36		4.20E-01 +- 4.77E-01	7.81E-01	3.70E-01	5.04E+04
	583.14		1.34E-01 +- 5.20E-02	7.24E-02	3.36E-02	5.04E+04
Pb-214	Average:x		3.41E-01 +- 1.03E-01	. . . .	. . . .	1.40E+07
	295.21		2.21E-01 +- 1.50E-01	2.34E-01	1.10E-01	1.40E+07
	351.92		4.47E-01 +- 1.41E-01	1.95E-01	9.22E-02	1.40E+07
Ac-228	Average:x		3.95E-01 +- 1.35E-01	. . . .	. . . .	5.04E+04
	338.40		4.63E-01 +- 3.70E-01	5.91E-01	2.79E-01	5.04E+04
	911.07		4.04E-01 +- 1.76E-01	2.41E-01	1.09E-01	5.04E+04
	968.90		3.43E-01 +- 2.53E-01	3.87E-01	1.74E-01	5.04E+04
Bi-214	Average:x		3.05E-01 +- 1.16E-01	. . . .	. . . .	1.40E+07
	609.31		3.09E-01 +- 1.25E-01	1.83E-01	8.64E-02	1.40E+07
	1764.49		2.80E-01 +- 3.18E-01	5.12E-01	2.20E-01	1.40E+07
K-40	1460.75		7.83E+00 +- 1.24E+00	1.25E+00	5.79E-01	1.12E+13
Pb-210	46.52	N	-4.80E+01 +- 4.95E+01	9.23E+01	4.36E+01	1.79E+05
Tl-201	70.82	N	2.22E+03 +- 3.66E+03	6.10E+03	2.89E+03	7.35E+01
U-238	92.60	N	-1.28E-01 +- 8.11E-01	1.41E+00	6.73E-01	3.92E+13
U-235	143.76	N	-2.86E-02 +- 2.24E-01	3.91E-01	1.86E-01	3.33E+10
Ra-224	241.00	N	1.93E+00 +- 7.34E-01	1.04E+00b	4.88E-01	5.04E+04

181897D05.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-223	269.39	N	9.50E-02 +- 2.12E-01	3.57E-01	1.69E-01	2.87E+08
Ir-192	316.49	N	2.69E-02 +- 6.24E-02	1.06E-01	4.94E-02	1.78E+03
Be-7	477.56	N	-5.70E-02 +- 5.92E-01	1.05E+00	4.91E-01	1.28E+03
Bi-212	727.17	N	3.83E-01 +- 3.18E-01	4.97E-01	2.26E-01	5.04E+04
Tl-210	795.00	N	1.23E-02 +- 3.68E-02	6.38E-02	2.91E-02	1.40E+07
Sc-46	889.26	N	-4.93E-02 +- 6.27E-02	1.20E-01	5.57E-02	2.01E+03
Pa-234	946.00	N	-1.59E-01 +- 1.91E-01	3.78E-01	1.73E-01	3.95E+13
Na-22	1274.54	N	1.54E-02 +- 4.18E-02	7.36E-02	3.23E-02	2.28E+04

MEASURED TOTAL: 2.23E+03 +- 3.67E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	77.18	155.40	53	26	18	79	0.43	Unknown
3	198.41	397.58	0	25	21	57	0.50	Deleted
4	209.12	418.98	22	27	21	90	0.90	Unknown
10	510.92	1021.87	-30	45	38	94	2.10	Deleted
13	661.70	1323.09	68	24	14	41	1.28	Unknown

c:\SEEKER\BIN\181897d05.res Analysis Results Saved.

181952D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-3D GS181103-1

Sampling Start:	10/22/2018 12:00:00	Counting Start:	12/04/2018 10:18:29
Sampling Stop:	10/22/2018 12:00:00	Decay Time.	1.03E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	4500 Sec
Sample Size	2.18E+002 g	Real Time	4547 Sec
Collection Efficiency	1.0000	Spc. File	.181952D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.27 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.57	97.38	48	34	25	111	1.11	a
2	63.23	130.61	59	25	16	65	0.46	a
3	74.84	153.78	85	32	22	94	0.83	a
4	77.01	158.10	140	35	22	94	0.77	b
5	87.23	178.48	28	20	14	56	0.41	a
6	92.62	189.23	76	37	27	138	1.00	a
7	185.76	374.96	43	22	15	47	0.70	a
8	208.90	421.12	27	26	19	70	1.05	a
9	238.58	480.29	177	37	21	89	0.81	a
10	295.14	593.10	51	26	18	57	1.19	a
11	338.66	679.88	40	24	17	50	1.19	a
12	351.97	706.42	105	30	18	54	1.23	a
13	511.03	1023.62	125	34	22	69	2.01	a
14	558.77	1118.83	24	18	12	29	1.20	a
15	583.36	1167.87	40	20	13	34	1.07	a
16	609.63	1220.25	79	23	12	28	1.21	a
17	661.97	1324.63	52	21	13	33	1.12	a
18	911.47	1822.18	37	15	8	12	1.42	a
19	1460.64	2917.34	168	27	5	4	2.09	a

181952D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET081128.BKG (112818-8 LONG BKG CAL)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.57	48	34	25	22	36	28	NET<CL
2	63.23	59	25	16	16	29	23	NET<CL
3	74.84	85	32	22	65	34	24	
4	77.01	140	35	22	120	37	25	
5	87.23	28	20	14	22	23	17	
6	92.62	76	37	27	17	40	32	NET<CL
7	185.76	43	22	15	19	24	19	
9	238.58	177	37	21	151	39	25	
10	295.14	51	26	18	40	28	21	
11	338.66	40	24	17	35	26	19	
12	351.97	105	30	18	90	31	20	
13	511.03	125	35	22	-7	39	33	NET<CL
14	558.77	24	18	12	6	20	16	NET<CL
15	583.36	40	20	13	32	22	16	
16	609.63	79	23	12	64	25	16	
18	911.47	37	15	8	31	16	10	
19	1460.64	168	27	5	153	27	10	

181952D08.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-3D GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:29
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 4500 Sec
Sample Size . . . . . 2.18e+002 g	Real Time . . . . . 4547 Sec
Collection Efficiency 1.0000	Spectrum File 181952D08.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 8 (Detector 8)

Efficiency File: (D08)(Sh17).EFF (Geo 17 Eff Cal)
Eff.=1/[5.03E-02*En^-2.20E+00 + 1.32E+02*En^8.10E-01] 05/17/2018

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52	N	8.35E-01 +- 1.34E+00	2.23E+00	1.06E+00	1.79E+05
U-238	92.60	N	2.48E-01 +- 5.69E-01	9.55E-01	4.58E-01	3.92E+13
Ra-226	186.10		5.39E-01 +- 6.83E-01	1.12E+00	5.24E-01	1.40E+07
Pb-212	238.63		4.17E-01 +- 1.07E-01	1.44E-01	6.81E-02	5.04E+04
Pb-214	Average:x		3.68E-01 +- 1.15E-01	. . . .	. . . .	1.40E+07
	295.21		2.99E-01 +- 2.11E-01	3.31E-01	1.55E-01	1.40E+07
	351.92		3.97E-01 +- 1.37E-01	1.90E-01	8.91E-02	1.40E+07
Ac-228	Average:x		3.89E-01 +- 1.68E-01	. . . .	. . . .	5.04E+04
	338.40		4.53E-01 +- 3.37E-01	5.30E-01	2.47E-01	5.04E+04
	911.07		3.68E-01 +- 1.94E-01	2.69E-01	1.18E-01	5.04E+04
Tl-208	583.14		8.98E-02 +- 6.20E-02	9.57E-02	4.41E-02	5.04E+04
Bi-214	609.31		3.52E-01 +- 1.38E-01	1.92E-01	8.84E-02	1.40E+07
K-40	1460.75		7.08E+00 +- 1.26E+00	1.01E+00	4.43E-01	1.12E+13
Tl-201	70.82	N	-5.37E+01 +- 8.89E+02	1.55E+03	7.34E+02	7.35E+01
U-235	143.76	N	-2.05E-01 +- 2.19E-01	4.06E-01	1.92E-01	3.33E+10
Ra-224	241.00	N	1.66E+00 +- 1.31E+00	1.96E+00r	9.39E-01	5.04E+04
Ra-223	269.39	N	1.42E-01 +- 2.23E-01	3.72E-01	1.73E-01	2.87E+08
Ir-192	316.49	N	-6.24E-03 +- 5.62E-02	1.00E-01	4.66E-02	1.78E+03
Be-7	477.56	N	-3.84E-02 +- 5.41E-01	9.90E-01	4.49E-01	1.28E+03
Bi-212	727.17	N	3.03E-02 +- 3.56E-01	6.44E-01	2.89E-01	5.04E+04
Tl-210	795.00	N	3.70E-02 +- 4.28E-02	6.94E-02	3.06E-02	1.40E+07
Sc-46	889.26	N	9.47E-03 +- 6.28E-02	1.14E-01	5.05E-02	2.01E+03

181952D08.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pa-234	946.00	N	3.50E-02 +- 2.27E-01	4.11E-01	1.82E-01	3.95E+13
Na-22	1274.54	N	-3.67E-02 +- 4.85E-02	1.03E-01	4.52E-02	2.28E+04

MEASURED TOTAL: 1.22E+01 +- 6.67E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	63.23	130.61	16	29	23	65	0.46	Deleted
3	74.84	153.78	65	34	24	94	0.83	Unknown
4	77.01	158.10	120	37	25	94	0.77	Unknown
5	87.23	178.48	22	23	17	56	0.41	Unknown
8	208.90	421.12	27	26	19	70	1.05	Unknown
13	511.03	1023.62	-7	39	33	69	2.01	Deleted
14	558.77	1118.83	6	20	16	29	1.20	Deleted
17	661.97	1324.63	52	21	13	33	1.12	Unknown

c:\SEEKER\BIN\181952d08.res Analysis Results Saved.

181815D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-4 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:38
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.17E+002 g	Real Time . . . . . 7257 Sec
Collection Efficiency 1.0000	Spc. File 181815D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.19 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018

FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018

Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.42	96.98	49	30	22	106	0.62	a	
2	63.15	130.34	56	33	24	130	0.67	a	
3	74.69	153.35	142	44	31	176	0.93	a	
4	77.02	158.01	209	44	27	147	0.81	b	
5	87.21	178.34	39	47	37	238	1.09	a	
6	92.71	189.32	101	43	31	177	1.05	a	
7	186.03	375.46	75	49	37	182	1.87	a	Wide Pk
8	238.63	480.40	230	44	26	122	0.98	a	
9	295.11	593.05	80	30	20	71	0.92	a	
10	338.40	679.40	38	19	12	35	0.56	a	
11	352.03	706.61	166	34	18	54	1.14	a	
12	510.61	1022.94	120	36	23	84	1.73	a	
13	512.07	1025.84	79	35	25	92	2.03	b	
14	583.47	1168.28	92	28	16	44	1.58	a	
15	609.36	1219.92	81	28	18	58	1.28	a	
16	661.85	1324.63	76	28	18	59	1.43	a	
17	803.27	1606.75	26	15	9	18	1.17	a	
18	911.26	1822.16	38	18	11	24	1.40	a	
19	969.13	1937.59	21	13	8	16	0.85	a	
20	1460.55	2917.90	239	32	6	6	1.75	a	
21	1763.65	3522.52	21	14	9	13	2.45	a	

181815D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET091128.BKG (112818-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.42	49	30	22	9	37	30	NET<CL
2	63.15	56	33	24	16	39	31	NET<CL
3	74.69	142	44	31	119	47	35	
4	77.02	209	44	27	184	48	32	
5	87.21	39	47	37	28	50	40	NET<CL
6	92.71	101	43	31	28	47	38	NET<CL
7	186.03	75	49	37	39	51	41	NET<CL
8	238.63	230	44	26	199	46	30	
9	295.11	80	30	20	70	33	23	
10	338.40	38	19	12	34	21	14	
11	352.03	166	34	18	145	36	22	
12	510.61	120	36	23	-66	46	40	NET<CL
14	583.47	92	28	16	80	30	20	
15	609.36	81	28	18	68	31	21	
17	803.27	26	15	9	16	18	13	
18	911.26	38	18	11	31	19	13	
20	1460.55	239	32	6	221	33	12	
21	1763.65	21	14	9	17	16	11	

181815D09.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-4 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:18:38
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.17e+002 g	Real Time . . . . . 7257 Sec
Collection Efficiency 1.0000	Spectrum File 181815D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.47E+01 +1.58E+01*L +-5.94E+00*L^2 +6.70E-01*L^3] 11/06/2018
Eff.=10^[-4.97E+00 +4.67E+00*L +-1.91E+00*L^2 +2.19E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52	N	2.17E-01 +- 9.19E-01	1.56E+00	7.47E-01	1.79E+05
U-238	92.60	N	2.74E-01 +- 4.61E-01	7.66E-01	3.70E-01	3.92E+13
Ra-226	186.10	N	7.71E-01 +- 1.02E+00	1.68E+00	8.11E-01	1.40E+07
Pb-212	238.63		4.12E-01 +- 9.63E-02	1.32E-01	6.30E-02	5.04E+04
Pb-214	Average:x		4.59E-01 +- 1.01E-01	. . . .	. . . .	1.40E+07
	295.21		4.32E-01 +- 2.01E-01	3.00E-01	1.42E-01	1.40E+07
	351.92		4.68E-01 +- 1.17E-01	1.53E-01	7.22E-02	1.40E+07
Ac-228	Average:x		3.07E-01 +- 1.11E-01	. . . .	. . . .	5.04E+04
	338.40		3.21E-01 +- 1.99E-01	2.99E-01	1.36E-01	5.04E+04
	911.07		2.79E-01 +- 1.74E-01	2.60E-01	1.18E-01	5.04E+04
	968.90		3.31E-01 +- 2.11E-01	2.95E-01	1.26E-01	5.04E+04
Tl-208	583.14		1.64E-01 +- 6.25E-02	8.88E-02	4.16E-02	5.04E+04
Bi-214	Average:x		2.90E-01 +- 1.19E-01	. . . .	. . . .	1.40E+07
	609.31		2.76E-01 +- 1.24E-01	1.82E-01	8.57E-02	1.40E+07
	1764.49		4.77E-01 +- 4.60E-01	7.33E-01	3.28E-01	1.40E+07
K-40	1460.75		7.88E+00 +- 1.17E+00	9.36E-01	4.20E-01	1.12E+13
Tl-201	70.82	N	6.37E+02 +- 7.35E+02	1.20E+03B	5.74E+02	7.35E+01
U-235	143.76	N	-5.90E-02 +- 1.83E-01	3.22E-01	1.54E-01	3.33E+10
Ra-224	241.00	N	4.86E-01 +- 1.13E+00	1.85E+00r	8.92E-01	5.04E+04
Ra-223	269.39	N	3.72E-02 +- 2.18E-01	3.75E-01	1.77E-01	2.87E+08
Ir-192	316.49	N	-1.55E-02 +- 4.70E-02	8.42E-02	3.96E-02	1.78E+03

181815D09.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Be-7	477.56	N	-9.38E-02	+- 4.78E-01	8.70E-01	4.01E-01	1.28E+03
Bi-212	727.17	N	4.19E-01	+- 3.57E-01	5.62E-01	2.57E-01	5.04E+04
Tl-210	795.00	N	2.90E-02	+- 3.94E-02	6.52E-02	2.95E-02	1.40E+07
Sc-46	889.26	N	4.01E-02	+- 5.00E-02	8.19E-02	3.61E-02	2.01E+03
Pa-234	946.00	N	5.30E-02	+- 1.91E-01	3.38E-01	1.51E-01	3.95E+13
Na-22	1274.54	N	-7.74E-03	+- 4.91E-02	9.20E-02	4.13E-02	2.28E+04

MEASURED TOTAL: 6.48E+02 +- 7.41E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	63.15	130.34	16	39	31	130	0.67	Deleted
3	74.69	153.35	119	47	35	176	0.93	Unknown
4	77.02	158.01	184	48	32	147	0.81	Unknown
5	87.21	178.34	28	50	40	238	1.09	Deleted
12	510.61	1022.94	-66	46	40	84	1.73	Deleted
13	512.07	1025.84	79	35	25	92	2.03	Unknown
16	661.85	1324.63	76	28	18	59	1.43	Unknown
17	803.27	1606.75	16	18	13	18	1.17	Unknown

c:\SEEKER\BIN\181815d09.res Analysis Results Saved.

182187D02.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-5 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:25:08
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.14E+002 g	Real Time . . . . . 7247 Sec
Collection Efficiency 1.0000	Spc. File 182187D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.31 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	66.72	135.79	47	60	48	320	1.67 a	NET< CL
2	74.70	151.71	54	33	24	129	0.60 a	
3	77.18	156.66	77	34	24	129	0.72 b	
4	185.78	373.42	107	41	29	165	1.21 a	
5	238.59	478.83	426	56	31	178	1.38 a	
6	241.67	484.97	67	48	37	223	1.56 b	
7	260.06	521.67	30	32	25	119	1.17 a	
8	295.20	591.81	124	37	25	121	1.11 a	
9	338.33	677.90	86	35	25	112	1.34 a	
10	351.91	705.01	276	45	25	111	1.46 a	
11	510.88	1022.31	241	47	30	117	2.35 a	
12	583.27	1166.78	127	33	20	79	1.47 a	
13	609.43	1219.00	180	40	24	102	1.76 a	
14	795.16	1589.69	36	20	13	36	1.27 a	
15	911.47	1821.85	66	26	16	52	1.73 a	
16	969.31	1937.30	48	23	15	41	1.82 a	
17	1460.87	2918.42	374	42	13	26	2.84 a	
18	1764.72	3524.89	31	14	7	10	2.18 a	

182187D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET021128.BKG (112818-2 LONG BKG CAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	66.72	47	60	48	12	68	55	NET<CL
2	74.70	54	33	24	26	60	48	NET<CL
4	185.78	107	41	29	62	46	36	
5	238.59	426	56	31	387	61	38	
8	295.20	124	37	25	115	41	28	
10	351.91	276	45	25	248	49	31	
11	510.88	241	47	30	44	57	46	NET<CL
12	583.27	127	33	20	114	35	23	
13	609.43	180	40	24	162	43	29	
15	911.47	66	26	16	56	28	19	
17	1460.87	374	42	13	331	44	20	
18	1764.72	31	14	7	24	16	11	

182187D02.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 1810627-5 GS181103-1

Sampling Start: 10/22/2018 12:00:00	Counting Start: 12/04/2018 10:25:08
Sampling Stop: 10/22/2018 12:00:00	Decay Time. . . . . 1.03e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.14e+002 g	Real Time . . . . . 7247 Sec
Collection Efficiency 1.0000	Spectrum File 182187D02.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.25E+02 +1.62E+02*L +-7.06E+01*L^2 +1.02E+01*L^3] 09/06/2018

Eff.=10^[-1.14E+01 +1.13E+01*L +-4.16E+00*L^2 +4.74E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.10		1.13E+00 +- 8.49E-01	1.36E+00	6.58E-01	1.40E+07
Pb-212	238.63		6.72E-01 +- 1.06E-01	1.38E-01	6.67E-02	5.04E+04
Pb-214	Average:x		5.64E-01 +- 9.83E-02	. . . .	. . . .	1.40E+07
	295.21		4.70E-01 +- 1.66E-01	2.44E-01	1.16E-01	1.40E+07
	351.92		6.14E-01 +- 1.22E-01	1.61E-01	7.71E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		4.68E-01 +- 1.26E-01	. . . .	. . . .	5.04E+04
	338.40		6.27E-01 +- 2.57E-01	3.79E-01	1.80E-01	5.04E+04
	911.07		3.59E-01 +- 1.77E-01	2.63E-01	1.23E-01	5.04E+04
	968.90		5.37E-01 +- 2.53E-01	3.59E-01	1.64E-01	5.04E+04
Tl-208	583.14		1.71E-01 +- 5.31E-02	7.36E-02	3.48E-02	5.04E+04
Bi-214	Average:x		4.78E-01 +- 1.19E-01	. . . .	. . . .	1.40E+07
	609.31		4.77E-01 +- 1.28E-01	1.79E-01	8.55E-02	1.40E+07
	1764.49		4.84E-01 +- 3.26E-01	4.82E-01	2.14E-01	1.40E+07
Tl-210	795.00		5.84E-02 +- 3.28E-02	4.79E-02	2.17E-02	1.40E+07
K-40	1460.75		8.27E+00 +- 1.09E+00	1.06E+00	4.95E-01	1.12E+13
Ra-224	241.00		1.85E-01 +- 5.56E+00	1.47E+00	7.09E-01	5.04E+04
Pb-210	46.52	N	1.03E+01 +- 1.04E+02	1.77E+02	8.52E+01	1.79E+05
Tl-201	70.82	N	2.28E+03 +- 6.00E+03	1.00E+04	4.87E+03	7.35E+01
U-238	92.60	N	-6.48E-02 +- 8.98E-01	1.53E+00	7.41E-01	3.92E+13
U-235	143.76	N	8.34E-03 +- 2.23E-01	3.82E-01	1.83E-01	3.33E+10

182187D02.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-223	269.39	N	2.86E-01 +- 2.00E-01	3.16E-01	1.50E-01	2.87E+08
Ir-192	316.49	N	1.28E-02 +- 4.75E-02	8.07E-02	3.84E-02	1.78E+03
Be-7	477.56	N	8.57E-02 +- 5.02E-01	8.66E-01	4.08E-01	1.28E+03
Bi-212	727.17	N	1.96E-01 +- 3.07E-01	5.11E-01	2.38E-01	5.04E+04
Sc-46	889.26	N	5.56E-03 +- 4.87E-02	8.61E-02	3.96E-02	2.01E+03
Pa-234	946.00	N	-2.08E-01 +- 1.69E-01	3.40E-01	1.57E-01	3.95E+13
Na-22	1274.54	N	-1.08E-02 +- 4.77E-02	8.69E-02	4.01E-02	2.28E+04

MEASURED TOTAL: 2.30E+03 +- 6.11E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	66.72	135.79	12	68	55	320	1.67	Deleted
2	74.70	151.71	26	60	48	129	0.60	Deleted
3	77.18	156.66	77	34	24	129	0.72	Unknown
6	241.67	484.97	67	48	37	223	1.56	SPLIT
7	260.06	521.67	30	32	25	119	1.17	Unknown
11	510.88	1022.31	44	57	46	117	2.35	Deleted

c:\SEEKER\BIN\182187d02.res Analysis Results Saved.

181992D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-6 GS181103-1

Sampling Start:	10/23/2018 12:00:00	Counting Start:	12/04/2018 10:26:44
Sampling Stop:	10/23/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	2.54E+002 g	Real Time	3616 Sec
Collection Efficiency	1.0000	Spc. File	.181992D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.03 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	74.76	153.23	98	54	42	276	1.29	a	
2	77.01	157.71	124	42	29	173	0.80	b	
3	86.99	177.63	22	28	21	114	0.55	a	
4	92.63	188.90	80	39	28	162	0.82	a	
5	139.61	282.64	35	39	31	159	1.09	a	
6	143.74	290.88	20	38	31	159	1.08	b	NET< CL
7	185.84	374.89	101	44	32	190	1.31	a	
8	198.41	399.98	53	37	28	151	1.15	a	
9	238.63	480.23	353	52	30	165	1.29	a	
10	241.87	486.70	87	38	27	144	1.09	b	
11	269.78	542.41	41	35	27	132	1.27	a	
12	295.21	593.15	173	40	24	109	1.33	a	
13	338.55	679.64	44	33	25	116	1.29	a	
14	352.03	706.54	365	47	23	100	1.33	a	
15	433.00	868.10	17	26	20	74	1.32	a	NET< CL
16	511.10	1023.96	298	55	35	176	2.63	a	Wide Pk
17	558.46	1118.46	58	29	21	75	1.75	a	
18	583.45	1168.33	100	34	23	97	1.57	a	
19	609.54	1220.39	265	45	26	125	1.63	a	
20	727.70	1456.18	26	19	13	38	0.92	a	
21	911.39	1822.75	79	27	17	52	2.07	a	

181992D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	969.53	1938.76	40	26	19	66	1.78	a
23	1120.89	2240.82	52	27	19	56	2.47	a
24	1460.61	2918.74	540	50	16	38	2.94	a
25	1764.04	3524.22	56	19	10	16	2.34	a

181992D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

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Background File:. . . . . DET101128.BKG (112818-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	74.76	98	54	42	54	58	47	
2	77.01	124	42	29	68	46	36	
3	86.99	22	28	21	10	31	25	NET<CL
4	92.63	80	39	28	8	44	36	NET<CL
5	139.61	35	39	31	5	42	34	NET<CL
6	143.74	20	38	31	11	41	33	NET<CL
7	185.84	101	44	32	21	48	39	NET<CL
8	198.41	53	37	28	-3	40	33	NET<CL
9	238.63	353	52	30	290	55	35	
10	241.87	87	38	27	38	41	32	
11	269.78	41	35	27	38	36	28	
12	295.21	173	40	24	79	43	32	
13	338.55	44	33	25	32	35	27	
14	352.03	365	48	23	177	51	36	
16	511.10	298	55	35	0	61	50	NET<CL
17	558.46	58	29	21	13	32	25	NET<CL
18	583.45	100	34	23	65	37	27	
19	609.54	265	45	26	125	49	36	
21	911.39	79	27	17	55	29	21	
22	969.53	40	26	19	26	27	21	
23	1120.89	52	27	19	17	29	22	NET<CL
24	1460.61	540	50	16	467	52	23	
25	1764.04	56	19	10	24	21	15	

181992D10.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-6 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 10:26:44
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 2.54e+002 g	Real Time . . . . . 3616 Sec
Collection Efficiency 1.0000	Spectrum File 181992D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)
Efficiency File: (D10)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018
Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV
Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60	N	9.92E-02 +- 5.10E-01	8.64E-01	4.16E-01	3.92E+13
Ra-226	186.10	N	3.35E-01 +- 7.70E-01	1.29E+00	6.22E-01	1.40E+07
Pb-212	238.63		4.26E-01 +- 8.06E-02	1.08E-01	5.19E-02	5.04E+04
Ra-224	241.00		6.20E-01 +- 6.71E-01	1.10E+00	5.26E-01	5.04E+04
Ra-223	269.39		1.84E-01 +- 1.73E-01	2.81E-01	1.34E-01	2.87E+08
Pb-214	Average:x		3.43E-01 +- 8.85E-02	. . . .	. . . .	1.40E+07
	295.21		2.85E-01 +- 1.55E-01	2.42E-01	1.16E-01	1.40E+07
	351.92		3.71E-01 +- 1.08E-01	1.57E-01	7.57E-02	1.40E+07
Ac-228	Average:x		2.35E-01 +- 1.03E-01	. . . .	. . . .	5.04E+04
	338.40		2.02E-01 +- 2.18E-01	3.56E-01	1.69E-01	5.04E+04
	911.07		2.57E-01 +- 1.37E-01	2.08E-01	9.74E-02	5.04E+04
	968.90		2.12E-01 +- 2.24E-01	3.65E-01	1.71E-01	5.04E+04
Tl-208	583.14		7.51E-02 +- 4.23E-02	6.56E-02	3.12E-02	5.04E+04
Bi-214	Average:x		2.86E-01 +- 1.02E-01	. . . .	. . . .	1.40E+07
	609.31		2.81E-01 +- 1.10E-01	1.67E-01	8.07E-02	1.40E+07
	1764.49		3.20E-01 +- 2.80E-01	4.44E-01	2.04E-01	1.40E+07
Bi-212	727.17		2.53E-01 +- 1.81E-01	2.77E-01	1.25E-01	5.04E+04
K-40	1460.75		8.15E+00 +- 8.98E-01	8.54E-01	4.03E-01	1.12E+13
Pb-210	46.52	N	-2.42E+00 +- 6.41E+00	1.11E+01	5.36E+00	1.79E+05
Tl-201	70.82	N	2.26E+02 +- 1.37E+03	2.32E+03B	1.12E+03	7.35E+01
U-235	143.76	N	2.55E-02 +- 1.89E-01	3.22E-01b	1.54E-01	3.33E+10

181992D10.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ir-192	316.49	N	8.75E-03 +- 4.07E-02	6.94E-02	3.30E-02	1.78E+03
Be-7	477.56	N	1.73E-01 +- 3.51E-01	5.92E-01	2.77E-01	1.28E+03
Tl-210	795.00	N	1.58E-02 +- 2.97E-02	5.00E-02	2.33E-02	1.40E+07
Sc-46	889.26	N	2.62E-02 +- 4.24E-02	7.09E-02	3.29E-02	2.01E+03
Pa-234	946.00	N	-6.34E-03 +- 1.42E-01	2.53E-01	1.17E-01	3.95E+13
Na-22	1274.54	N	1.86E-02 +- 3.45E-02	5.83E-02	2.67E-02	2.28E+04

MEASURED TOTAL: 2.37E+02 +- 1.38E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.76	153.23	54	58	47	276	1.29	Unknown
2	77.01	157.71	68	46	36	173	0.80	Unknown
3	86.99	177.63	10	31	25	114	0.55	Deleted
5	139.61	282.64	5	42	34	159	1.09	Deleted
6	143.74	290.88	11	41	33	159	1.08	Deleted
8	198.41	399.98	-3	40	33	151	1.15	Deleted
15	433.00	868.10	17	26	20	74	1.32	Deleted
16	511.10	1023.96	0	61	50	176	2.63	Deleted
17	558.46	1118.46	13	32	25	75	1.75	Deleted
23	1120.89	2240.82	17	29	22	56	2.47	Deleted

c:\SEEKER\BIN\181992d10.res Analysis Results Saved.

182018D07.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-7 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 11:35:17
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.71E+002 g	Real Time . . . . . 18051 Sec
Collection Efficiency 1.0000	Spc. File 182018D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.42 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	44.73	94.00	13	33	27	174	0.42	a	NET< CL
2	53.97	112.42	51	60	48	393	1.14	a	
3	66.22	136.83	30	66	54	491	1.21	a	NET< CL
4	70.30	144.98	18	66	54	491	1.11	b	NET< CL
5	74.78	153.90	113	55	42	351	0.80	c	
6	76.99	158.31	177	57	42	351	0.88	d	
7	87.05	178.36	46	50	40	322	0.80	a	
8	89.92	184.08	30	36	28	193	0.45	b	
9	92.60	189.43	150	61	46	386	1.02	c	
10	129.02	262.02	53	46	36	263	0.89	a	
11	144.59	293.08	38	43	34	235	0.81	a	
12	185.83	375.29	176	66	50	397	1.27	a	
13	198.25	400.03	75	45	35	242	0.87	a	
14	238.65	480.58	661	68	37	248	1.06	a	
15	241.66	486.58	151	66	50	372	1.47	b	
16	270.08	543.23	61	52	41	264	1.39	a	
17	277.58	558.18	65	55	44	282	1.54	a	
18	295.39	593.69	194	50	34	215	0.92	a	
19	306.25	615.33	31	44	35	214	1.17	a	NET< CL
20	338.57	679.76	104	43	32	184	1.00	a	
21	352.02	706.57	375	52	29	154	0.97	a	

182018D07.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	462.98	927.78	3	84	69	460	3.73	a	NET< CL Wide Pk
23	511.36	1024.22	564	71	44	244	2.42	a	Wide Pk
24	558.68	1118.54	59	31	22	100	1.06	a	
25	583.66	1168.35	183	44	28	137	1.56	a	
26	609.68	1220.22	306	50	30	163	1.38	a	
27	661.99	1324.49	34	28	21	88	1.14	a	
28	803.49	1606.57	33	23	16	61	1.06	a	
29	861.04	1721.30	30	26	19	74	1.31	a	
30	911.45	1821.79	165	38	23	91	1.98	a	
31	969.46	1937.44	59	25	16	57	1.20	a	
32	1120.70	2238.93	38	26	19	74	1.40	a	
33	1460.94	2917.18	527	50	17	50	2.33	a	
34	1764.60	3522.53	69	21	11	20	2.38	a	

182018D07.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET071128.BKG (112818-7 LONG BKG CAL)

Bkg.File Detector #: 7

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	44.73	13	33	27	-13	66	55	NET<CL
2	53.97	51	60	48	30	74	60	NET<CL
3	66.22	30	66	54	-25	82	68	NET<CL
4	70.30	18	66	54	7	80	66	NET<CL
5	74.78	113	55	42	71	69	55	
6	76.99	177	57	42	138	79	62	
9	92.60	150	61	46	42	80	65	NET<CL
12	185.83	176	66	50	97	79	63	
13	198.25	75	45	35	-8	66	54	NET<CL
14	238.65	661	68	37	577	80	53	
18	295.39	194	50	34	163	62	46	
20	338.57	104	43	32	93	52	39	
21	352.02	375	52	29	322	63	43	
23	511.36	564	71	44	60	103	84	NET<CL
24	558.68	59	31	22	-6	46	38	NET<CL
25	583.66	183	44	28	137	58	44	
26	609.68	306	50	30	261	64	46	
28	803.49	33	23	16	0	36	29	NET<CL
30	911.45	165	38	23	139	48	34	
33	1460.94	527	50	17	447	58	32	
34	1764.60	69	21	11	56	26	18	

182018D07.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-7 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 11:35:17
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.71e+002 g	Real Time . . . . . 18051 Sec
Collection Efficiency 1.0000	Spectrum File 182018D07.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 7 (Detector 7)

Efficiency File: (D07)(Sh17).EFF (DET 7 GEO 17 Eff Cal)
Eff=10^[-1.18E+02 +1.52E+02*L +-6.65E+01*L^2 +9.63E+00*L^3] 09/25/2018
Eff.=10^[9.78E-01 +-1.35E+00*L +1.03E-01*L^2 +-1.37E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60	N	4.69E-01 +- 8.80E-01	1.46E+00	7.14E-01	3.92E+13
U-235	143.76		1.35E-01 +- 1.54E-01	2.53E-01	1.21E-01	3.33E+10
Ra-226	186.10		1.13E+00 +- 9.27E-01	1.51E+00	7.39E-01	1.40E+07
Pb-212	238.63		6.36E-01 +- 8.86E-02	1.20E-01	5.85E-02	5.04E+04
Ra-223	269.39		2.19E-01 +- 1.85E-01	3.00E-01	1.45E-01	2.87E+08
Tl-208	Average:x		1.46E-01 +- 5.85E-02	. . . .	. . . .	5.04E+04
	277.36		4.94E-01 +- 4.20E-01	6.81E-01	3.30E-01	5.04E+04
	583.14		1.39E-01 +- 5.93E-02	9.22E-02	4.47E-02	5.04E+04
	860.47		1.46E-01 +- 7.26E-01	9.78E-01	4.76E-01	5.04E+04
Pb-214	Average:x		4.86E-01 +- 8.46E-02	. . . .	. . . .	1.40E+07
	295.21		4.25E-01 +- 1.61E-01	2.48E-01	1.20E-01	1.40E+07
	351.92		5.09E-01 +- 9.95E-02	1.39E-01	6.73E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		4.90E-01 +- 1.19E-01	. . . .	. . . .	5.04E+04
	338.40		4.29E-01 +- 2.39E-01	3.78E-01	1.83E-01	5.04E+04
	911.07		5.95E-01 +- 2.04E-01	3.04E-01	1.46E-01	5.04E+04
	968.90		4.40E-01 +- 1.86E-01	2.63E-01	1.21E-01	5.04E+04
Bi-214	Average:x		5.11E-01 +- 1.08E-01	. . . .	. . . .	1.40E+07
	609.31		5.19E-01 +- 1.28E-01	1.87E-01	9.09E-02	1.40E+07
	1120.29		3.68E-01 +- 2.50E-01	3.88E-01	1.81E-01	1.40E+07
	1764.49		7.27E-01 +- 3.45E-01	5.05E-01	2.35E-01	1.40E+07

182018D07.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
K-40	1460.75		7.31E+00 +- 9.42E-01	1.10E+00	5.27E-01	1.12E+13
Tl-210	Average:x		3.97E-02 +- 3.16E-02	. . . .	. . . .	1.40E+07
	860.00		2.55E-01 +- 2.60E+00	6.83E-01	3.19E-01	1.40E+07
	795.00	N	3.97E-02 +- 3.16E-02	5.02E-02	2.36E-02	1.40E+07
Ra-224	241.00		8.95E-01 +- 4.86E+00	1.26E+00	6.13E-01	5.04E+04
Pb-210	46.52	N	1.24E+01 +- 5.65E+01	9.54E+01	4.60E+01	1.79E+05
Tl-201	70.82	N	3.05E+03 +- 2.43E+03	3.93E+03B	1.90E+03	7.35E+01
Ir-192	316.49	N	-4.40E-04 +- 3.66E-02	6.26E-02	3.01E-02	1.78E+03
Be-7	477.56	N	3.68E-02 +- 3.96E-01	6.81E-01	3.24E-01	1.28E+03
Bi-212	727.17	N	2.89E-01 +- 3.70E-01	6.09E-01	2.92E-01	5.04E+04
Sc-46	889.26	N	-5.11E-02 +- 4.62E-02	8.66E-02	4.10E-02	2.01E+03
Pa-234	946.00	N	-6.30E-02 +- 1.48E-01	2.69E-01	1.26E-01	3.95E+13
Na-22	1274.54	N	3.26E-03 +- 3.58E-02	6.27E-02	2.92E-02	2.28E+04

MEASURED TOTAL: 3.07E+03 +- 2.50E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	44.73	94.00	-13	66	55	174	0.42	Deleted
2	53.97	112.42	30	74	60	393	1.14	Deleted
3	66.22	136.83	-25	82	68	491	1.21	Deleted
4	70.30	144.98	7	80	66	491	1.11	Deleted
5	74.78	153.90	71	69	55	351	0.80	Unknown
6	76.99	158.31	138	79	62	351	0.88	Unknown
7	87.05	178.36	46	50	40	322	0.80	Unknown
8	89.92	184.08	30	36	28	193	0.45	Unknown
10	129.02	262.02	53	46	36	263	0.89	Unknown
13	198.25	400.03	-8	66	54	242	0.87	Deleted
15	241.66	486.58	151	66	50	372	1.47	SPLIT
19	306.25	615.33	31	44	35	214	1.17	Deleted
22	462.98	927.78	3	84	69	460	3.73	Deleted
23	511.36	1024.22	60	103	84	244	2.42	Deleted
24	558.68	1118.54	-6	46	38	100	1.06	Deleted
27	661.99	1324.49	34	28	21	88	1.14	Unknown
28	803.49	1606.57	0	36	29	61	1.06	Deleted
29	861.04	1721.30	30	26	19	74	1.31	SPLIT

c:\SEEKER\BIN\182018d07.res Analysis Results Saved.

182154D01.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-8 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 10:59:29
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 5400 Sec
Sample Size . . . . . 2.59E+002 g	Real Time . . . . . 5407 Sec
Collection Efficiency 1.0000	Spc. File 182154D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.89 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.66 + 0.012*En + 6.94E-04*En^2 + 0.00E+00*En^3 08/21/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	77.16	157.79	28	27	21	94	0.68	a	
2	86.96	177.36	14	21	16	67	0.45	a	NET< CL
3	185.98	375.01	46	39	30	135	1.44	a	
4	238.61	480.08	123	36	23	101	0.93	a	
5	295.14	592.92	59	30	21	69	1.23	a	
6	337.86	678.19	35	29	22	72	1.55	a	
7	351.91	706.24	86	30	20	65	1.10	a	
8	511.13	1024.06	104	33	21	63	2.12	a	Wide Pk
9	583.28	1168.09	71	23	13	28	1.46	a	
10	609.39	1220.19	86	27	16	50	1.38	a	
11	911.43	1823.10	29	18	12	28	1.35	a	
12	1461.07	2920.25	233	33	9	16	2.04	a	

182154D01.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET011128.BKG (112818-1 LONG BKG CAL)

Bkg.File Detector #: 1

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	185.98	46	39	30	36	41	32	
4	238.61	123	36	23	109	39	27	
5	295.14	59	30	21	56	32	23	
7	351.91	86	30	20	70	33	24	
8	511.13	104	33	21	-15	40	34	NET<CL
9	583.28	71	23	13	64	25	16	
10	609.39	86	27	16	76	29	19	
11	911.43	29	18	12	23	20	14	
12	1461.07	233	33	9	194	34	16	

182154D01.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-8 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 10:59:29
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 5400 Sec
Sample Size . . . . . 2.59e+002 g	Real Time . . . . . 5407 Sec
Collection Efficiency 1.0000	Spectrum File 182154D01.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 1 (Detector 1)

Efficiency File: (D01)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.00E+02 +1.28E+02*L +-5.55E+01*L^2 +7.96E+00*L^3] 09/12/2018

Eff.=10^[-9.85E-01 +4.24E-01*L +-4.07E-01*L^2 +4.46E-02*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.10		8.85E-01 +- 1.00E+00	1.65E+00	7.91E-01	1.40E+07
Pb-212	238.63		2.61E-01 +- 9.18E-02	1.33E-01	6.34E-02	5.04E+04
Ac-228	Average:x		2.59E-01 +- 1.59E-01	. . . .	. . . .	5.04E+04
	338.40		3.56E-01 +- 3.00E-01	4.81E-01	2.27E-01	5.04E+04
	911.07		2.21E-01 +- 1.87E-01	2.96E-01	1.35E-01	5.04E+04
Pb-214	Average:x		2.46E-01 +- 1.15E-01	. . . .	. . . .	1.40E+07
	351.92		2.46E-01 +- 1.17E-01	1.77E-01	8.35E-02	1.40E+07
	295.21		2.46E-01 +- 5.95E-01	8.26E-01	4.05E-01	1.40E+07
Tl-208	583.14		1.42E-01 +- 5.63E-02	7.80E-02	3.60E-02	5.04E+04
Bi-214	609.31		3.31E-01 +- 1.24E-01	1.73E-01	8.08E-02	1.40E+07
K-40	1460.75		7.20E+00 +- 1.25E+00	1.26E+00	5.78E-01	1.12E+13
Tl-210	Average:x		2.92E-03 +- 3.52E-02	. . . .	. . . .	1.40E+07
	296.00		2.05E-02 +- 2.90E-01	6.91E-02	3.26E-02	1.40E+07
	795.00	N	2.65E-03 +- 3.55E-02	6.43E-02	2.89E-02	1.40E+07
Pb-210	46.52	N	-4.18E+01 +- 3.91E+01	7.32E+01	3.46E+01	1.79E+05
Tl-201	70.82	N	4.91E+02 +- 2.62E+03	4.48E+03	2.13E+03	7.35E+01
U-238	92.60	N	3.46E-01 +- 6.74E-01	1.13E+00	5.35E-01	3.92E+13
U-235	143.76	N	4.67E-02 +- 1.79E-01	3.08E-01	1.44E-01	3.33E+10
Ra-224	241.00	N	1.96E+00 +- 1.18E+00	1.71E+00r	8.17E-01	5.04E+04
Ra-223	269.39	N	-1.59E-02 +- 1.87E-01	3.31E-01	1.55E-01	2.87E+08
Ir-192	316.49	N	-5.24E-03 +- 4.71E-02	8.36E-02	3.91E-02	1.78E+03

182154D01.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Be-7	477.56	N	-1.87E-01 +- 5.16E-01	9.52E-01	4.40E-01	1.28E+03
Bi-212	727.17	N	2.53E-01 +- 3.18E-01	5.22E-01	2.35E-01	5.04E+04
Sc-46	889.26	N	3.74E-03 +- 4.67E-02	8.59E-02	3.79E-02	2.01E+03
Pa-234	946.00	N	1.39E-02 +- 1.74E-01	3.20E-01	1.41E-01	3.95E+13
Na-22	1274.54	N	1.46E-02 +- 5.07E-02	8.97E-02	3.99E-02	2.28E+04

MEASURED TOTAL: 5.03E+02 +- 2.63E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	77.16	157.79	28	27	21	94	0.68	Unknown
2	86.96	177.36	14	21	16	67	0.45	Deleted
5	295.14	592.92	56	32	23	69	1.23	SPLIT
8	511.13	1024.06	-15	40	34	63	2.12	Deleted

c:\SEEKER\BIN\182154d01.res Analysis Results Saved.

181953D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-9 GS181103-1

Sampling Start:	10/23/2018 12:00:00	Counting Start:	12/04/2018 12:04:52
Sampling Stop:	10/23/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	4500 Sec
Sample Size	2.41E+002 g	Real Time	4515 Sec
Collection Efficiency	1.0000	Spc. File	.181953D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.27 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.43	97.12	58	29	20	80	0.84	a	
2	63.16	130.48	46	29	21	95	0.65	a	
3	74.75	153.58	109	32	20	93	0.65	a	
4	77.09	158.25	116	36	24	116	0.87	b	
5	84.12	172.27	46	45	35	170	1.68	a	Wide Pk
6	87.07	178.16	43	25	18	68	0.68	b	
7	89.83	183.67	33	21	14	51	0.44	c	
8	92.56	189.11	99	35	23	102	0.91	d	
9	185.98	375.41	57	36	27	98	1.63	a	Wide Pk
10	238.65	480.45	174	33	16	53	0.80	a	Wide Pk
11	241.77	486.67	47	36	28	107	1.71	b	
12	295.40	593.61	59	24	15	43	0.86	a	
13	338.37	679.31	24	21	15	43	1.01	a	
14	352.01	706.51	112	27	14	34	0.91	a	
15	511.15	1023.87	135	37	23	69	2.41	a	Wide Pk
16	558.57	1118.44	25	21	15	41	1.46	a	
17	583.61	1168.37	47	21	13	32	1.17	a	
18	609.77	1220.53	68	24	14	37	1.28	a	
19	911.54	1822.33	44	17	9	17	1.30	a	
20	1460.61	2917.28	182	28	6	5	2.08	a	

181953D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET081128.BKG (112818-8 LONG BKG CAL)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.43	58	29	20	32	31	23	
2	63.16	46	29	21	3	32	26	NET<CL
3	74.75	109	32	20	90	34	23	
4	77.09	116	36	24	96	38	27	
5	84.12	46	45	35	32	47	38	NET<CL
6	87.07	43	25	18	37	27	20	
8	92.56	99	35	24	40	37	29	
9	185.98	57	36	27	33	37	29	
10	238.65	174	33	16	148	35	21	
12	295.40	59	24	15	49	26	18	
13	338.37	24	21	15	19	23	17	
14	352.01	112	27	14	96	28	17	
15	511.15	135	37	23	2	41	34	NET<CL
16	558.57	25	21	15	7	23	18	NET<CL
17	583.61	47	21	13	40	23	15	
18	609.77	68	24	14	54	26	18	
19	911.54	44	17	9	39	18	11	
20	1460.61	182	28	6	167	28	10	

181953D08.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-9 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 12:04:52
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 4500 Sec
Sample Size . . . . . 2.41e+002 g	Real Time . . . . . 4515 Sec
Collection Efficiency 1.0000	Spectrum File 181953D08.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 8 (Detector 8)

Efficiency File: (D08)(Sh17).EFF (Geo 17 Eff Cal)
Eff.=1/[5.03E-02*En^-2.20E+00 + 1.32E+02*En^8.10E-01] 05/17/2018

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52		1.08E+00 +- 1.04E+00	1.68E+00	7.93E-01	1.79E+05
U-238	92.60		5.15E-01 +- 4.79E-01	7.77E-01	3.71E-01	3.92E+13
Ra-226	186.10		8.49E-01 +- 9.45E-01	1.55E+00	7.39E-01	1.40E+07
Pb-212	238.63		3.69E-01 +- 8.72E-02	1.10E-01	5.16E-02	5.04E+04
Pb-214	Average:x		3.67E-01 +- 9.38E-02	. . . .	. . . .	1.40E+07
	295.21		3.27E-01 +- 1.72E-01	2.56E-01	1.19E-01	1.40E+07
	351.92		3.83E-01 +- 1.12E-01	1.43E-01	6.62E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		3.45E-01 +- 1.57E-01	. . . .	. . . .	5.04E+04
	338.40		2.21E-01 +- 2.67E-01	4.38E-01	2.03E-01	5.04E+04
	911.07		4.11E-01 +- 1.95E-01	2.64E-01	1.18E-01	5.04E+04
Tl-208	583.14		9.92E-02 +- 5.65E-02	8.41E-02	3.87E-02	5.04E+04
Bi-214	609.31		2.67E-01 +- 1.29E-01	1.90E-01	8.81E-02	1.40E+07
K-40	1460.75		6.96E+00 +- 1.19E+00	9.39E-01	4.13E-01	1.12E+13
Ra-224	241.00		5.78E-01 +- 6.10E+00	1.61E+00	7.70E-01	5.04E+04
Tl-201	70.82	N	3.15E+01 +- 6.57E+02	1.14E+03	5.39E+02	7.35E+01
U-235	143.76	N	1.38E-01 +- 1.90E-01	3.14E-01	1.47E-01	3.33E+10
Ra-223	269.39	N	0.00E+00 +- 1.87E-01	3.30E-01	1.54E-01	2.87E+08
Ir-192	316.49	N	-1.45E-02 +- 4.94E-02	8.94E-02	4.17E-02	1.78E+03
Be-7	477.56	N	7.59E-02 +- 4.77E-01	8.50E-01	3.84E-01	1.28E+03
Bi-212	727.17	N	3.60E-01 +- 3.99E-01	6.47E-01	2.94E-01	5.04E+04
Tl-210	795.00	N	3.33E-02 +- 3.86E-02	6.25E-02	2.76E-02	1.40E+07

181953D08.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Sc-46	889.26	N	1.27E-02	+- 6.16E-02	1.10E-01	4.93E-02	2.01E+03
Pa-234	946.00	N	-1.42E-01	+- 2.11E-01	4.23E-01	1.90E-01	3.95E+13
Na-22	1274.54	N	-8.26E-03	+- 5.35E-02	1.01E-01	4.51E-02	2.28E+04

MEASURED TOTAL: 4.35E+01 +- 6.68E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	63.16	130.48	3	32	26	95	0.65	Deleted
3	74.75	153.58	90	34	23	93	0.65	Unknown
4	77.09	158.25	96	38	27	116	0.87	Unknown
5	84.12	172.27	32	47	38	170	1.68	Deleted
6	87.07	178.16	37	27	20	68	0.68	Unknown
7	89.83	183.67	33	21	14	51	0.44	Unknown
11	241.77	486.67	47	36	28	107	1.71	SPLIT
15	511.15	1023.87	2	41	34	69	2.41	Deleted
16	558.57	1118.44	7	23	18	41	1.46	Deleted

c:\SEEKER\BIN\181953d08.res Analysis Results Saved.

181993D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-10 GS181103-1

Sampling Start:	10/23/2018 12:00:00	Counting Start:	12/04/2018 12:07:35
Sampling Stop:	10/23/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	2.73E+002 g	Real Time	3614 Sec
Collection Efficiency	1.0000	Spc. File	.181993D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.03 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	66.05	135.84	58	46	35	212	1.19	a	
2	74.66	153.03	86	39	28	161	0.81	a	
3	77.03	157.76	130	45	32	193	0.92	b	
4	87.05	177.75	18	24	19	87	0.54	a	NET< CL
5	90.00	183.64	29	25	19	87	0.54	b	
6	92.61	188.86	74	54	42	260	1.51	c	
7	139.48	282.38	26	23	17	69	0.57	a	
8	185.93	375.07	90	36	25	137	1.05	a	
9	198.28	399.73	40	35	27	149	0.94	a	
10	238.60	480.18	263	49	30	165	1.34	a	
11	241.93	486.83	72	37	27	144	1.20	b	
12	269.71	542.26	36	33	25	115	1.33	a	
13	295.32	593.35	172	40	25	111	1.32	a	
14	300.25	603.19	32	27	20	83	1.04	b	
15	338.49	679.51	45	35	27	131	1.32	a	
16	352.02	706.51	309	48	26	122	1.42	a	
17	511.27	1024.30	331	52	31	133	2.72	a	Wide Pk
18	558.85	1119.25	39	25	18	69	1.36	a	
19	583.51	1168.46	86	29	18	63	1.52	a	
20	609.57	1220.45	225	42	24	116	1.49	a	
21	727.28	1455.36	23	23	18	60	1.55	a	

181993D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	911.37	1822.71	81	28	18	62	1.74	a
23	1120.77	2240.57	41	23	16	49	1.87	a
24	1460.57	2918.64	580	52	17	41	2.99	a
25	1764.16	3524.47	59	21	12	24	2.55	a

181993D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET101128.BKG (112818-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	66.05	58	46	35	20	49	39	NET<CL
2	74.66	86	39	28	42	44	35	
3	77.03	130	45	32	74	49	38	
4	87.05	18	24	19	6	28	23	NET<CL
6	92.61	74	54	42	3	57	47	NET<CL
7	139.48	26	23	17	-5	27	23	NET<CL
8	185.93	90	36	25	10	42	34	NET<CL
9	198.28	40	35	27	-15	38	32	NET<CL
10	238.60	263	49	30	200	51	35	
11	241.93	72	37	27	23	40	32	NET<CL
12	269.71	36	33	25	33	34	26	
13	295.32	172	40	25	77	43	32	
15	338.49	45	35	27	33	36	28	
16	352.02	309	48	26	121	51	38	
17	511.27	331	52	31	33	58	47	NET<CL
18	558.85	39	25	18	-6	28	24	NET<CL
19	583.51	86	29	18	52	32	23	
20	609.57	225	42	24	85	46	35	
22	911.37	81	28	18	57	30	21	
23	1120.77	41	23	16	7	25	20	NET<CL
24	1460.57	580	52	17	508	53	24	
25	1764.16	59	21	12	27	23	17	

181993D10.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-10 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 12:07:35
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 2.73e+002 g	Real Time . . . . . 3614 Sec
Collection Efficiency 1.0000	Spectrum File 181993D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)

Efficiency File: (D10)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018
Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60	N	3.16E-02 +- 6.24E-01	1.06E+00	5.13E-01	3.92E+13
Ra-226	186.10	N	1.49E-01 +- 6.17E-01	1.04E+00	5.02E-01	1.40E+07
Pb-212	Average:x		2.80E-01 +- 6.98E-02	. . . .	. . . .	5.04E+04
	238.63		2.74E-01 +- 7.04E-02	1.00E-01	4.84E-02	5.04E+04
	300.09		6.77E-01 +- 5.61E-01	8.93E-01	4.18E-01	5.04E+04
Ra-224	241.00	N	3.52E-01 +- 6.13E-01	1.02E+00	4.90E-01	5.04E+04
Ra-223	269.39		1.46E-01 +- 1.51E-01	2.46E-01	1.17E-01	2.87E+08
Ac-228	Average:x		2.34E-01 +- 1.12E-01	. . . .	. . . .	5.04E+04
	338.40		1.94E-01 +- 2.13E-01	3.49E-01	1.66E-01	5.04E+04
	911.07		2.49E-01 +- 1.32E-01	2.00E-01	9.39E-02	5.04E+04
Pb-214	Average:x		2.37E-01 +- 9.81E-02	. . . .	. . . .	1.40E+07
	351.92		2.37E-01 +- 1.00E-01	1.55E-01	7.47E-02	1.40E+07
	295.21		2.37E-01 +- 4.57E-01	6.37E-01	3.14E-01	1.40E+07
Tl-208	583.14		5.51E-02 +- 3.39E-02	5.26E-02	2.49E-02	5.04E+04
Bi-214	Average:x		1.93E-01 +- 9.14E-02	. . . .	. . . .	1.40E+07
	609.31		1.78E-01 +- 9.64E-02	1.51E-01	7.28E-02	1.40E+07
	1764.49		3.32E-01 +- 2.87E-01	4.57E-01	2.12E-01	1.40E+07
Bi-212	727.17		2.14E-01 +- 2.13E-01	3.46E-01	1.60E-01	5.04E+04
K-40	1460.75		8.25E+00 +- 8.67E-01	8.10E-01	3.83E-01	1.12E+13
Tl-210	Average:x		-2.16E-03 +- 2.59E-02	. . . .	. . . .	1.40E+07
	296.00		5.66E-03 +- 2.22E-01	5.25E-02	2.52E-02	1.40E+07

181993D10.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
	795.00	N	-2.27E-03	+- 2.60E-02	4.62E-02	2.16E-02	1.40E+07
Pb-210	46.52	N	-1.18E+00	+- 6.06E+00	1.04E+01	5.03E+00	1.79E+05
Tl-201	70.82	N	-1.78E+03	+- 1.26E+03	2.28E+03B	1.10E+03	7.35E+01
U-235	143.76	N	-3.95E-02	+- 1.86E-01	3.21E-01	1.54E-01	3.33E+10
Ir-192	316.49	N	-3.49E-02	+- 3.47E-02	6.40E-02	3.04E-02	1.78E+03
Be-7	477.56	N	1.18E-01	+- 3.20E-01	5.46E-01	2.55E-01	1.28E+03
Sc-46	889.26	N	1.92E-02	+- 3.68E-02	6.22E-02	2.87E-02	2.01E+03
Pa-234	946.00	N	2.20E-02	+- 1.46E-01	2.54E-01	1.18E-01	3.95E+13
Na-22	1274.54	N	-1.65E-02	+- 3.52E-02	6.48E-02	3.02E-02	2.28E+04

MEASURED TOTAL: 1.03E+01 +- 3.99E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	66.05	135.84	20	49	39	212	1.19	Deleted
2	74.66	153.03	42	44	35	161	0.81	Unknown
3	77.03	157.76	74	49	38	193	0.92	Unknown
4	87.05	177.75	6	28	23	87	0.54	Deleted
5	90.00	183.64	29	25	19	87	0.54	Unknown
7	139.48	282.38	-5	27	23	69	0.57	Deleted
9	198.28	399.73	-15	38	32	149	0.94	Deleted
13	295.32	593.35	77	43	32	111	1.32	SPLIT
17	511.27	1024.30	33	58	47	133	2.72	Deleted
18	558.85	1119.25	-6	28	24	69	1.36	Deleted
23	1120.77	2240.57	7	25	20	49	1.87	Deleted

c:\SEEKER\BIN\181993d10.res Analysis Results Saved.

182669D03.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-11 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 14:50:12
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 24000 Sec
Sample Size . . . . . 2.11E+002 g	Real Time . . . . . 24048 Sec
Collection Efficiency 1.0000	Spc. File 182669D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.37 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.79 + 0.012*En + 1.05E-03*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.51	129.40	80	49	37	343	0.57	a	
2	66.45	135.28	57	76	61	685	1.02	b	NET< CL
3	74.92	152.16	336	75	53	575	0.89	a	
4	77.04	156.39	576	96	69	805	1.10	b	
5	84.24	170.74	151	98	78	906	1.53	a	
6	86.97	176.19	295	93	71	805	1.36	b	
7	89.83	181.90	192	83	64	705	1.21	c	
8	92.89	188.01	344	94	71	805	1.32	d	
9	105.73	213.61	50	42	33	261	0.51	a	
10	129.25	260.53	82	80	64	693	1.14	a	
11	140.03	282.03	41	66	53	525	1.01	a	NET< CL
12	185.86	373.43	362	87	65	663	1.26	a	
13	198.52	398.68	33	48	39	332	0.58	a	NET< CL
14	209.16	419.92	105	54	41	377	0.87	a	
15	221.29	444.10	54	99	81	913	2.11	a	NET< CL Wide Pk
16	238.57	478.58	1724	104	52	491	1.33	a	
17	241.64	484.69	368	78	56	552	1.44	b	
18	270.49	542.23	123	81	65	615	2.01	a	
19	295.24	591.60	586	83	55	499	1.60	a	
20	300.15	601.40	85	59	46	399	1.30	b	

182669D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	328.19	657.31	75	66	53	456	1.70	a	
22	338.23	677.34	334	72	51	434	1.67	a	
23	351.85	704.51	991	88	50	413	1.56	a	
24	463.17	926.55	82	47	36	247	1.42	a	
25	511.01	1021.97	687	85	55	449	2.49	a	
26	558.82	1117.32	58	37	28	166	1.13	a	
27	583.23	1166.01	512	62	35	224	1.70	a	
28	609.27	1217.93	654	73	43	329	1.88	a	
29	693.17	1385.28	34	40	32	195	1.54	a	
30	727.38	1453.53	72	39	29	173	1.48	a	
31	795.38	1589.14	67	37	27	146	1.86	a	
32	803.14	1604.62	64	39	29	159	1.95	b	
33	860.48	1719.00	31	26	19	88	1.03	a	
34	911.36	1820.47	282	48	28	150	2.01	a	
35	969.26	1935.96	133	47	34	199	2.09	a	
36	1120.46	2237.53	132	40	27	131	2.20	a	
37	1460.90	2916.54	957	70	26	100	3.04	a	HiResid
38	1764.14	3521.38	97	39	27	86	4.39	a	

182669D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET031128.BKG (112818-3 LONG BKG CAL)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.51	80	49	37	42	78	63	NET<CL
2	66.45	57	76	61	-34	109	90	NET<CL
4	77.04	576	96	69	551	118	89	
5	84.24	151	98	78	128	113	91	
8	92.89	344	94	71	217	115	91	
11	140.03	41	66	53	-12	103	85	NET<CL
12	185.86	362	87	65	238	120	96	
13	198.52	33	48	39	-57	99	82	NET<CL
15	221.29	54	99	81	40	106	87	NET<CL
16	238.57	1724	104	52	1631	118	71	
17	241.64	368	79	56	342	104	80	
19	295.24	586	83	55	537	98	71	
22	338.23	334	72	51	321	86	64	
23	351.85	991	88	50	891	104	70	
25	511.01	687	85	55	69	131	107	NET<CL
26	558.82	58	37	28	-3	56	46	NET<CL
27	583.23	512	62	35	459	83	58	
28	609.27	654	73	43	590	87	60	
32	803.14	64	39	29	7	60	49	NET<CL
34	911.36	282	48	28	257	64	46	
37	1460.90	957	70	26	892	77	40	
38	1764.14	97	39	27	79	44	34	

182669D03.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-11 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 14:50:12
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 24000 Sec
Sample Size . . . . . 2.11e+002 g	Real Time . . . . . 24048 Sec
Collection Efficiency 1.0000	Spectrum File 182669D03.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-8.15E+01 +1.04E+02*L +-4.49E+01*L^2 +6.40E+00*L^3] 11/01/2018
Eff.=10^[-2.02E-01 +-3.44E-01*L +-1.27E-01*L^2 +7.29E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		1.04E+00 +- 5.53E-01	8.92E-01	4.39E-01	3.92E+13
Ra-226	186.10		1.44E+00 +- 7.25E-01	1.17E+00	5.76E-01	1.40E+07
Pb-212	Average:x		9.57E-01 +- 6.88E-02	. . . .	. . . .	5.04E+04
	238.63		9.60E-01 +- 6.94E-02	8.47E-02	4.16E-02	5.04E+04
	300.09		7.39E-01 +- 5.17E-01	8.33E-01	4.04E-01	5.04E+04
Ra-223	269.39		2.44E-01 +- 1.61E-01	2.61E-01	1.28E-01	2.87E+08
Pb-214	Average:x		8.03E-01 +- 7.89E-02	. . . .	. . . .	1.40E+07
	295.21		8.14E-01 +- 1.49E-01	2.20E-01	1.08E-01	1.40E+07
	351.92		7.99E-01 +- 9.31E-02	1.28E-01	6.26E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		6.92E-01 +- 1.13E-01	. . . .	. . . .	5.04E+04
	338.40		8.41E-01 +- 2.24E-01	3.42E-01	1.68E-01	5.04E+04
	911.07		6.65E-01 +- 1.66E-01	2.43E-01	1.18E-01	5.04E+04
	968.90		6.04E-01 +- 2.12E-01	3.16E-01	1.52E-01	5.04E+04
Tl-208	Average:x		2.61E-01 +- 4.62E-02	. . . .	. . . .	5.04E+04
	583.14		2.69E-01 +- 4.85E-02	6.99E-02	3.42E-02	5.04E+04
	860.47		1.86E-01 +- 1.51E-01	2.40E-01	1.12E-01	5.04E+04
Bi-214	Average:x		6.97E-01 +- 9.05E-02	. . . .	. . . .	1.40E+07
	609.31		6.79E-01 +- 1.01E-01	1.41E-01	6.90E-02	1.40E+07
	1120.29		7.95E-01 +- 2.42E-01	3.44E-01	1.64E-01	1.40E+07
	1764.49		6.99E-01 +- 3.92E-01	6.16E-01	2.96E-01	1.40E+07

182669D03.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NE T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Bi-212	727.17		3.73E-01 +- 2.01E-01	3.11E-01	1.48E-01	5.04E+04
Tl-210	795.00		4.36E-02 +- 2.43E-02	3.77E-02	1.80E-02	1.40E+07
K-40	1460.75		9.48E+00 +- 8.16E-01	8.71E-01	4.21E-01	1.12E+13
Ra-224	241.00		6.81E-01 +- 4.13E+00	1.07E+00	5.24E-01	5.04E+04
Pb-210	46.52	N	8.19E+00 +- 1.13E+01	1.87E+01	9.14E+00	1.79E+05
Tl-201	70.82	N	-4.81E+02 +- 1.53E+03	2.58E+03	1.27E+03	7.35E+01
U-235	143.76	N	5.01E-02 +- 1.36E-01	2.27E-01	1.11E-01	3.33E+10
Ir-192	316.49	N	3.51E-03 +- 2.70E-02	4.55E-02	2.21E-02	1.78E+03
Be-7	477.56	N	2.73E-01 +- 2.97E-01	4.86E-01	2.33E-01	1.28E+03
Sc-46	889.26	N	-1.72E-02 +- 3.57E-02	6.31E-02	3.02E-02	2.01E+03
Pa-234	946.00	N	-1.09E-01 +- 1.35E-01	2.42E-01	1.16E-01	3.95E+13
Na-22	1274.54	N	-6.90E-03 +- 3.46E-02	6.04E-02	2.88E-02	2.28E+04

MEASURED TOTAL: 2.52E+01 +- 1.88E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.51	129.40	42	78	63	343	0.57	Deleted
2	66.45	135.28	-34	109	90	685	1.02	Deleted
3	74.92	152.16	336	75	53	575	0.89	Unknown
4	77.04	156.39	551	118	89	805	1.10	Unknown
5	84.24	170.74	128	113	91	906	1.53	Unknown
6	86.97	176.19	295	93	71	805	1.36	Unknown
7	89.83	181.90	192	83	64	705	1.21	Unknown
9	105.73	213.61	50	42	33	261	0.51	Unknown
10	129.25	260.53	82	80	64	693	1.14	Unknown
11	140.03	282.03	-12	103	85	525	1.01	Deleted
13	198.52	398.68	-57	99	82	332	0.58	Deleted
14	209.16	419.92	105	54	41	377	0.87	Unknown
15	221.29	444.10	40	106	87	913	2.11	Deleted
17	241.64	484.69	342	104	80	552	1.44	SPLIT
21	328.19	657.31	75	66	53	456	1.70	Unknown
24	463.17	926.55	82	47	36	247	1.42	Unknown
25	511.01	1021.97	69	131	107	449	2.49	Deleted
26	558.82	1117.32	-3	56	46	166	1.13	Deleted
29	693.17	1385.28	34	40	32	195	1.54	Unknown
32	803.14	1604.62	7	60	49	159	1.95	Deleted

c:\SEEKER\BIN\182669d03.res Analysis Results Saved.

181899D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-12 GS181103-1

Sampling Start:	10/23/2018 12:00:00	Counting Start:	12/04/2018 14:50:26
Sampling Stop:	10/23/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	18000 Sec
Sample Size	2.02E+002 g	Real Time	18032 Sec
Collection Efficiency	1.0000	Spc. File	.181899D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.61 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	43.58	88.28	25	46	37	331	0.42	a	NET< CL
2	53.89	108.87	41	69	55	568	0.98	a	NET< CL
3	66.46	133.98	89	62	49	481	0.82	a	
4	74.83	150.72	235	74	55	566	1.02	a	
5	77.12	155.27	383	78	55	566	0.92	b	
6	83.84	168.70	18	34	27	197	0.40	a	NET< CL
7	87.42	175.85	64	62	49	493	0.78	b	
8	92.82	186.64	163	80	62	666	1.22	a	
9	104.22	209.42	34	40	31	241	0.45	a	
10	121.88	244.70	26	45	36	293	0.68	a	NET< CL
11	128.84	258.60	50	42	32	258	0.44	a	
12	140.06	281.02	77	79	64	643	1.29	a	
13	185.89	372.58	277	68	49	435	0.96	a	
14	198.19	397.15	78	88	71	705	1.56	a	Wide Pk
15	205.52	411.78	75	72	57	517	1.37	a	
16	209.23	419.19	127	80	63	582	1.44	b	
17	238.54	477.74	1348	90	43	346	0.99	a	
18	241.68	484.02	290	74	54	461	1.30	b	
19	248.76	498.17	36	45	36	259	0.81	a	NET< CL
20	270.37	541.34	100	58	44	336	1.11	a	
21	295.06	590.66	470	68	43	320	1.17	a	

181899D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	300.16	600.85	67	39	29	183	0.61	b	
23	327.86	656.19	38	40	31	225	0.83	a	
24	338.28	677.00	237	51	33	235	1.05	a	
25	351.88	704.17	884	75	37	272	1.19	a	
26	462.86	925.88	77	37	27	154	1.00	a	
27	493.24	986.57	27	42	33	205	1.31	a	NET< CL
28	510.90	1021.83	640	79	50	340	2.35	a	Wide Pk
29	558.43	1116.79	50	42	32	202	1.45	a	
30	583.22	1166.31	451	58	32	198	1.43	a	
31	609.30	1218.41	637	68	37	258	1.57	a	
32	650.79	1301.29	34	25	19	85	0.81	a	
33	727.41	1454.35	122	42	29	155	1.68	a	
34	768.54	1536.53	39	35	27	139	1.53	a	
35	794.85	1589.07	45	31	23	106	1.34	a	
36	861.07	1721.37	32	29	22	108	1.35	a	
37	911.29	1821.70	283	46	25	124	1.83	a	
38	969.10	1937.18	119	40	28	153	1.63	a	
39	1120.28	2239.19	108	40	28	138	2.18	a	
40	1237.94	2474.24	45	35	27	129	2.08	a	
41	1378.08	2754.20	40	32	24	79	3.44	a	
42	1460.94	2919.72	1047	70	21	76	2.36	a	
43	1764.80	3526.74	104	28	16	41	2.41	a	

181899D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

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Background File:. . . . . DET051128.BKG (112818-5 LONG BKG CAL)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	53.89	41	69	55	31	78	63	NET<CL
3	66.46	89	62	49	21	88	72	NET<CL
4	74.84	235	74	55	214	86	67	
8	92.82	163	80	63	103	96	77	
11	128.84	50	42	32	38	60	48	NET<CL
12	140.06	77	79	64	9	92	75	NET<CL
13	185.90	277	68	49	189	85	66	
14	198.19	78	89	71	-2	100	82	NET<CL
17	238.54	1348	90	43	1288	100	58	
21	295.06	470	68	43	447	78	54	
24	338.28	237	51	33	217	63	46	
25	351.88	884	75	37	828	83	49	
27	493.24	27	42	33	17	47	38	NET<CL
28	510.90	640	79	50	118	112	90	
29	558.43	50	42	32	-6	56	46	NET<CL
30	583.22	451	58	32	425	64	40	
31	609.30	637	68	37	581	83	55	
37	911.29	283	46	25	264	51	32	
38	969.10	119	40	28	112	48	36	
39	1120.28	108	40	28	98	45	33	
42	1460.94	1047	70	21	915	77	39	
43	1764.80	104	28	16	93	33	22	

181899D05.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-12 GS181103-1

Sampling Start: 10/23/2018 12:00:00	Counting Start: 12/04/2018 14:50:26
Sampling Stop: 10/23/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 2.02e+002 g	Real Time . . . . . 18032 Sec
Collection Efficiency 1.0000	Spectrum File 181899D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)

Efficiency File: (D05)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018
Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		7.21E-01 +- 6.76E-01	1.11E+00	5.44E-01	3.92E+13
Ra-226	186.10		1.34E+00 +- 6.04E-01	9.59E-01	4.70E-01	1.40E+07
U-235	Average:x		9.64E-02 +- 1.31E-01	. . . .	. . . .	3.33E+10
	205.31		4.20E-01 +- 4.00E-01	6.54E-01	3.20E-01	3.33E+10
	143.76	N	5.77E-02 +- 1.38E-01	2.31E-01b	1.12E-01	3.33E+10
Pb-212	Average:x		8.68E-01 +- 6.69E-02	. . . .	. . . .	5.04E+04
	238.63		8.66E-01 +- 6.74E-02	7.93E-02	3.87E-02	5.04E+04
	300.09		9.86E-01 +- 5.66E-01	8.83E-01	4.22E-01	5.04E+04
Ra-223	269.39		2.21E-01 +- 1.27E-01	2.02E-01	9.81E-02	2.87E+08
Pb-214	Average:x		9.20E-01 +- 8.06E-02	. . . .	. . . .	1.40E+07
	295.21		7.38E-01 +- 1.29E-01	1.82E-01	8.88E-02	1.40E+07
	351.92		1.04E+00 +- 1.03E-01	1.25E-01	6.10E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		6.66E-01 +- 1.01E-01	. . . .	. . . .	5.04E+04
	338.40		8.30E-01 +- 2.41E-01	3.60E-01	1.75E-01	5.04E+04
	911.07		6.76E-01 +- 1.29E-01	1.70E-01	8.16E-02	5.04E+04
	968.90		5.03E-01 +- 2.18E-01	3.34E-01	1.61E-01	5.04E+04
Tl-208	Average:x		2.53E-01 +- 3.77E-02	. . . .	. . . .	5.04E+04
	583.14		2.57E-01 +- 3.87E-02	5.03E-02	2.44E-02	5.04E+04
	860.47		1.87E-01 +- 1.70E-01	2.75E-01	1.29E-01	5.04E+04
Bi-214	Average:x		6.81E-01 +- 8.40E-02	. . . .	. . . .	1.40E+07

181899D05.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	609.31		6.84E-01 +- 9.73E-02	1.33E-01	6.50E-02	1.40E+07
	768.36		5.08E-01 +- 4.55E-01	7.35E-01	3.50E-01	1.40E+07
	1120.29		5.83E-01 +- 2.70E-01	4.16E-01	2.00E-01	1.40E+07
	1238.11		7.35E-01 +- 5.84E-01	9.35E-01	4.45E-01	1.40E+07
	1377.67		1.08E+00 +- 8.66E-01	1.38E+00	6.55E-01	1.40E+07
	1764.49		7.74E-01 +- 2.77E-01	3.94E-01	1.86E-01	1.40E+07
Bi-212	727.17		6.32E-01 +- 2.15E-01	3.13E-01	1.50E-01	5.04E+04
Tl-210	795.00		2.91E-02 +- 1.98E-02	3.11E-02	1.47E-02	1.40E+07
K-40	1460.75		9.52E+00 +- 7.96E-01	8.30E-01	4.01E-01	1.12E+13
Ra-224	241.00		3.73E-01 +- 3.37E+00	8.27E-01	4.03E-01	5.04E+04
Pb-210	46.52	N	5.41E+00 +- 3.05E+01	5.14E+01	2.49E+01	1.79E+05
Tl-201	70.82	N	2.70E+01 +- 2.00E+03	3.37E+03	1.65E+03	7.35E+01
Ir-192	316.49	N	-5.52E-03 +- 3.81E-02	6.52E-02	3.15E-02	1.78E+03
Be-7	477.56	N	8.76E-03 +- 3.40E-01	5.80E-01	2.80E-01	1.28E+03
Sc-46	889.26	N	1.22E-02 +- 3.23E-02	5.46E-02	2.59E-02	2.01E+03
Pa-234	946.00	N	6.81E-02 +- 1.19E-01	1.99E-01	9.43E-02	3.95E+13
Na-22	1274.54	N	-9.73E-03 +- 2.97E-02	5.27E-02	2.50E-02	2.28E+04

MEASURED TOTAL: 4.88E+01 +- 2.04E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	43.58	88.28	25	46	37	331	0.42	Deleted
2	53.89	108.87	31	78	63	568	0.98	Deleted
3	66.46	133.98	21	88	72	481	0.82	Deleted
4	74.83	150.72	214	86	67	566	1.02	Unknown
5	77.12	155.27	383	78	55	566	0.92	Unknown
6	83.84	168.70	18	34	27	197	0.40	Deleted
7	87.42	175.85	64	62	49	493	0.78	Unknown
9	104.22	209.42	34	40	31	241	0.45	Unknown
10	121.88	244.70	26	45	36	293	0.68	Deleted
11	128.84	258.60	38	60	48	258	0.44	Deleted
12	140.06	281.02	9	92	75	643	1.29	Deleted
14	198.19	397.15	-2	100	82	705	1.56	Deleted
16	209.23	419.19	127	80	63	582	1.44	Unknown
18	241.68	484.02	290	74	54	461	1.30	SPLIT
19	248.76	498.17	36	45	36	259	0.81	Deleted
23	327.86	656.19	38	40	31	225	0.83	Unknown
26	462.86	925.88	77	37	27	154	1.00	Unknown
27	493.24	986.57	17	47	38	205	1.31	Deleted
28	510.90	1021.83	118	112	90	340	2.35	Unknown
29	558.43	1116.79	-6	56	46	202	1.45	Deleted

181899D05.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
32	650.79	1301.29	34	25	19	85	0.81	Unknown

c:\SEEKER\BIN\181899d05.res Analysis Results Saved.

182189D02.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-13 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/04/2018 14:50:03
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 9.87E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.86E+002 g	Real Time . . . . . 18046 Sec
Collection Efficiency 1.0000	Spc. File 182189D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.31 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	49.65	101.72	34	59	48	458	0.88	a	NET< CL
2	66.12	134.58	43	60	48	461	0.79	a	NET< CL Wide Pk
3	70.87	144.07	46	60	48	461	0.81	b	NET< CL
4	74.66	151.64	181	142	114	1383	2.40	c	
5	77.12	156.53	192	72	55	553	0.96	d	
6	86.74	175.75	136	100	80	880	1.64	a	
7	89.84	181.93	81	67	53	528	0.96	b	
8	92.87	187.98	195	78	60	616	1.21	c	
9	129.32	260.73	91	76	61	583	1.38	a	
10	139.94	281.92	72	63	50	460	0.94	a	
11	154.15	310.28	49	66	53	482	1.20	a	NET< CL
12	185.89	373.64	220	69	51	517	1.12	a	
13	198.24	398.29	55	62	50	487	1.09	a	
14	209.22	420.21	96	69	54	540	1.38	a	
15	238.64	478.92	1223	89	46	416	1.22	a	
16	241.61	484.85	266	70	51	475	1.39	b	
17	270.23	541.97	111	59	45	374	1.32	a	
18	277.50	556.49	54	62	50	433	1.46	a	
19	295.29	592.00	436	64	39	305	1.20	a	
20	300.15	601.69	70	46	35	262	1.06	b	

182189D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	327.97	657.22	54	57	45	354	1.49	a	
22	338.29	677.81	275	66	47	366	1.61	a	
23	351.82	704.83	689	71	39	277	1.30	a	
24	462.78	926.29	54	49	38	257	1.47	a	
25	470.08	940.86	28	34	27	152	0.93	a	
26	510.98	1022.50	557	81	54	394	2.24	a	
27	558.20	1116.74	51	38	29	167	1.24	a	
28	583.18	1166.61	416	61	38	239	1.90	a	
29	609.32	1218.79	583	65	36	238	1.63	a	
30	661.83	1323.58	368	51	28	148	1.46	a	
31	727.07	1453.80	75	40	30	163	1.59	a	
32	768.33	1536.15	45	33	24	122	1.33	a	
33	803.25	1605.86	25	37	30	154	1.76	a	NET< CL
34	860.58	1720.28	39	36	28	132	1.90	a	
35	911.31	1821.53	305	47	26	125	1.99	a	
36	969.22	1937.12	111	42	29	167	1.86	a	
37	1120.39	2238.84	81	32	22	93	1.77	a	
38	1460.97	2918.63	777	60	19	59	2.61	a	
39	1764.69	3524.82	116	28	15	32	3.15	a	

182189D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET021128.BKG (112818-2 LONG BKG CAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	66.11	43	60	48	-44	99	82	NET<CL
3	70.87	46	60	48	10	126	103	NET<CL
4	74.66	181	142	114	111	189	154	NET<CL
8	92.87	195	78	60	131	95	76	
10	139.94	72	63	50	34	78	63	NET<CL
12	185.89	220	69	51	109	88	71	
13	198.24	55	62	50	-11	82	68	NET<CL
15	238.64	1223	89	46	1126	108	70	
19	295.29	436	64	39	413	75	52	
23	351.82	689	71	39	621	86	57	
26	510.98	557	81	54	64	113	92	NET<CL
27	558.20	51	38	29	-9	52	43	NET<CL
28	583.18	416	61	38	383	68	46	
29	609.32	583	65	36	538	79	52	
33	803.25	25	37	30	-27	55	46	NET<CL
35	911.31	305	47	26	281	54	34	
38	1460.97	777	60	19	669	68	37	
39	1764.69	116	28	15	99	34	23	

182189D02.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-13 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/04/2018 14:50:03
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 9.87e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.86e+002 g	Real Time . . . . . 18046 Sec
Collection Efficiency 1.0000	Spectrum File 182189D02.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.25E+02 +1.62E+02*L +-7.06E+01*L^2 +1.02E+01*L^3] 09/06/2018
Eff.=10^[-1.14E+01 +1.13E+01*L +-4.16E+00*L^2 +4.74E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pa-234	Average:x		5.93E-02 +- 8.13E-02	. . . .	. . . .	3.95E+13
	131.28		1.25E-01 +- 1.04E-01	1.70E-01	8.29E-02	3.95E+13
	946.00	N	-4.80E-02 +- 1.32E-01	2.34E-01	1.11E-01	3.95E+13
	94.67		1.25E-01 +- 7.74E-01	1.04E+00	5.14E-01	3.95E+13
Ra-226	186.10		9.15E-01 +- 7.45E-01	1.21E+00	5.95E-01	1.40E+07
Pb-212	Average:x		8.98E-01 +- 8.55E-02	. . . .	. . . .	5.04E+04
	238.63		9.00E-01 +- 8.66E-02	1.14E-01	5.59E-02	5.04E+04
	300.09		8.09E-01 +- 5.29E-01	8.41E-01	4.05E-01	5.04E+04
Ra-223	269.39		2.87E-01 +- 1.51E-01	2.39E-01	1.16E-01	2.87E+08
Tl-208	Average:x		2.66E-01 +- 4.65E-02	. . . .	. . . .	5.04E+04
	277.36		2.96E-01 +- 3.42E-01	5.62E-01	2.73E-01	5.04E+04
	583.14		2.65E-01 +- 4.70E-02	6.51E-02	3.16E-02	5.04E+04
	860.47		2.66E-01 +- 7.05E-01	9.41E-01	4.61E-01	5.04E+04
Pb-214	Average:x		7.30E-01 +- 8.03E-02	. . . .	. . . .	1.40E+07
	295.21		7.78E-01 +- 1.41E-01	2.01E-01	9.77E-02	1.40E+07
	351.92		7.06E-01 +- 9.76E-02	1.34E-01	6.54E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		7.84E-01 +- 1.10E-01	. . . .	. . . .	5.04E+04
	338.40		9.23E-01 +- 2.23E-01	3.26E-01	1.59E-01	5.04E+04
	911.07		8.29E-01 +- 1.58E-01	2.11E-01	1.01E-01	5.04E+04
	968.90		5.74E-01 +- 2.14E-01	3.18E-01	1.52E-01	5.04E+04

182189D02.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Bi-214	Average:x		7.12E-01 +- 9.00E-02	. . . .	. . . .	1.40E+07
	609.31		7.29E-01 +- 1.07E-01	1.45E-01	7.08E-02	1.40E+07
	768.36		6.95E-01 +- 4.98E-01	7.89E-01	3.74E-01	1.40E+07
	1120.29		5.48E-01 +- 2.17E-01	3.15E-01	1.48E-01	1.40E+07
	1764.49		9.05E-01 +- 3.14E-01	4.46E-01	2.10E-01	1.40E+07
Bi-212	727.17		4.50E-01 +- 2.41E-01	3.74E-01	1.79E-01	5.04E+04
K-40	1460.75		7.70E+00 +- 7.86E-01	8.76E-01	4.22E-01	1.12E+13
Tl-210	Average:x		1.08E-02 +- 2.75E-02	. . . .	. . . .	1.40E+07
	860.00		2.65E-03 +- 2.53E+00	6.77E-01	3.23E-01	1.40E+07
	795.00	N	1.08E-02 +- 2.75E-02	4.62E-02	2.21E-02	1.40E+07
Ra-224	241.00		9.39E-01 +- 3.76E+00	9.23E-01	4.50E-01	5.04E+04
U-238	92.60		7.03E-01 +- 4.83E+00	1.26E+00	6.21E-01	3.92E+13
Pb-210	46.52	N	7.14E+00 +- 8.04E+01	1.35E+02	6.60E+01	1.79E+05
Tl-201	70.82	N	3.46E+02 +- 2.93E+03	4.89E+03R	2.40E+03	7.35E+01
U-235	143.76	N	-4.82E-02 +- 1.73E-01	2.94E-01b	1.44E-01	3.33E+10
Ir-192	316.49	N	5.17E-03 +- 3.28E-02	5.54E-02	2.68E-02	1.78E+03
Be-7	477.56	N	1.32E-01 +- 3.71E-01	6.24E-01	3.01E-01	1.28E+03
Sc-46	889.26	N	-2.50E-02 +- 3.48E-02	6.31E-02	3.00E-02	2.01E+03
Na-22	1274.54	N	-1.30E-02 +- 3.16E-02	5.66E-02	2.68E-02	2.28E+04

MEASURED TOTAL: 3.67E+02 +- 3.02E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.65	101.72	34	59	48	458	0.88	Deleted
2	66.11	134.58	-44	99	82	461	0.79	Deleted
3	70.87	144.07	10	126	103	461	0.81	Deleted
4	74.66	151.64	111	189	154	1383	2.40	Deleted
5	77.12	156.53	192	72	55	553	0.96	Unknown
6	86.74	175.75	136	100	80	880	1.64	Unknown
7	89.84	181.93	81	67	53	528	0.96	Unknown
8	92.87	187.98	131	95	76	616	1.21	SPLIT
10	139.94	281.92	34	78	63	460	0.94	Deleted
11	154.15	310.28	49	66	53	482	1.20	Deleted
13	198.24	398.29	-11	82	68	487	1.09	Deleted
14	209.22	420.21	96	69	54	540	1.38	Unknown
16	241.61	484.85	266	70	51	475	1.39	SPLIT
21	327.97	657.22	54	57	45	354	1.49	Unknown
24	462.78	926.29	54	49	38	257	1.47	Unknown
25	470.08	940.86	28	34	27	152	0.93	Unknown
26	510.98	1022.50	64	113	92	394	2.24	Deleted
27	558.20	1116.74	-9	52	43	167	1.24	Deleted

182189D02.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
30	661.83	1323.58	368	51	28	148	1.46	Unknown
33	803.25	1605.86	-27	55	46	154	1.76	Deleted
34	860.58	1720.28	39	36	28	132	1.90	SPLIT

c:\SEEKER\BIN\182189d02.res Analysis Results Saved.

182195D02.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-14 GS181103-1

Sampling Start:	10/24/2018 12:00:00	Counting Start:	12/05/2018 14:08:31
Sampling Stop:	10/24/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	60000 Sec
Sample Size	1.55E+002 g	Real Time	60095 Sec
Collection Efficiency	1.0000	Spc. File	.182195D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.29 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	57.17	116.70	62	79	64	996	0.53	a	NET< CL
2	63.44	129.21	237	223	182	4082	1.90	a	Wide Pk
3	66.32	134.96	186	162	131	2721	1.27	b	
4	74.81	151.90	898	161	123	2581	1.18	a	
5	77.09	156.45	1441	168	123	2581	1.07	b	
6	84.21	170.68	337	143	114	2203	1.09	a	
7	87.13	176.50	898	179	138	2832	1.52	b	
8	89.89	182.00	508	145	114	2203	1.22	c	
9	92.74	187.70	1022	166	126	2517	1.32	d	
10	129.02	260.12	205	110	87	1538	0.79	a	
11	139.78	281.59	188	150	121	2321	1.27	a	
12	143.78	289.57	292	165	133	2612	1.43	b	
13	154.27	310.52	105	121	98	1765	0.98	a	
14	185.95	373.75	1241	152	111	2260	1.25	a	
15	198.46	398.74	215	123	98	1887	1.18	a	
16	209.21	420.19	569	128	98	1880	1.11	a	
17	211.63	425.02	4	80	66	1074	0.60	b	NET< CL
18	238.60	478.86	6918	205	99	1817	1.28	a	
19	241.61	484.86	1632	155	108	2044	1.54	b	
20	270.13	541.79	559	127	97	1644	1.40	a	
21	277.25	556.00	309	104	81	1278	1.18	b	

182195D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	295.18	591.80	2546	145	85	1339	1.27 a	
23	300.00	601.41	455	112	85	1339	1.26 b	
24	327.77	656.86	330	125	99	1594	1.67 a	
25	338.15	677.57	1389	124	81	1215	1.24 a	
26	351.85	704.91	3982	158	79	1148	1.34 a	
27	409.35	819.69	129	74	58	698	1.03 a	
28	462.93	926.64	375	108	83	1070	1.72 a	
29	510.93	1022.47	2243	159	105	1416	2.45 a	Wide Pk
30	558.54	1117.51	133	67	51	574	1.12 a	
31	563.00	1126.41	100	101	81	1066	2.18 b	
32	569.43	1139.24	74	71	57	656	1.27 c	
33	583.15	1166.64	2327	124	64	756	1.59 a	
34	596.99	1194.25	94	94	76	1016	1.74 a	
35	609.22	1218.66	3131	141	70	913	1.65 a	
36	661.56	1323.14	168	69	53	567	1.25 a	
37	692.67	1385.24	53	49	38	362	0.84 a	
38	694.78	1389.45	169	113	90	1157	2.65 b	
39	727.28	1454.34	493	86	60	638	1.81 a	
40	755.06	1509.79	52	47	37	320	1.03 a	
41	768.45	1536.51	282	81	61	626	1.96 a	
42	772.64	1544.87	83	67	53	522	1.57 b	
43	786.05	1571.64	136	76	60	595	1.91 a	
44	794.94	1589.38	224	65	48	446	1.42 b	
45	803.18	1605.83	146	63	48	446	1.44 c	
46	806.45	1612.37	72	61	48	446	1.48 d	
47	835.57	1670.50	124	76	60	607	2.04 a	
48	839.59	1678.52	87	52	40	354	1.20 b	
49	860.58	1720.42	269	79	60	569	2.10 a	
50	911.29	1821.63	1604	101	51	463	2.08 a	
51	933.91	1866.80	176	67	51	460	2.20 a	
52	964.67	1928.19	296	76	56	534	2.33 a	
53	968.92	1936.68	871	82	47	420	1.87 b	
54	1001.91	2002.53	89	73	58	513	2.78 a	
55	1094.16	2186.68	31	104	85	798	4.59 a	NET< CL Wide Pk
56	1120.31	2238.88	606	78	50	440	2.05 a	
57	1155.19	2308.49	46	41	32	231	1.24 a	
58	1238.03	2473.86	226	66	48	400	2.36 a	
59	1280.83	2559.30	47	35	27	167	1.17 a	
60	1377.20	2751.67	159	60	44	302	2.76 a	
61	1407.75	2812.65	49	48	37	248	2.19 a	
62	1460.78	2918.50	2185	105	40	252	2.66 a	
63	1509.02	3014.80	38	48	38	239	2.41 a	
64	1588.65	3173.75	93	46	34	206	2.11 a	
65	1620.67	3237.67	44	38	29	148	2.05 a	
66	1729.65	3455.21	102	42	30	148	2.54 a	

182195D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
67	1764.32	3524.42	571	61	31	146	2.86	a
68	1847.38	3690.22	42	46	36	187	3.06	a

182195D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET021128.BKG (112818-2 LONG BKG CAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	66.32	186	162	131	-103	309	254	NET<CL
4	74.81	898	161	123	666	445	363	
9	92.74	1022	166	126	808	245	196	
11	139.78	188	150	121	62	214	176	NET<CL
14	185.95	1241	152	111	868	238	190	
15	198.46	215	123	98	-5	216	178	NET<CL
18	238.60	6918	205	99	6596	289	197	
22	295.18	2547	145	85	2470	197	140	
26	351.85	3982	158	79	3754	227	157	
29	510.93	2243	159	105	599	307	249	
30	558.54	133	67	51	-65	138	114	NET<CL
32	569.43	74	71	57	-41	164	135	NET<CL
33	583.15	2327	124	64	2218	158	104	
34	596.99	94	94	76	0	195	160	NET<CL
35	609.22	3131	141	70	2978	204	141	
45	803.18	146	63	48	-26	150	124	NET<CL
50	911.29	1604	101	51	1523	132	88	
62	1460.78	2185	105	40	1826	150	101	
67	1764.32	571	61	31	513	89	63	

182195D02.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-14 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 14:08:31
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.55e+002 g	Real Time . . . . . 60095 Sec
Collection Efficiency 1.0000	Spectrum File 182195D02.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.25E+02 +1.62E+02*L +-7.06E+01*L^2 +1.02E+01*L^3] 09/06/2018

Eff.=10^[-1.14E+01 +1.13E+01*L +-4.16E+00*L^2 +4.74E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	Average:	x	2.43E+00 +- 7.14E-01	. . . .	. . . .	3.92E+13
	63.29		6.06E+00 +- 5.71E+00	9.37E+00	4.65E+00	3.92E+13
	92.60		2.38E+00 +- 7.19E-01	1.16E+00	5.76E-01	3.92E+13
U-235	143.76		2.69E-01 +- 1.52E-01	2.47E-01	1.22E-01	3.33E+10
Ra-223	Average:	x	4.37E-01 +- 1.03E-01	. . . .	. . . .	2.87E+08
	154.18		1.83E-01 +- 2.10E-01	3.45E-01	1.70E-01	2.87E+08
	269.39		5.18E-01 +- 1.18E-01	1.83E-01	9.01E-02	2.87E+08
Ra-226	186.10		2.63E+00 +- 7.22E-01	1.16E+00	5.75E-01	1.40E+07
Pb-212	Average:	x	1.89E+00 +- 8.18E-02	. . . .	. . . .	5.04E+04
	238.63		1.89E+00 +- 8.31E-02	1.14E-01	5.66E-02	5.04E+04
	300.09		1.88E+00 +- 4.63E-01	7.15E-01	3.52E-01	5.04E+04
Tl-208	Average:	x	5.53E-01 +- 3.84E-02	. . . .	. . . .	5.04E+04
	277.36		6.09E-01 +- 2.05E-01	3.22E-01	1.58E-01	5.04E+04
	583.14		5.51E-01 +- 3.92E-02	5.24E-02	2.59E-02	5.04E+04
	860.47		5.53E-01 +- 5.55E-01	7.33E-01	3.63E-01	5.04E+04
Ac-228	Average:	x	1.64E+00 +- 8.33E-02	. . . .	. . . .	5.04E+04
	338.40		1.67E+00 +- 1.49E-01	1.99E-01	9.78E-02	5.04E+04
	911.07		1.62E+00 +- 1.40E-01	1.89E-01	9.30E-02	5.04E+04
	964.60		1.75E+00 +- 4.51E-01	6.79E-01	3.31E-01	5.04E+04
	968.90		1.62E+00 +- 1.52E-01	1.78E-01	8.65E-02	5.04E+04
Pb-214	Average:	x	1.53E+00 +- 9.06E-02	. . . .	. . . .	1.40E+07

182195D02.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	351.92		1.53E+00 +- 9.28E-02	1.30E-01	6.43E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
	295.21		1.53E+00 +- 4.19E-01	5.79E-01	2.88E-01	1.40E+07
Bi-214	Average:x		1.49E+00 +- 8.01E-02	. . . .	. . . .	1.40E+07
	609.31		1.45E+00 +- 9.91E-02	1.39E-01	6.88E-02	1.40E+07
	768.36		1.55E+00 +- 4.47E-01	6.86E-01	3.35E-01	1.40E+07
	934.06		1.80E+00 +- 6.89E-01	1.07E+00	5.21E-01	1.40E+07
	1120.29		1.47E+00 +- 1.89E-01	2.48E-01	1.21E-01	1.40E+07
	1238.11		1.50E+00 +- 4.39E-01	6.62E-01	3.22E-01	1.40E+07
	1377.67		1.72E+00 +- 6.43E-01	9.88E-01	4.79E-01	1.40E+07
	1764.49		1.69E+00 +- 2.93E-01	4.24E-01	2.08E-01	1.40E+07
Bi-212	Average:x		1.07E+00 +- 1.76E-01	. . . .	. . . .	5.04E+04
	727.17		1.07E+00 +- 1.85E-01	2.66E-01	1.30E-01	5.04E+04
	785.42		1.85E+00 +- 1.03E+00	1.66E+00	8.10E-01	5.04E+04
	1620.56		7.79E-01 +- 6.61E-01	1.06E+00	5.09E-01	5.04E+04
Tl-210	Average:x		6.05E-02 +- 1.77E-02	. . . .	. . . .	1.40E+07
	795.00		6.08E-02 +- 1.78E-02	2.67E-02	1.30E-02	1.40E+07
	860.00		1.79E-01 +- 1.99E+00	5.03E-01	2.46E-01	1.40E+07
	296.00		3.12E-02 +- 2.03E-01	4.41E-02	2.18E-02	1.40E+07
Pa-234	Average:x		6.64E-02 +- 8.78E-02	. . . .	. . . .	3.95E+13
	808.10		4.05E-01 +- 3.40E-01	5.52E-01	2.69E-01	3.95E+13
	946.00	N	4.23E-02 +- 9.09E-02	1.51E-01	7.35E-02	3.95E+13
K-40	1460.75		7.54E+00 +- 6.18E-01	8.45E-01	4.17E-01	1.12E+13
Ra-224	241.00		2.13E+00 +- 3.01E+00	6.99E-01	3.45E-01	5.04E+04
Pb-210	46.52	N	7.69E+00 +- 5.69E+01	9.46E+01	4.67E+01	1.79E+05
Tl-201	70.82	N	6.50E+02 +- 5.81E+03	9.59E+03B	4.77E+03	7.35E+01
Ir-192	316.49	N	-7.27E-03 +- 2.35E-02	3.96E-02	1.95E-02	1.78E+03
Be-7	477.56	N	3.46E-02 +- 2.60E-01	4.34E-01	2.13E-01	1.28E+03
Sc-46	889.26	N	-1.09E-02 +- 2.42E-02	4.16E-02	2.02E-02	2.01E+03
Na-22	1274.54	N	8.22E-04 +- 2.11E-02	3.57E-02B	1.73E-02	2.28E+04

MEASURED TOTAL: 6.82E+02 +- 5.87E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	57.17	116.70	62	79	64	996	0.53	Deleted
3	66.32	134.96	-103	309	254	2721	1.27	Deleted
4	74.81	151.90	666	445	363	2581	1.18	Unknown
5	77.09	156.45	1441	168	123	2581	1.07	Unknown
6	84.21	170.68	337	143	114	2203	1.09	Unknown
7	87.13	176.50	898	179	138	2832	1.52	Unknown
8	89.89	182.00	508	145	114	2203	1.22	Unknown

182195D02.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
10	129.02	260.12	205	110	87	1538	0.79	Unknown
11	139.78	281.59	62	214	176	2321	1.27	Deleted
15	198.46	398.74	-5	216	178	1887	1.18	Deleted
16	209.21	420.19	569	128	98	1880	1.11	Unknown
17	211.63	425.02	4	80	66	1074	0.60	Deleted
19	241.61	484.86	1632	155	108	2044	1.54	SPLIT
22	295.18	591.80	2470	197	140	1339	1.27	SPLIT
24	327.77	656.86	330	125	99	1594	1.67	Unknown
27	409.35	819.69	129	74	58	698	1.03	Unknown
28	462.93	926.64	375	108	83	1070	1.72	Unknown
29	510.93	1022.47	599	307	249	1416	2.45	Unknown
30	558.54	1117.51	-65	138	114	574	1.12	Deleted
31	563.00	1126.41	100	101	81	1066	2.18	Unknown
32	569.43	1139.24	-41	164	135	656	1.27	Deleted
34	596.99	1194.25	0	195	160	1016	1.74	Deleted
36	661.56	1323.14	168	69	53	567	1.25	Unknown
37	692.67	1385.24	53	49	38	362	0.84	Unknown
38	694.78	1389.45	169	113	90	1157	2.65	Unknown
40	755.06	1509.79	52	47	37	320	1.03	Unknown
42	772.64	1544.87	83	67	53	522	1.57	Unknown
45	803.18	1605.83	-26	150	124	446	1.44	Deleted
47	835.57	1670.50	124	76	60	607	2.04	Unknown
48	839.59	1678.52	87	52	40	354	1.20	Unknown
49	860.58	1720.42	269	79	60	569	2.10	SPLIT
54	1001.91	2002.53	89	73	58	513	2.78	Unknown
55	1094.16	2186.68	31	104	85	798	4.59	Deleted
57	1155.19	2308.49	46	41	32	231	1.24	Unknown
59	1280.83	2559.30	47	35	27	167	1.17	Unknown
61	1407.75	2812.65	49	48	37	248	2.19	Unknown
63	1509.02	3014.80	38	48	38	239	2.41	Unknown
64	1588.65	3173.75	93	46	34	206	2.11	Unknown
66	1729.65	3455.21	102	42	30	148	2.54	Unknown
68	1847.38	3690.22	42	46	36	187	3.06	Unknown

c:\SEEKER\BIN\182195d02.res Analysis Results Saved.

182672D03.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-14D GS181103-1

Sampling Start:	10/24/2018 12:00:00	Counting Start:	12/05/2018 14:08:44
Sampling Stop:	10/24/2018 12:00:00	Decay Time.	1.01E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	60000 Sec
Sample Size	1.52E+002 g	Real Time	60095 Sec
Collection Efficiency	1.0000	Spc. File	.182672D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.30 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.79 + 0.012*En + 1.05E-03*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.46	129.20	108	94	75	1259	0.64	a	
2	66.59	135.44	106	125	101	1888	1.01	b	
3	74.87	151.95	1288	161	119	2401	1.14	a	
4	77.08	156.37	2141	158	106	2058	0.94	b	
5	84.28	170.72	316	136	108	1982	1.17	a	
6	87.17	176.49	931	145	108	1982	1.13	b	
7	89.94	182.02	484	111	84	1416	0.80	c	
8	92.89	187.90	1162	148	108	1982	1.13	d	
9	99.56	201.22	96	89	71	1133	0.64	e	
10	105.24	212.54	120	133	108	1982	1.16	f	
11	129.04	260.03	233	102	80	1280	0.83	a	
12	140.16	282.21	184	111	89	1456	1.01	a	
13	144.17	290.19	147	137	111	1941	1.23	b	
14	154.17	310.15	116	85	67	1007	0.63	a	
15	163.57	328.90	73	106	86	1374	0.92	a	NET< CL
16	185.89	373.43	1188	146	106	1780	1.34	a	
17	198.65	398.88	202	133	107	1803	1.31	a	
18	209.31	420.15	562	124	95	1657	1.27	a	
19	226.29	454.03	51	91	74	1155	1.03	a	NET< CL
20	238.61	478.61	6512	194	89	1467	1.36	a	
21	241.61	484.58	1314	148	106	1834	1.68	b	

182672D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	265.13	531.51	46	62	50	615	0.63	a	NET< CL
23	270.25	541.72	448	108	82	1230	1.38	b	
24	277.41	556.01	167	74	57	743	0.87	a	
25	288.64	578.42	40	58	47	538	0.65	a	NET< CL
26	295.19	591.47	2047	135	82	1168	1.53	a	
27	300.18	601.42	389	115	89	1298	1.58	b	
28	327.97	656.87	282	96	74	1001	1.31	a	
29	338.20	677.28	1222	119	79	1087	1.44	a	
30	351.81	704.43	3359	151	80	1039	1.58	a	
31	409.71	819.93	131	74	58	657	1.21	a	
32	462.80	925.83	308	87	66	802	1.70	a	
33	511.01	1022.01	1874	141	91	1178	2.55	a	Wide Pk
34	558.72	1117.18	77	48	37	340	0.83	a	
35	583.12	1165.87	1989	122	68	778	1.89	a	
36	596.82	1193.20	61	61	48	507	1.22	a	
37	609.23	1217.96	2366	130	71	838	1.99	a	HiResid
38	661.84	1322.91	158	90	71	778	2.25	a	
39	727.05	1452.99	386	81	58	606	2.18	a	
40	766.52	1531.73	-6	50	41	381	1.33	a	NET< CL HiResid
41	770.45	1539.57	-5	41	34	286	0.97	b	NET< CL HiResid
42	795.10	1588.75	196	59	43	370	1.63	a	
43	803.02	1604.54	-0	40	33	259	1.08	b	NET< CL
44	803.29	1605.08	107	63	49	444	1.91	c	
45	860.52	1719.25	206	64	47	409	1.95	a	
46	874.86	1747.87	26	36	28	197	1.03	a	NET< CL
47	911.17	1820.29	1198	93	51	439	2.32	a	
48	934.18	1866.19	69	50	39	299	1.59	a	
49	965.19	1928.05	305	78	57	496	2.83	a	
50	969.06	1935.78	670	76	46	379	2.07	b	
51	1119.83	2236.55	491	81	56	428	3.20	a	
52	1238.52	2473.33	148	55	41	299	2.06	a	
53	1377.26	2750.11	131	61	47	300	3.21	a	
54	1460.69	2916.54	1508	91	40	226	3.12	a	HiResid
55	1509.20	3013.32	34	36	28	149	2.01	a	
56	1588.45	3171.40	64	39	29	151	2.06	a	
57	1631.07	3256.44	44	46	36	187	3.10	a	
58	1729.79	3453.37	62	46	35	159	3.83	a	
59	1764.61	3522.82	344	55	34	158	3.25	a	

182672D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET031128.BKG (112818-3 LONG BKG CAL)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.46	108	94	75	12	178	146	NET<CL
2	66.59	106	125	101	-121	233	192	NET<CL
4	77.08	2141	158	106	2078	233	176	
5	84.28	316	136	108	259	195	158	
8	92.89	1162	148	108	844	221	175	
12	140.16	184	111	89	52	228	187	NET<CL
16	185.89	1188	146	106	879	253	202	
17	198.65	202	133	107	-24	252	208	NET<CL
20	238.61	6512	194	89	6280	239	147	
21	241.61	1314	148	106	1251	226	176	
26	295.19	2047	135	82	1925	189	138	
29	338.20	1222	119	79	1189	165	123	
30	351.81	3359	151	80	3109	205	142	
33	511.01	1874	141	91	329	285	233	
34	558.72	77	48	37	-75	116	96	NET<CL
35	583.12	1989	122	68	1858	184	134	
37	609.23	2366	130	71	2205	176	123	
43	803.02	-0	40	33	-144	122	102	NET<CL
47	911.17	1198	93	51	1138	141	102	
54	1460.69	1508	91	40	1346	122	80	
59	1764.61	344	55	34	300	78	57	

182672D03.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-14D GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 14:08:44
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.52e+002 g	Real Time . . . . . 60095 Sec
Collection Efficiency 1.0000	Spectrum File 182672D03.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-8.15E+01 +1.04E+02*L +-4.49E+01*L^2 +6.40E+00*L^3] 11/01/2018
Eff.=10^[-2.02E-01 +-3.44E-01*L +-1.27E-01*L^2 +7.29E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
U-238	92.60		2.26E+00	+- 5.91E-01	9.45E-01	4.69E-01	3.92E+13
Pa-234	Average:x		1.56E-03	+- 1.07E-01	. . . .	. . . .	3.95E+13
	99.70		2.70E-01	+- 2.49E-01	4.08E-01	2.00E-01	3.95E+13
	946.00	N	-5.91E-02	+- 1.19E-01	2.04E-01	9.93E-02	3.95E+13
U-235	143.76		1.48E-01	+- 1.38E-01	2.26E-01	1.12E-01	3.33E+10
Ra-223	Average:x		3.99E-01	+- 9.59E-02	. . . .	. . . .	2.87E+08
	154.18		2.23E-01	+- 1.62E-01	2.64E-01	1.29E-01	2.87E+08
	269.39		4.93E-01	+- 1.19E-01	1.83E-01	8.98E-02	2.87E+08
Ra-226	186.10		2.95E+00	+- 8.48E-01	1.37E+00	6.78E-01	1.40E+07
Pb-212	Average:x		2.05E+00	+- 7.73E-02	. . . .	. . . .	5.04E+04
	238.63		2.06E+00	+- 7.81E-02	9.69E-02	4.80E-02	5.04E+04
	300.09		1.88E+00	+- 5.57E-01	8.73E-01	4.30E-01	5.04E+04
Tl-208	Average:x		5.83E-01	+- 5.64E-02	. . . .	. . . .	5.04E+04
	277.36		3.95E-01	+- 1.76E-01	2.77E-01	1.35E-01	5.04E+04
	583.14		6.04E-01	+- 5.98E-02	8.78E-02	4.35E-02	5.04E+04
	860.47		5.83E-01	+- 6.07E-01	8.07E-01	3.99E-01	5.04E+04
Ac-228	Average:x		1.71E+00	+- 1.18E-01	. . . .	. . . .	5.04E+04
	338.40		1.73E+00	+- 2.40E-01	3.63E-01	1.79E-01	5.04E+04
	911.07		1.63E+00	+- 2.02E-01	2.96E-01	1.46E-01	5.04E+04
	964.60		2.46E+00	+- 6.24E-01	9.38E-01	4.58E-01	5.04E+04
	968.90		1.69E+00	+- 1.93E-01	2.40E-01	1.17E-01	5.04E+04

182672D03.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Pb-214	Average:x		1.55E+00	+- 1.00E-01	. . . .	. . . .	1.40E+07
	351.92		1.55E+00	+- 1.02E-01	1.43E-01	7.07E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	. . . .	1.40E+07
	295.21		1.59E+00	+- 4.93E-01	6.74E-01	3.36E-01	1.40E+07
Bi-214	Average:x		1.44E+00	+- 9.71E-02	. . . .	. . . .	1.40E+07
	609.31		1.41E+00	+- 1.13E-01	1.59E-01	7.86E-02	1.40E+07
	934.06		9.58E-01	+- 6.89E-01	1.11E+00	5.34E-01	1.40E+07
	1120.29		1.64E+00	+- 2.70E-01	3.81E-01	1.86E-01	1.40E+07
	1238.11		1.37E+00	+- 5.14E-01	7.86E-01	3.80E-01	1.40E+07
	1377.67		2.01E+00	+- 9.33E-01	1.46E+00	7.11E-01	1.40E+07
	1764.49		1.47E+00	+- 3.82E-01	5.75E-01	2.81E-01	1.40E+07
Bi-212	727.17		1.11E+00	+- 2.34E-01	3.45E-01	1.68E-01	5.04E+04
Tl-210	Average:x		7.06E-02	+- 2.14E-02	. . . .	. . . .	1.40E+07
	795.00		7.11E-02	+- 2.15E-02	3.21E-02	1.56E-02	1.40E+07
	860.00		1.63E-01	+- 2.17E+00	5.39E-01	2.62E-01	1.40E+07
	296.00		6.67E-03	+- 2.40E-01	5.43E-02	2.69E-02	1.40E+07
K-40	1460.75		7.95E+00	+- 7.19E-01	9.60E-01	4.72E-01	1.12E+13
Ra-224	241.00		1.50E+00	+- 4.97E+00	1.29E+00	6.42E-01	5.04E+04
Pb-210	46.52	N	3.76E+00	+- 1.06E+01	1.75E+01	8.64E+00	1.79E+05
Tl-201	70.82	N	-2.28E+02	+- 1.73E+03	2.88E+03B	1.43E+03	7.35E+01
Ir-192	316.49	N	1.20E-02	+- 2.53E-02	4.19E-02	2.06E-02	1.78E+03
Be-7	477.56	N	-5.39E-02	+- 2.82E-01	4.77E-01	2.33E-01	1.28E+03
Sc-46	889.26	N	-5.94E-03	+- 3.41E-02	5.80E-02	2.82E-02	2.01E+03
Na-22	1274.54	N	-1.63E-02	+- 3.05E-02	5.27E-02	2.56E-02	2.28E+04

MEASURED TOTAL: 2.75E+01 +- 1.88E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.46	129.20	12	178	146	1259	0.64	Deleted
2	66.59	135.44	-121	233	192	1888	1.01	Deleted
3	74.87	151.95	1288	161	119	2401	1.14	Unknown
4	77.08	156.37	2078	233	176	2058	0.94	Unknown
5	84.28	170.72	259	195	158	1982	1.17	Unknown
6	87.17	176.49	931	145	108	1982	1.13	Unknown
7	89.94	182.02	484	111	84	1416	0.80	Unknown
10	105.24	212.54	120	133	108	1982	1.16	Unknown
11	129.04	260.03	233	102	80	1280	0.83	Unknown
12	140.16	282.21	52	228	187	1456	1.01	Deleted
15	163.57	328.90	73	106	86	1374	0.92	Deleted
17	198.65	398.88	-24	252	208	1803	1.31	Deleted
18	209.31	420.15	562	125	95	1657	1.27	Unknown

182672D03.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
19	226.29	454.03	51	91	74	1155	1.03	Deleted
21	241.61	484.58	1251	226	176	1834	1.68	SPLIT
22	265.13	531.51	46	62	50	615	0.63	Deleted
25	288.64	578.42	40	58	47	538	0.65	Deleted
26	295.19	591.47	1925	189	138	1168	1.53	SPLIT
28	327.97	656.87	282	96	74	1001	1.31	Unknown
31	409.71	819.93	131	74	58	657	1.21	Unknown
32	462.80	925.84	308	87	66	802	1.70	Unknown
33	511.01	1022.01	329	285	233	1178	2.55	Unknown
34	558.72	1117.18	-75	116	96	340	0.83	Deleted
36	596.82	1193.20	61	61	48	507	1.22	Unknown
38	661.84	1322.91	158	90	71	778	2.25	Unknown
40	766.52	1531.73	-6	50	41	381	1.33	Deleted
41	770.45	1539.57	-5	41	34	286	0.97	Deleted
43	803.02	1604.54	-144	122	102	259	1.08	Deleted
44	803.29	1605.08	107	63	49	444	1.91	Unknown
45	860.52	1719.25	206	64	47	409	1.95	SPLIT
46	874.86	1747.87	26	36	28	197	1.03	Deleted
55	1509.20	3013.32	34	36	28	149	2.01	Unknown
56	1588.45	3171.40	64	39	29	151	2.06	Unknown
57	1631.07	3256.44	44	46	36	187	3.10	Unknown
58	1729.79	3453.37	62	46	35	159	3.83	Unknown

c:\SEEKER\BIN\182672d03.res Analysis Results Saved.

181997D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-15 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 08:31:52
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.00E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 1.80E+002 g	Real Time . . . . . 7255 Sec
Collection Efficiency 1.0000	Spc. File 181997D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.04 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.76	97.37	44	55	44	352	1.06	a	NET< CL
2	63.23	130.23	147	79	62	572	1.48	a	
3	66.18	136.13	72	58	45	381	0.90	b	
4	74.77	153.26	310	69	49	445	0.94	a	
5	76.97	157.66	492	80	55	519	1.17	b	
6	86.99	177.64	173	63	47	411	1.00	a	
7	89.94	183.54	94	60	47	411	0.96	b	
8	92.68	189.01	294	86	65	617	1.47	c	
9	128.80	261.07	35	46	37	275	0.84	a	NET< CL
10	185.77	374.76	261	66	48	421	1.30	a	
11	198.49	400.14	102	61	47	415	1.32	a	
12	209.55	422.21	119	67	52	449	1.56	a	
13	238.56	480.10	1007	83	44	363	1.24	a	
14	241.56	486.08	262	63	44	363	1.32	b	
15	270.12	543.06	74	54	42	311	1.40	a	
16	295.20	593.12	614	67	37	254	1.36	a	
17	300.41	603.52	54	43	34	222	1.23	b	
18	338.32	679.15	203	53	37	249	1.26	a	
19	351.92	706.30	1046	79	37	243	1.42	a	
20	511.10	1023.93	665	78	48	345	2.53	a	Wide Pk
21	558.52	1118.55	81	40	30	162	1.71	a	

181997D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	583.38	1168.16	360	54	32	184	1.71	a	
23	609.49	1220.26	751	73	40	291	1.66	a	
24	661.64	1324.32	304	51	31	174	1.60	a	
25	727.57	1455.87	74	37	27	138	1.56	a	
26	768.42	1537.39	54	31	23	113	1.33	a	
27	795.07	1590.57	18	42	34	188	2.39	a	NET< CL
28	861.08	1722.28	49	31	23	108	1.71	a	
29	911.27	1822.43	283	47	27	131	2.04	a	
30	968.91	1937.45	120	40	28	144	1.98	a	
31	1120.63	2240.21	173	42	27	123	2.22	a	
32	1238.19	2474.79	31	23	17	65	1.21	a	
33	1377.94	2753.65	32	29	22	85	2.31	a	
34	1460.59	2918.56	900	64	18	51	2.87	a	HiResid
35	1729.27	3454.70	38	19	12	28	1.77	a	
36	1764.20	3524.39	157	34	19	56	2.58	a	
37	1846.70	3689.02	22	16	11	23	1.62	a	

181997D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

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Background File:. . . . . DET101128.BKG (112818-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.76	44	55	44	8	73	60	NET<CL
2	63.23	147	79	62	92	89	72	
3	66.18	72	58	45	-4	67	55	NET<CL
4	74.77	310	69	49	221	81	62	
5	76.97	492	80	55	379	89	66	
6	86.99	173	63	47	148	69	53	
8	92.68	294	86	65	151	95	75	
10	185.77	261	66	48	102	78	62	
11	198.49	102	61	47	-9	69	57	NET<CL
13	238.57	1007	83	44	881	90	55	
14	241.56	262	63	44	164	71	54	
15	270.12	74	54	42	63	59	47	
16	295.20	614	67	37	424	75	51	
18	338.32	203	53	37	180	57	41	
19	351.92	1046	79	37	670	88	58	
20	511.10	665	78	48	70	93	76	NET<CL
21	558.52	81	40	30	-10	47	39	NET<CL
22	583.38	360	54	32	290	60	41	
23	609.49	751	73	40	472	82	58	
26	768.42	54	31	23	14	43	34	NET<CL
28	861.08	49	31	23	39	36	28	
29	911.27	283	47	27	234	51	33	
30	968.91	120	40	28	91	44	33	
31	1120.63	173	42	27	105	47	34	
32	1238.19	31	23	17	12	29	23	NET<CL
33	1377.94	32	29	22	17	33	26	NET<CL
34	1460.59	900	64	18	755	68	33	
35	1729.27	38	19	12	21	25	20	
36	1764.20	157	34	19	93	38	27	

181997D10.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-15 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 08:31:52
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.00e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 1.80e+002 g	Real Time . . . . . 7255 Sec
Collection Efficiency 1.0000	Spectrum File 181997D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)

Efficiency File: (D10)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018

Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	Average:	x	1.36E+00 +- 7.43E-01	. . . .	. . . .	3.92E+13
	63.29		2.51E+00 +- 2.45E+00	4.01E+00	1.97E+00	3.92E+13
	92.60		1.24E+00 +- 7.80E-01	1.26E+00	6.19E-01	3.92E+13
Ra-226	186.10		1.14E+00 +- 8.74E-01	1.42E+00	6.95E-01	1.40E+07
Pb-212	Average:	x	9.12E-01 +- 9.20E-02	. . . .	. . . .	5.04E+04
	238.63		9.14E-01 +- 9.28E-02	1.17E-01	5.72E-02	5.04E+04
	300.09		8.53E-01 +- 6.90E-01	1.11E+00	5.35E-01	5.04E+04
Ra-224	241.00		1.89E+00 +- 8.12E-01	1.28E+00	6.23E-01	5.04E+04
Ra-223	269.39		2.13E-01 +- 2.00E-01	3.25E-01	1.58E-01	2.87E+08
Pb-214	Average:	x	1.02E+00 +- 1.07E-01	. . . .	. . . .	1.40E+07
	295.21		1.08E+00 +- 1.91E-01	2.69E-01	1.31E-01	1.40E+07
	351.92		9.93E-01 +- 1.30E-01	1.77E-01	8.64E-02	1.40E+07
Ac-228	Average:	x	7.24E-01 +- 1.23E-01	. . . .	. . . .	5.04E+04
	338.40		7.97E-01 +- 2.51E-01	3.75E-01	1.82E-01	5.04E+04
	911.07		7.80E-01 +- 1.69E-01	2.31E-01	1.11E-01	5.04E+04
	968.90		5.23E-01 +- 2.56E-01	3.95E-01	1.90E-01	5.04E+04
Tl-208	Average:	x	2.35E-01 +- 4.87E-02	. . . .	. . . .	5.04E+04
	583.14		2.35E-01 +- 4.88E-02	6.84E-02	3.31E-02	5.04E+04
	860.47		2.35E-01 +- 7.93E-01	1.06E+00	5.18E-01	5.04E+04
Bi-214	Average:	x	7.63E-01 +- 1.15E-01	. . . .	. . . .	1.40E+07
	609.31		7.45E-01 +- 1.30E-01	1.86E-01	9.08E-02	1.40E+07

181997D10.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	1120.29		7.83E-01 +- 3.48E-01	5.35E-01	2.57E-01	1.40E+07
	1764.49		8.76E-01 +- 3.59E-01	5.35E-01	2.55E-01	1.40E+07
Bi-212	727.17		5.11E-01 +- 2.58E-01	3.96E-01	1.88E-01	5.04E+04
K-40	1460.75		9.28E+00 +- 8.33E-01	8.36E-01	4.01E-01	1.12E+13
Tl-210	Average:x		4.55E-02 +- 2.98E-02	. . . .	. . . .	1.40E+07
	860.00		1.17E-01 +- 2.84E+00	7.62E-01	3.63E-01	1.40E+07
	795.00	N	4.55E-02 +- 2.98E-02	4.68E-02	2.22E-02	1.40E+07
Pb-210	46.52	N	5.45E+00 +- 5.62E+00	9.18E+00	4.45E+00	1.79E+05
Tl-201	70.82	N	8.57E+02 +- 1.39E+03	2.30E+03B	1.12E+03	7.35E+01
U-235	143.76	N	1.18E-01 +- 2.33E-01	3.87E-01	1.89E-01	3.33E+10
Ir-192	316.49	N	1.06E-02 +- 4.05E-02	6.82E-02	3.29E-02	1.78E+03
Be-7	477.56	N	8.81E-02 +- 3.86E-01	6.54E-01	3.13E-01	1.28E+03
Sc-46	889.26	N	-1.19E-02 +- 4.41E-02	7.73E-02	3.69E-02	2.01E+03
Pa-234	946.00	N	4.16E-02 +- 1.51E-01	2.58E-01	1.22E-01	3.95E+13
Na-22	1274.54	N	4.68E-03 +- 3.70E-02	6.38E-02	3.02E-02	2.28E+04

MEASURED TOTAL: 8.81E+02 +- 1.40E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.76	97.37	8	73	60	352	1.06	Deleted
3	66.18	136.13	-4	67	55	381	0.90	Deleted
4	74.77	153.26	221	81	62	445	0.94	Unknown
5	76.97	157.66	379	89	66	519	1.17	Unknown
6	86.99	177.64	148	69	53	411	1.00	Unknown
7	89.94	183.54	94	61	47	411	0.96	Unknown
9	128.80	261.07	35	46	37	275	0.84	Deleted
11	198.49	400.14	-9	69	57	415	1.32	Deleted
12	209.55	422.21	119	67	52	449	1.56	Unknown
20	511.10	1023.93	70	93	76	345	2.53	Deleted
21	558.52	1118.55	-10	47	39	162	1.71	Deleted
24	661.64	1324.32	304	51	31	174	1.60	Unknown
26	768.42	1537.39	14	43	34	113	1.33	Deleted
27	795.07	1590.57	18	42	34	188	2.39	Deleted
28	861.08	1722.28	39	36	28	108	1.71	SPLIT
32	1238.19	2474.79	12	29	23	65	1.21	Deleted
33	1377.94	2753.65	17	33	26	85	2.31	Deleted
35	1729.27	3454.70	21	25	20	28	1.77	Unknown
37	1846.70	3689.02	22	16	11	23	1.62	Unknown

c:\SEEKER\BIN\181997d10.res Analysis Results Saved.

182000D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-16 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 14:09:19
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.01E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 8.29E+001 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spc. File 182000D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.04 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.54	96.93	291	132	105	2233	0.81 a	
2	53.37	110.55	175	144	116	2488	0.91 a	
3	63.18	130.13	737	142	108	2339	0.84 a	
4	66.23	136.23	711	177	139	3275	1.07 b	
5	72.73	149.19	142	117	94	1957	0.67 a	
6	74.72	153.17	2127	195	142	3425	1.13 b	
7	76.99	157.69	3287	191	126	2936	1.03 c	
8	84.13	171.94	632	158	123	2575	1.21 a	
9	87.16	177.99	1464	168	123	2575	1.09 b	
10	89.75	183.16	765	159	123	2575	1.11 c	
11	92.62	188.89	2635	195	136	2943	1.31 d	
12	98.58	200.77	110	167	136	2943	1.34 e	NET< CL
13	128.61	260.70	134	100	80	1431	0.70 a	
14	139.59	282.61	566	136	105	2024	0.98 a	
15	143.65	290.71	386	179	143	3036	1.47 b	
16	163.30	329.91	141	162	132	2748	1.31 a	
17	185.89	374.99	2555	178	121	2703	1.31 a	
18	198.36	399.89	864	133	98	2020	1.03 a	
19	209.29	421.69	256	132	105	2194	1.10 a	
20	238.59	480.15	3936	183	110	2232	1.30 a	
21	241.79	486.54	2377	165	110	2232	1.28 b	

182000D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	258.81	520.49	134	106	85	1538	1.04	a	
23	270.14	543.10	301	130	103	1962	1.31	a	
24	277.25	557.29	111	115	93	1710	1.22	a	
25	295.21	593.13	5017	186	99	1829	1.32	a	
26	300.25	603.19	174	90	71	1143	0.78	b	
27	321.06	644.71	23	118	97	1726	1.24	a	NET< CL
28	327.83	658.22	182	109	87	1488	1.21	a	
29	338.36	679.23	771	139	105	1904	1.43	a	
30	351.97	706.40	8574	223	102	1802	1.43	a	
31	409.33	820.86	54	97	79	1237	1.20	a	NET< CL
32	417.07	836.29	74	105	85	1345	1.30	a	NET< CL
33	463.03	928.00	254	111	87	1317	1.50	a	
34	511.10	1023.92	5058	220	138	2618	2.74	a	Wide Pk
35	537.33	1076.26	92	71	57	739	1.06	a	
36	558.70	1118.91	646	105	76	1112	1.44	a	
37	569.71	1140.89	232	100	79	1206	1.42	a	
38	583.47	1168.33	1472	131	87	1346	1.84	a	
39	597.29	1195.91	279	123	97	1672	1.81	a	
40	599.46	1200.24	152	81	64	996	0.84	b	
41	609.51	1220.29	6688	206	104	1985	1.67	a	
42	661.88	1324.80	680	115	84	1243	1.76	a	
43	665.48	1331.97	127	91	72	1017	1.41	b	
44	727.49	1455.71	325	109	85	1202	1.96	a	
45	768.27	1537.09	576	112	83	1222	2.05	a	
46	785.62	1571.72	210	93	73	986	2.02	a	
47	795.17	1590.78	154	70	54	641	1.30	a	
48	803.46	1607.30	574	95	68	881	1.85	b	
49	806.10	1612.57	135	64	49	561	1.10	c	
50	835.92	1672.08	125	81	64	869	1.49	a	
51	839.33	1678.88	246	135	108	1737	3.02	b	
52	860.65	1721.44	142	83	65	863	1.62	a	
53	898.64	1797.24	127	84	67	853	1.74	a	
54	911.25	1822.40	1114	110	72	915	2.18	a	
55	934.31	1868.42	317	98	75	965	2.22	a	
56	964.14	1927.94	455	134	104	1380	3.80	a	Wide Pk
57	969.06	1937.75	749	97	66	780	2.17	b	
58	1000.29	2000.06	234	132	106	1372	3.98	a	Wide Pk
59	1063.44	2126.08	78	87	70	872	2.14	a	
60	1120.43	2239.79	1430	111	67	790	2.13	a	
61	1155.45	2309.68	120	76	60	656	1.89	a	
62	1207.57	2413.68	97	63	49	513	1.42	a	
63	1238.08	2474.57	544	91	65	712	2.30	a	
64	1281.12	2560.44	46	68	55	550	2.04	a	NET< CL
65	1377.37	2752.51	437	82	58	531	2.60	a	
66	1385.54	2768.80	133	77	61	564	2.86	b	
67	1407.86	2813.35	148	63	48	447	1.77	a	

182000D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
68	1460.61	2918.61	3458	136	56	516	2.51	a	HiResid
69	1509.35	3015.85	150	70	54	478	2.48	a	
70	1660.91	3318.28	86	57	44	331	2.35	a	
71	1729.05	3454.26	299	70	50	387	2.83	a	
72	1764.05	3524.10	1436	98	52	382	3.09	a	
73	1846.68	3688.98	199	68	51	366	3.09	a	

182000D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET101128.BKG (112818-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.54	291	132	105	-7	424	348	NET<CL
2	53.37	175	144	116	-30	348	287	NET<CL
3	63.18	737	142	108	278	372	304	NET<CL
4	66.23	711	177	139	79	335	275	NET<CL
6	74.72	2127	195	142	1387	402	325	
7	76.99	3287	191	126	2350	378	300	
8	84.13	632	158	123	469	302	246	
9	87.16	1464	168	123	1258	283	225	
11	92.62	2635	195	136	1442	386	312	
14	139.59	566	136	105	60	279	229	NET<CL
15	143.65	386	179	143	240	315	258	NET<CL
17	185.89	2555	178	121	1228	382	309	
18	198.36	864	133	98	-63	299	246	NET<CL
20	238.59	3936	183	110	2886	331	257	
21	241.79	2377	165	110	1566	315	251	
22	258.81	134	106	85	75	182	149	NET<CL
23	270.14	301	130	103	206	231	188	
25	295.21	5017	186	99	3441	332	256	
29	338.36	771	139	105	576	216	173	
30	351.97	8574	223	102	5437	388	296	
34	511.10	5058	220	138	100	480	395	NET<CL
35	537.33	92	71	57	19	192	157	NET<CL
36	558.70	646	105	76	-106	229	189	NET<CL
37	569.71	232	100	79	-85	251	207	NET<CL
38	583.47	1472	131	87	891	260	208	
39	597.29	279	123	97	129	254	208	NET<CL
40	599.46	152	81	64	-453	419	347	NET<CL
41	609.51	6688	206	104	4364	379	292	
45	768.27	576	112	83	241	266	218	
48	803.46	574	95	68	66	205	168	NET<CL
50	835.92	125	81	64	-224	312	258	NET<CL
51	839.33	246	135	108	-31	245	201	NET<CL
52	860.65	142	83	65	67	171	140	NET<CL
53	898.64	127	84	67	-13	171	141	NET<CL
54	911.25	1114	110	72	710	200	158	
55	934.31	317	98	75	228	162	131	

182000D10.SPC Analyzed by

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
56	964.14	455	134	104	182	271	222	NET<CL
57	969.06	749	97	66	506	179	143	
58	1000.29	234	132	106	196	168	137	
59	1063.44	78	87	70	26	194	159	NET<CL
60	1120.43	1430	111	67	857	202	159	
63	1238.08	544	91	65	379	172	137	
64	1281.12	46	68	55	-19	128	106	NET<CL
65	1377.37	437	82	58	315	152	121	
67	1407.86	148	63	48	96	137	112	NET<CL
68	1460.61	3458	136	56	2245	231	173	
69	1509.35	150	70	54	73	113	92	NET<CL
70	1660.91	86	57	44	36	129	106	NET<CL
71	1729.05	299	70	50	155	157	127	
72	1764.05	1436	98	52	904	175	135	

182000D10.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-16 GS181103-1

Sampling Start: 10/24/2018 12:00:00	Counting Start: 12/05/2018 14:09:19
Sampling Stop: 10/24/2018 12:00:00	Decay Time. . . . . 1.01e+003 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 8.29e+001 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spectrum File 182000D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)

Efficiency File: (D10)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018

Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		3.10E+00 +- 8.31E-01	1.35E+00	6.70E-01	3.92E+13
U-235	Average:x		2.49E-01 +- 2.18E-01	. . . .	. . . .	3.33E+10
	143.76	N	2.18E-01 +- 2.86E-01	4.71E-01	2.34E-01	3.33E+10
	163.35		2.93E-01 +- 3.37E-01	5.54E-01	2.74E-01	3.33E+10
Ra-226	186.10		3.60E+00 +- 1.12E+00	1.82E+00	9.06E-01	1.40E+07
Pb-212	Average:x		7.78E-01 +- 8.70E-02	. . . .	. . . .	5.04E+04
	238.63		7.81E-01 +- 8.95E-02	1.40E-01	6.96E-02	5.04E+04
	300.09		7.24E-01 +- 3.75E-01	6.01E-01	2.95E-01	5.04E+04
Ra-223	269.39		1.82E-01 +- 2.04E-01	3.36E-01	1.67E-01	2.87E+08
Tl-208	Average:x		1.89E-01 +- 5.33E-02	. . . .	. . . .	5.04E+04
	277.36		2.11E-01 +- 2.18E-01	3.58E-01	1.77E-01	5.04E+04
	583.14		1.88E-01 +- 5.49E-02	8.85E-02	4.40E-02	5.04E+04
Ac-228	Average:x		6.61E-01 +- 1.26E-01	. . . .	. . . .	5.04E+04
	338.40		6.66E-01 +- 2.50E-01	4.04E-01	2.00E-01	5.04E+04
	911.07		6.16E-01 +- 1.73E-01	2.77E-01	1.37E-01	5.04E+04
	968.90		7.64E-01 +- 2.70E-01	4.35E-01	2.15E-01	5.04E+04
Pb-214	Average:x		2.10E+00 +- 1.47E-01	. . . .	. . . .	1.40E+07
	351.92		2.10E+00 +- 1.50E-01	2.30E-01	1.14E-01	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
	295.21		2.13E+00 +- 6.89E-01	9.44E-01	4.71E-01	1.40E+07
Bi-214	Average:x		1.83E+00 +- 1.34E-01	. . . .	. . . .	1.40E+07

182000D10.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	609.31		1.80E+00 +- 1.56E-01	2.41E-01	1.20E-01	1.40E+07
	768.36		1.10E+00 +- 1.21E+00	1.99E+00	9.90E-01	1.40E+07
	934.06		1.91E+00 +- 1.35E+00	2.20E+00	1.09E+00	1.40E+07
	1120.29		1.67E+00 +- 3.95E-01	6.28E-01	3.11E-01	1.40E+07
	1238.11		2.00E+00 +- 9.07E-01	1.47E+00	7.26E-01	1.40E+07
	1377.67		2.66E+00 +- 1.28E+00	2.08E+00	1.03E+00	1.40E+07
	1764.49		2.22E+00 +- 4.31E-01	6.73E-01	3.33E-01	1.40E+07
Bi-212	Average:x		6.44E-01 +- 1.93E-01	. . . .	. . . .	5.04E+04
	727.17		5.84E-01 +- 1.96E-01	3.09E-01	1.52E-01	5.04E+04
	785.42		2.36E+00 +- 1.05E+00	1.67E+00	8.22E-01	5.04E+04
Tl-210	Average:x		3.45E-02 +- 1.56E-02	. . . .	. . . .	1.40E+07
	795.00		3.45E-02 +- 1.56E-02	2.47E-02	1.20E-02	1.40E+07
	296.00		3.80E-02 +- 3.35E-01	7.93E-02	3.94E-02	1.40E+07
K-40	1460.75		7.20E+00 +- 7.41E-01	1.12E+00	5.56E-01	1.12E+13
Ra-224	241.00		4.91E-01 +- 5.76E+00	1.51E+00	7.53E-01	5.04E+04
Pb-210	46.52	N	8.98E+00 +- 3.98E+00	6.41E+00	3.17E+00	1.79E+05
Tl-201	70.82	N	3.43E+03 +- 1.64E+03	2.62E+03R	1.30E+03	7.35E+01
Ir-192	316.49	N	9.24E-03 +- 2.73E-02	4.53E-02	2.23E-02	1.78E+03
Be-7	477.56	N	4.18E-02 +- 2.64E-01	4.40E-01	2.16E-01	1.28E+03
Sc-46	889.26	N	1.59E-02 +- 2.99E-02	4.95E-02	2.43E-02	2.01E+03
Pa-234	946.00	N	-8.34E-02 +- 1.09E-01	1.87E-01	9.16E-02	3.95E+13
Na-22	1274.54	N	-1.48E-02 +- 2.59E-02	4.41E-02	2.16E-02	2.28E+04

MEASURED TOTAL: 3.46E+03 +- 1.65E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.54	96.93	-7	424	348	2233	0.81	Deleted
2	53.37	110.55	-30	348	287	2488	0.91	Deleted
3	63.18	130.13	278	372	304	2339	0.84	Deleted
4	66.23	136.23	79	335	275	3275	1.07	Deleted
5	72.73	149.19	142	117	94	1957	0.67	Unknown
6	74.72	153.17	1387	402	325	3425	1.13	Unknown
7	76.99	157.69	2350	378	300	2936	1.03	Unknown
8	84.13	171.94	469	302	246	2575	1.21	Unknown
9	87.16	177.99	1258	283	225	2575	1.09	Unknown
10	89.75	183.16	765	159	123	2575	1.11	Unknown
12	98.58	200.77	110	167	136	2943	1.34	Deleted
13	128.61	260.70	134	100	80	1431	0.70	Unknown
14	139.59	282.61	60	279	229	2024	0.98	Deleted
18	198.36	399.89	-63	299	246	2020	1.03	Deleted
19	209.29	421.69	256	132	106	2194	1.10	Unknown

182000D10.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	241.79	486.54	1566	315	251	2232	1.28	SPLIT
22	258.81	520.49	75	182	149	1538	1.04	Deleted
25	295.21	593.13	3441	332	256	1829	1.32	SPLIT
27	321.06	644.71	23	118	97	1726	1.24	Deleted
28	327.83	658.22	182	109	87	1488	1.21	Unknown
31	409.33	820.86	54	97	79	1237	1.20	Deleted
32	417.07	836.29	74	105	85	1345	1.30	Deleted
33	463.03	928.00	254	111	87	1317	1.50	Unknown
34	511.10	1023.92	100	480	395	2618	2.74	Deleted
35	537.33	1076.26	19	192	157	739	1.06	Deleted
36	558.70	1118.91	-106	229	189	1112	1.44	Deleted
37	569.71	1140.89	-85	251	207	1206	1.42	Deleted
39	597.29	1195.91	129	254	208	1672	1.81	Deleted
40	599.46	1200.24	-453	419	347	996	0.84	Deleted
42	661.88	1324.80	680	115	84	1243	1.76	Unknown
43	665.48	1331.97	127	91	72	1017	1.41	Unknown
48	803.46	1607.30	66	205	168	881	1.85	Deleted
49	806.10	1612.57	135	64	49	561	1.10	Unknown
50	835.92	1672.08	-224	312	258	869	1.49	Deleted
51	839.33	1678.88	-31	245	201	1737	3.02	Deleted
52	860.65	1721.44	67	171	140	863	1.62	Deleted
53	898.64	1797.24	-13	171	141	853	1.74	Deleted
56	964.14	1927.94	182	271	222	1380	3.80	Deleted
58	1000.29	2000.06	196	168	137	1372	3.98	Unknown
59	1063.44	2126.08	26	194	159	872	2.14	Deleted
61	1155.45	2309.68	120	76	60	656	1.89	Unknown
62	1207.57	2413.68	97	63	49	513	1.42	Unknown
64	1281.12	2560.44	-19	128	106	550	2.04	Deleted
66	1385.54	2768.80	133	77	61	564	2.86	Unknown
67	1407.86	2813.35	96	137	112	447	1.77	Deleted
69	1509.35	3015.85	73	113	92	478	2.48	Deleted
70	1660.91	3318.28	36	129	106	331	2.35	Deleted
71	1729.05	3454.26	155	157	127	387	2.83	Unknown
73	1846.68	3688.98	199	68	51	366	3.09	Unknown

c:\SEEKER\BIN\182000d10.res Analysis Results Saved.

181902D05.SPC Analyzed by SK

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-17 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/05/2018 08:31:28
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.81E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.13E+002 g	Real Time . . . . . 7213 Sec
Collection Efficiency 1.0000	Spc. File 181902D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.63 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.90	150.87	102	59	46	328	1.30 a	Wide Pk
2	77.02	155.11	165	47	32	205	0.89 b	
3	87.39	175.83	37	40	31	196	0.75 a	
4	89.76	180.56	45	45	36	235	0.99 b	
5	92.94	186.92	109	58	44	313	1.28 c	
6	125.08	251.12	23	27	21	104	0.44 a	
7	129.14	259.23	30	27	21	104	0.48 b	
8	185.84	372.51	91	36	25	142	0.73 a	
9	209.20	419.18	46	32	23	122	0.66 a	
10	238.50	477.71	656	60	25	131	0.90 a	
11	241.83	484.35	144	54	40	236	1.45 b	
12	270.13	540.90	53	31	23	103	0.83 a	
13	276.97	554.56	36	27	20	88	0.74 a	
14	295.07	590.72	246	46	27	127	1.21 a	
15	300.26	601.08	56	36	27	127	1.21 b	
16	338.27	677.02	122	36	24	112	1.23 a	
17	351.82	704.09	402	49	24	109	1.15 a	
18	463.12	926.44	34	27	20	80	1.13 a	
19	510.72	1021.53	263	55	37	159	2.86 a	Wide Pk
20	583.16	1166.24	172	35	19	75	1.36 a	
21	609.26	1218.38	310	44	21	89	1.52 a	

181902D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	727.54	1454.67	48	22	14	43	1.02	a
23	911.20	1821.59	145	30	14	40	1.73	a
24	969.03	1937.12	73	26	16	56	1.36	a
25	1120.71	2240.13	51	27	19	61	2.27	a
26	1460.88	2919.68	432	44	13	26	2.49	a
27	1764.86	3526.96	56	17	7	9	2.24	a

181902D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET051128.BKG (112818-5 LONG BKG CAL)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	74.90	102	59	46	93	61	48	
5	92.94	109	58	44	85	62	48	
7	129.14	30	27	21	25	32	25	NET<CL
8	185.84	91	36	25	55	42	32	
10	238.50	656	60	25	632	62	30	
14	295.07	246	46	27	236	48	30	
16	338.27	122	36	24	114	39	27	
17	351.82	402	49	24	380	51	27	
19	510.72	263	55	37	54	63	51	
20	583.16	172	35	19	161	37	22	
21	609.26	310	44	21	288	48	28	
23	911.20	145	30	14	138	31	17	
24	969.03	73	26	16	70	28	19	
25	1120.71	51	27	19	47	28	20	
26	1460.88	432	44	13	379	46	20	
27	1764.86	56	17	7	52	19	10	

181902D05.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 1810627-17 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/05/2018 08:31:28
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.81e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.13e+002 g	Real Time . . . . . 7213 Sec
Collection Efficiency 1.0000	Spectrum File 181902D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)

Efficiency File: (D05)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018

Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
U-238	92.60		1.42E+00	+- 1.03E+00	1.67E+00	8.11E-01	3.92E+13
Ra-226	186.10		9.37E-01	+- 7.03E-01	1.13E+00	5.40E-01	1.40E+07
Pb-212	Average:x		1.02E+00	+- 9.94E-02	. . . .	. . . .	5.04E+04
	238.63		1.01E+00	+- 9.97E-02	1.01E-01	4.85E-02	5.04E+04
	300.09		1.96E+00	+- 1.27E+00	2.00E+00	9.54E-01	5.04E+04
Ra-223	269.39		2.76E-01	+- 1.63E-01	2.52E-01	1.19E-01	2.87E+08
Tl-208	Average:x		2.37E-01	+- 5.21E-02	. . . .	. . . .	5.04E+04
	277.36		4.09E-01	+- 3.04E-01	4.78E-01	2.24E-01	5.04E+04
	583.14		2.32E-01	+- 5.29E-02	6.69E-02	3.15E-02	5.04E+04
Pb-214	Average:x		1.05E+00	+- 1.19E-01	. . . .	. . . .	1.40E+07
	295.21		9.28E-01	+- 1.89E-01	2.49E-01	1.19E-01	1.40E+07
	351.92		1.13E+00	+- 1.53E-01	1.71E-01	8.16E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	. . . .	1.40E+07
Ac-228	Average:x		8.49E-01	+- 1.46E-01	. . . .	. . . .	5.04E+04
	338.40		1.04E+00	+- 3.57E-01	5.18E-01	2.47E-01	5.04E+04
	911.07		8.36E-01	+- 1.89E-01	2.20E-01	1.02E-01	5.04E+04
	968.90		7.53E-01	+- 2.99E-01	4.24E-01	1.98E-01	5.04E+04
Bi-214	Average:x		8.16E-01	+- 1.20E-01	. . . .	. . . .	1.40E+07
	609.31		8.06E-01	+- 1.33E-01	1.62E-01	7.71E-02	1.40E+07
	1120.29		6.65E-01	+- 4.02E-01	6.19E-01	2.90E-01	1.40E+07
	1764.49		1.03E+00	+- 3.73E-01	4.52E-01	1.99E-01	1.40E+07

181902D05.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Bi-212	727.17		5.89E-01 +- 2.66E-01	3.69E-01	1.68E-01	5.04E+04
K-40	1460.75		9.38E+00 +- 1.14E+00	1.07E+00	5.02E-01	1.12E+13
Ra-224	241.00		5.04E-01 +- 5.84E+00	1.47E+00	7.09E-01	5.04E+04
Pb-210	46.52	N	5.98E+00 +- 4.90E+01	8.38E+01	4.00E+01	1.79E+05
Tl-201	70.82	N	-4.23E+02 +- 2.23E+03	3.85E+03B	1.85E+03	7.35E+01
U-235	143.76	N	3.17E-02 +- 2.18E-01	3.71E-01	1.78E-01	3.33E+10
Ir-192	316.49	N	1.46E-02 +- 5.93E-02	1.01E-01	4.80E-02	1.78E+03
Be-7	477.56	N	-3.12E-01 +- 4.84E-01	8.83E-01	4.17E-01	1.28E+03
Tl-210	795.00	N	4.31E-03 +- 3.72E-02	6.48E-02	3.03E-02	1.40E+07
Sc-46	889.26	N	-7.16E-03 +- 5.46E-02	9.73E-02	4.54E-02	2.01E+03
Pa-234	946.00	N	-6.31E-02 +- 1.83E-01	3.35E-01	1.55E-01	3.95E+13
Na-22	1274.54	N	-2.39E-02 +- 4.32E-02	8.19E-02	3.77E-02	2.28E+04

MEASURED TOTAL: 2.31E+01 +- 5.90E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.90	150.87	93	61	48	328	1.30	Unknown
2	77.02	155.11	165	47	32	205	0.89	Unknown
3	87.39	175.83	37	40	31	196	0.75	Unknown
4	89.76	180.56	45	45	36	235	0.99	Unknown
6	125.08	251.12	23	27	21	104	0.44	Unknown
7	129.14	259.23	25	32	25	104	0.48	Deleted
9	209.20	419.18	46	32	23	122	0.66	Unknown
11	241.83	484.35	144	54	40	236	1.45	SPLIT
18	463.12	926.44	34	27	20	80	1.13	Unknown
19	510.72	1021.53	54	63	51	159	2.86	Unknown

c:\SEEKER\BIN\181902d05.res Analysis Results Saved.

182159D01.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-18 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/04/2018 15:05:18
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.63E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.82E+002 g	Real Time . . . . . 18027 Sec
Collection Efficiency 1.0000	Spc. File 182159D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.89 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.66 + 0.012*En + 6.94E-04*En^2 + 0.00E+00*En^3 08/21/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	66.44	136.39	42	41	32	247	0.41	a	
2	74.90	153.29	147	66	51	477	0.92	a	
3	77.09	157.66	317	71	51	477	0.92	b	
4	84.29	172.03	135	78	61	555	1.45	a	Wide Pk
5	87.26	177.97	214	68	50	432	1.08	b	
6	89.93	183.29	116	59	45	370	1.03	c	
7	92.92	189.26	263	75	56	493	1.34	d	
8	185.90	374.86	308	79	58	536	1.24	a	
9	209.16	421.29	95	57	44	353	1.00	a	
10	238.63	480.11	1154	89	47	373	1.07	a	Wide Pk
11	241.72	486.28	299	83	62	533	1.58	b	
12	270.19	543.12	110	63	49	359	1.40	a	
13	277.68	558.05	61	60	48	339	1.43	a	
14	295.24	593.11	488	65	39	265	1.10	a	
15	327.82	658.15	54	58	46	317	1.48	a	
16	338.31	679.08	231	54	36	226	1.17	a	
17	351.87	706.16	746	69	35	207	1.21	a	
18	462.87	927.72	98	43	31	172	1.49	a	
19	511.01	1023.83	478	75	50	319	2.48	a	Wide Pk
20	558.39	1118.40	37	27	20	88	0.74	a	
21	570.11	1141.80	48	37	28	138	1.47	a	

182159D01.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	583.32	1168.16	378	53	30	153	1.49	a
23	609.32	1220.05	545	59	30	170	1.29	a
24	727.38	1455.71	47	33	25	116	1.24	a
25	768.49	1537.78	49	37	28	136	1.89	a
26	860.63	1721.71	40	26	19	74	1.32	a
27	911.35	1822.95	232	42	24	95	1.94	a
28	969.12	1938.26	108	36	24	113	1.47	a
29	1120.61	2240.67	122	32	19	65	1.71	a
30	1238.73	2476.45	30	26	20	71	1.95	a
31	1461.00	2920.12	486	49	17	51	2.28	a
32	1764.74	3526.42	91	24	12	28	1.79	a

182159D01.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
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Background File:. . . . . DET011128.BKG (112818-1 LONG BKG CAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	66.44	43	41	32	13	73	60	NET<CL
2	74.90	147	66	51	124	72	56	
7	92.92	263	75	56	230	89	69	
8	185.90	308	79	58	276	89	68	
10	238.63	1154	89	47	1109	99	61	
14	295.24	488	65	39	476	77	52	
17	351.87	746	69	35	693	84	54	
19	511.01	478	75	50	83	107	86	NET<CL
20	558.39	37	27	20	-26	42	35	NET<CL
21	570.11	48	37	28	26	43	34	NET<CL
22	583.32	378	53	30	356	65	43	
23	609.32	545	59	30	513	66	40	
27	911.35	232	42	24	214	52	35	
31	1461.00	486	49	17	356	57	35	
32	1764.74	91	24	12	73	29	20	

182159D01.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 1810627-18 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/04/2018 15:05:18
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.63e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 1.82e+002 g	Real Time . . . . . 18027 Sec
Collection Efficiency 1.0000	Spectrum File 182159D01.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 1 (Detector 1)

Efficiency File: (D01)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.00E+02 +1.28E+02*L +-5.55E+01*L^2 +7.96E+00*L^3] 09/12/2018

Eff.=10^[-9.85E-01 +4.24E-01*L +-4.07E-01*L^2 +4.46E-02*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
U-238	92.60		2.14E+00	+- 8.27E-01	1.30E+00	6.40E-01	3.92E+13
Ra-226	186.10		2.88E+00	+- 9.33E-01	1.45E+00	7.13E-01	1.40E+07
Pb-212	238.63		1.13E+00	+- 1.01E-01	1.26E-01	6.18E-02	5.04E+04
Ra-223	269.39		3.73E-01	+- 2.15E-01	3.44E-01	1.67E-01	2.87E+08
Tl-208	Average:x		3.37E-01	+- 6.03E-02	. . . .	. . . .	5.04E+04
	277.36		4.46E-01	+- 4.39E-01	7.17E-01	3.49E-01	5.04E+04
	583.14		3.35E-01	+- 6.11E-02	8.44E-02	4.09E-02	5.04E+04
	860.47		3.37E-01	+- 7.01E-01	9.46E-01	4.60E-01	5.04E+04
Pb-214	Average:x		1.09E+00	+- 1.06E-01	. . . .	. . . .	1.40E+07
	295.21		1.22E+00	+- 1.98E-01	2.75E-01	1.34E-01	1.40E+07
	351.92		1.04E+00	+- 1.26E-01	1.66E-01	8.11E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	. . . .	1.40E+07
Ac-228	Average:x		8.80E-01	+- 1.32E-01	. . . .	. . . .	5.04E+04
	338.40		1.01E+00	+- 2.35E-01	3.31E-01	1.60E-01	5.04E+04
	911.07		8.61E-01	+- 2.08E-01	2.93E-01	1.41E-01	5.04E+04
	968.90		7.55E-01	+- 2.52E-01	3.57E-01	1.69E-01	5.04E+04
Bi-214	Average:x		9.68E-01	+- 1.06E-01	. . . .	. . . .	1.40E+07
	609.31		9.49E-01	+- 1.22E-01	1.52E-01	7.34E-02	1.40E+07
	768.36		1.02E+00	+- 7.77E-01	1.24E+00	5.92E-01	1.40E+07
	1120.29		1.12E+00	+- 2.92E-01	3.70E-01	1.73E-01	1.40E+07
	1238.11		7.68E-01	+- 6.61E-01	1.06E+00	4.94E-01	1.40E+07

182159D01.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	1764.49		9.43E-01 +- 3.79E-01	5.43E-01	2.54E-01	1.40E+07
Bi-212	727.17		3.83E-01 +- 2.74E-01	4.34E-01	2.06E-01	5.04E+04
K-40	1460.75		5.63E+00 +- 8.99E-01	1.15E+00	5.54E-01	1.12E+13
Tl-210	Average:x		1.15E-02 +- 3.05E-02	. . . .	. . . .	1.40E+07
	860.00		5.98E-02 +- 2.51E+00	6.39E-01	2.98E-01	1.40E+07
	795.00	N	1.15E-02 +- 3.05E-02	5.17E-02	2.44E-02	1.40E+07
Ra-224	241.00		1.26E+00 +- 5.68E+00	1.43E+00	7.01E-01	5.04E+04
Pb-210	46.52	N	1.44E+01 +- 3.25E+01	5.42E+01	2.62E+01	1.79E+05
Tl-201	70.82	N	7.99E+02 +- 1.73E+03	2.88E+03B	1.41E+03	7.35E+01
U-235	143.76	N	1.46E-01 +- 1.58E-01	2.58E-01	1.25E-01	3.33E+10
Ir-192	316.49	N	2.42E-02 +- 3.78E-02	6.26E-02	3.02E-02	1.78E+03
Be-7	477.56	N	-1.23E-01 +- 3.86E-01	6.76E-01	3.23E-01	1.28E+03
Sc-46	889.26	N	2.83E-02 +- 4.00E-02	6.63E-02	3.10E-02	2.01E+03
Pa-234	946.00	N	-2.37E-02 +- 1.55E-01	2.75E-01	1.29E-01	3.95E+13
Na-22	1274.54	N	1.40E-02 +- 3.13E-02	5.34E-02	2.46E-02	2.28E+04

MEASURED TOTAL: 8.31E+02 +- 1.78E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	66.44	136.39	13	73	60	247	0.41	Deleted
2	74.90	153.29	124	72	56	477	0.92	Unknown
3	77.09	157.66	317	71	51	477	0.92	Unknown
4	84.29	172.03	135	78	61	555	1.45	Unknown
5	87.26	177.97	214	68	50	432	1.08	Unknown
6	89.93	183.29	116	59	45	370	1.03	Unknown
9	209.16	421.29	95	57	44	353	1.00	Unknown
11	241.72	486.28	299	83	62	533	1.58	SPLIT
15	327.82	658.15	54	58	46	317	1.48	Unknown
18	462.87	927.72	98	43	31	172	1.49	Unknown
19	511.01	1023.83	83	107	86	319	2.48	Deleted
20	558.39	1118.40	-26	42	35	88	0.74	Deleted
21	570.11	1141.80	26	43	34	138	1.47	Deleted
26	860.63	1721.71	40	26	19	74	1.32	SPLIT

c:\SEEKER\BIN\182159d01.res Analysis Results Saved.

181905D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-19 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/05/2018 14:09:05
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.86E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.60E+002 g	Real Time . . . . . 60109 Sec
Collection Efficiency 1.0000	Spc. File 181905D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.63 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018

FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018

Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.43	127.97	161	114	92	1699	0.83	a	
2	66.41	133.92	298	117	92	1699	0.78	b	
3	74.82	150.72	937	115	80	1424	0.73	a	HiResid
4	77.07	155.21	1339	122	80	1424	0.67	b	HiResid
5	83.74	168.53	81	78	63	970	0.50	a	
6	84.64	170.33	106	79	63	970	0.45	b	
7	87.23	175.52	733	136	102	1939	0.94	c	
8	89.94	180.92	394	116	90	1616	0.74	d	
9	92.92	186.88	885	152	115	2262	1.15	e	
10	99.50	200.03	119	90	72	1145	0.67	a	
11	105.29	211.60	126	119	96	1713	1.06	a	
12	108.47	217.94	81	104	84	1428	0.89	b	NET< CL
13	128.99	258.94	365	121	95	1660	1.06	a	
14	139.84	280.60	298	106	83	1382	0.87	a	
15	144.03	288.99	163	132	106	1934	1.15	b	
16	154.12	309.13	109	107	86	1497	0.80	a	
17	163.76	328.40	60	72	58	824	0.48	a	
18	185.92	372.67	1227	147	107	1939	1.12	a	
19	198.52	397.84	203	101	80	1278	0.79	a	
20	205.47	411.72	69	70	56	774	0.50	a	
21	209.23	419.23	533	108	80	1290	0.85	b	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	238.56	477.83	6620	193	86	1355	1.00	a	HiResid
23	241.46	483.63	1323	149	107	1807	1.36	b	HiResid
24	270.21	541.06	482	124	96	1449	1.28	a	
25	277.48	555.58	220	108	86	1255	1.14	a	
26	295.14	590.86	2508	139	79	1075	1.18	a	
27	299.93	600.43	406	114	88	1228	1.36	b	
28	327.91	656.32	246	87	66	933	0.94	a	
29	338.25	676.98	1199	105	65	881	1.05	a	
30	351.85	704.16	4100	153	68	920	1.18	a	
31	409.48	819.29	142	73	57	677	0.92	a	
32	462.92	926.03	313	79	58	673	1.21	a	
33	510.86	1021.81	2133	153	101	1363	2.36	a	Wide Pk
34	558.47	1116.93	111	69	54	591	1.27	a	
35	562.54	1125.05	154	75	58	665	1.52	b	
36	569.99	1139.94	85	100	81	1045	2.05	a	
37	583.11	1166.15	1930	114	60	692	1.46	a	
38	596.70	1193.30	132	88	70	901	1.57	a	
39	609.26	1218.40	2980	134	64	803	1.54	a	
40	665.41	1330.55	78	63	50	511	1.26	a	
41	693.50	1386.68	99	95	76	932	2.16	a	
42	727.28	1454.16	409	84	60	642	1.81	a	
43	768.36	1536.23	238	71	53	514	1.61	a	
44	772.07	1543.64	112	68	53	514	1.61	b	
45	785.52	1570.50	134	61	46	413	1.40	a	
46	794.87	1589.19	180	58	42	367	1.29	b	
47	803.01	1605.44	135	61	46	413	1.50	c	
48	806.18	1611.77	45	39	31	229	0.90	d	
49	835.81	1670.98	55	50	39	355	0.91	a	
50	860.49	1720.27	220	66	49	460	1.73	a	
51	898.17	1795.56	48	61	49	462	1.75	a	NET< CL
52	911.24	1821.66	1378	93	46	409	1.81	a	
53	934.35	1867.83	92	49	37	300	1.25	a	
54	964.78	1928.62	292	67	48	440	1.85	a	
55	969.02	1937.09	756	77	45	400	1.56	b	
56	1000.71	2000.40	69	50	39	305	1.70	a	
57	1120.28	2239.27	622	76	47	394	2.06	a	
58	1155.05	2308.72	69	51	40	305	1.86	a	
59	1238.04	2474.53	186	58	42	341	1.79	a	
60	1377.98	2754.07	151	50	36	241	1.92	a	
61	1408.79	2815.63	45	38	29	176	1.41	a	
62	1460.85	2919.63	2375	107	37	235	2.30	a	HiResid
63	1509.32	3016.47	64	45	35	200	2.49	a	
64	1588.61	3174.87	45	47	37	242	2.06	a	
65	1630.91	3259.36	49	41	32	164	2.44	a	
66	1729.46	3456.23	136	42	29	134	2.51	a	
67	1764.56	3526.36	463	55	28	137	2.20	a	

181905D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
68	1847.59	3692.23	66	37	28	126	2.39	a

181905D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET051128.BKG (112818-5 LONG BKG CAL)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.43	161	114	92	79	209	171	NET<CL
2	66.41	298	117	92	71	236	194	NET<CL
3	74.82	937	115	80	866	187	146	
9	92.92	885	152	115	684	234	187	
10	99.50	119	90	72	85	152	124	NET<CL
13	128.99	365	121	95	326	187	151	
14	139.84	298	106	83	73	187	153	NET<CL
17	163.76	60	72	58	2	195	160	NET<CL
18	185.92	1227	147	107	933	225	178	
19	198.52	203	101	80	-66	184	152	NET<CL
22	238.56	6620	193	86	6420	242	149	
26	295.14	2508	139	79	2430	187	131	
29	338.25	1199	105	65	1135	162	121	
30	351.85	4100	153	68	3913	193	120	
33	510.86	2133	153	101	397	304	248	
34	558.47	111	69	54	-74	142	117	NET<CL
36	569.99	85	100	81	10	167	137	NET<CL
37	583.11	1930	114	60	1842	148	99	
38	596.70	132	88	70	-57	171	141	NET<CL
39	609.26	2980	134	64	2793	207	146	
41	693.50	99	95	76	26	140	115	NET<CL
47	803.01	135	61	46	-45	120	99	NET<CL
51	898.17	48	61	49	-41	147	121	NET<CL
52	911.24	1378	93	46	1316	118	77	
55	969.02	756	77	45	732	120	88	
57	1120.28	623	76	47	588	105	76	
62	1460.85	2375	107	37	1935	151	101	
67	1764.56	463	55	28	428	81	58	

181905D05.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-19 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/05/2018 14:09:05
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.86e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.60e+002 g	Real Time . . . . . 60109 Sec
Collection Efficiency 1.0000	Spectrum File 181905D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)

Efficiency File: (D05)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018
Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-235	Average:x		1.37E-01 +- 1.08E-01	. . . .	. . . .	3.33E+10
	143.76		1.37E-01 +- 1.11E-01	1.82E-01	8.99E-02	3.33E+10
	205.31		1.37E-01 +- 4.77E-01	6.65E-01	3.30E-01	3.33E+10
Ra-223	Average:x		3.41E-01 +- 8.90E-02	. . . .	. . . .	2.87E+08
	154.18		1.72E-01 +- 1.69E-01	2.78E-01	1.37E-01	2.87E+08
	269.39		4.05E-01 +- 1.04E-01	1.63E-01	8.04E-02	2.87E+08
Ra-226	186.10		2.52E+00 +- 6.10E-01	9.73E-01	4.83E-01	1.40E+07
Pb-212	Average:x		1.65E+00 +- 6.15E-02	. . . .	. . . .	5.04E+04
	238.63		1.64E+00 +- 6.18E-02	7.67E-02	3.80E-02	5.04E+04
	300.09		2.27E+00 +- 6.39E-01	9.99E-01	4.92E-01	5.04E+04
Tl-208	Average:x		4.22E-01 +- 3.33E-02	. . . .	. . . .	5.04E+04
	277.36		3.95E-01 +- 1.95E-01	3.13E-01	1.54E-01	5.04E+04
	583.14		4.23E-01 +- 3.39E-02	4.60E-02	2.27E-02	5.04E+04
	860.47		4.22E-01 +- 4.24E-01	5.62E-01	2.78E-01	5.04E+04
Pb-214	Average:x		1.74E+00 +- 7.23E-02	. . . .	. . . .	1.40E+07
	295.21		1.53E+00 +- 1.17E-01	1.66E-01	8.20E-02	1.40E+07
	351.92		1.86E+00 +- 9.18E-02	1.16E-01	5.74E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		1.34E+00 +- 8.94E-02	. . . .	. . . .	5.04E+04
	338.40		1.65E+00 +- 2.35E-01	3.56E-01	1.76E-01	5.04E+04
	911.07		1.28E+00 +- 1.15E-01	1.52E-01	7.47E-02	5.04E+04

181905D05.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	964.60		1.59E+00 +- 3.67E-01	5.35E-01	2.60E-01	5.04E+04
	968.90		1.25E+00 +- 2.05E-01	3.05E-01	1.50E-01	5.04E+04
Bi-214	Average:x		1.26E+00 +- 7.58E-02	. . . .	. . . .	1.40E+07
	609.31		1.25E+00 +- 9.24E-02	1.32E-01	6.53E-02	1.40E+07
	768.36		1.18E+00 +- 3.55E-01	5.39E-01	2.63E-01	1.40E+07
	934.06		8.67E-01 +- 4.57E-01	7.16E-01	3.45E-01	1.40E+07
	1120.29		1.34E+00 +- 2.38E-01	3.53E-01	1.74E-01	1.40E+07
	1238.11		1.17E+00 +- 3.64E-01	5.45E-01	2.64E-01	1.40E+07
	1377.67		1.55E+00 +- 5.18E-01	7.71E-01	3.72E-01	1.40E+07
	1764.49		1.35E+00 +- 2.57E-01	3.73E-01	1.82E-01	1.40E+07
Bi-212	Average:x		8.42E-01 +- 1.61E-01	. . . .	. . . .	5.04E+04
	727.17		8.03E-01 +- 1.65E-01	2.43E-01	1.19E-01	5.04E+04
	785.42		1.65E+00 +- 7.49E-01	1.17E+00	5.69E-01	5.04E+04
Tl-210	Average:x		4.50E-02 +- 1.43E-02	. . . .	. . . .	1.40E+07
	795.00		4.43E-02 +- 1.43E-02	2.15E-02	1.04E-02	1.40E+07
	860.00		1.17E-01 +- 1.52E+00	3.79E-01	1.84E-01	1.40E+07
	1410.00		3.68E-01 +- 3.08E-01	4.96E-01	2.37E-01	1.40E+07
Pa-234	Average:x		8.58E-02 +- 7.49E-02	. . . .	. . . .	3.95E+13
	808.10		2.30E-01 +- 2.01E-01	3.25E-01	1.56E-01	3.95E+13
	946.00	N	6.04E-02 +- 8.12E-02	1.34E-01	6.50E-02	3.95E+13
	94.67		2.30E-01 +- 7.23E-01	1.03E+00	5.12E-01	3.95E+13
K-40	1460.75		7.65E+00 +- 5.96E-01	8.08E-01	3.99E-01	1.12E+13
Ra-224	241.00		3.77E-01 +- 2.60E+00	6.14E-01	3.03E-01	5.04E+04
Ir-192	Average:x		-5.47E-03 +- 2.62E-02	. . . .	. . . .	1.78E+03
	205.78		1.99E-02 +- 1.99E+00	4.85E-01	2.37E-01	1.78E+03
	316.49	N	-5.47E-03 +- 2.62E-02	4.41E-02	2.16E-02	1.78E+03
U-238	92.60		1.15E+00 +- 4.43E+00	1.01E+00	5.00E-01	3.92E+13
Pb-210	46.52	N	8.75E+00 +- 2.18E+01	3.61E+01	1.78E+01	1.79E+05
Tl-201	70.82	N	9.83E+02 +- 1.45E+03	2.39E+03	1.18E+03	7.35E+01
Be-7	477.56	N	-2.47E-01 +- 2.44E-01	4.20E-01	2.06E-01	1.28E+03
Sc-46	889.26	N	-6.13E-03 +- 2.43E-02	4.12E-02	2.01E-02	2.01E+03
Na-22	1274.54	N	1.17E-03 +- 2.06E-02	3.49E-02	1.69E-02	2.28E+04

MEASURED TOTAL: 1.01E+03 +- 1.48E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.43	127.97	79	209	171	1699	0.83	Deleted
2	66.41	133.92	71	236	194	1699	0.78	Deleted
3	74.82	150.72	866	187	146	1424	0.73	Unknown
4	77.07	155.21	1339	122	80	1424	0.67	Unknown
5	83.74	168.53	81	78	63	970	0.50	Unknown

181905D05.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
6	84.64	170.33	106	79	63	970	0.45	Unknown
7	87.23	175.52	733	136	102	1939	0.94	Unknown
8	89.94	180.92	394	116	90	1616	0.74	Unknown
9	92.92	186.88	684	234	187	2262	1.15	SPLIT
10	99.50	200.03	85	152	124	1145	0.67	Deleted
11	105.29	211.60	126	119	96	1713	1.06	Unknown
12	108.47	217.94	81	104	84	1428	0.89	Deleted
13	128.99	258.94	326	187	151	1660	1.06	Unknown
14	139.84	280.60	73	187	153	1382	0.87	Deleted
17	163.76	328.40	2	195	160	824	0.48	Deleted
19	198.52	397.84	-66	184	152	1278	0.79	Deleted
20	205.47	411.72	69	70	56	774	0.50	SPLIT
21	209.23	419.23	533	108	80	1290	0.85	Unknown
23	241.46	483.63	1323	149	107	1807	1.36	SPLIT
28	327.91	656.32	246	87	66	933	0.94	Unknown
31	409.48	819.29	142	73	57	677	0.92	Unknown
32	462.92	926.03	313	79	58	673	1.21	Unknown
33	510.86	1021.81	397	304	248	1363	2.36	Unknown
34	558.47	1116.93	-74	142	117	591	1.27	Deleted
35	562.54	1125.05	154	75	58	665	1.52	Unknown
36	569.99	1139.94	10	167	137	1045	2.05	Deleted
38	596.70	1193.30	-57	171	141	901	1.57	Deleted
40	665.41	1330.55	79	63	50	511	1.26	Unknown
41	693.50	1386.68	26	140	115	932	2.16	Deleted
44	772.07	1543.64	112	68	53	514	1.61	Unknown
47	803.01	1605.44	-45	120	99	413	1.50	Deleted
49	835.81	1670.98	55	50	39	355	0.91	Unknown
50	860.49	1720.27	220	66	49	460	1.73	SPLIT
51	898.17	1795.56	-41	147	121	462	1.75	Deleted
56	1000.71	2000.40	69	50	39	305	1.70	Unknown
58	1155.05	2308.72	69	51	40	305	1.86	Unknown
63	1509.32	3016.47	64	45	35	200	2.49	Unknown
64	1588.61	3174.87	45	47	37	242	2.06	Unknown
65	1630.91	3259.36	49	41	32	164	2.44	Unknown
66	1729.46	3456.23	136	42	29	134	2.51	Unknown
68	1847.59	3692.23	66	37	28	126	2.39	Unknown

c:\SEEKER\BIN\181905d05.res Analysis Results Saved.

181816D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-20 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/04/2018 14:50:45
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.63E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 2.18E+002 g	Real Time . . . . . 18064 Sec
Collection Efficiency 1.0000	Spc. File 181816D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.19 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/04/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.32	96.77	176	65	49	437	0.92	a	
2	63.21	130.46	246	56	38	355	0.53	a	
3	66.41	136.85	74	49	38	355	0.54	b	
4	74.76	153.50	698	93	63	733	0.97	a	
5	77.05	158.07	1073	94	55	611	0.88	b	
6	84.22	172.38	192	78	60	607	1.21	a	Wide Pk
7	87.09	178.10	452	84	60	607	1.14	b	
8	89.91	183.73	252	65	46	433	0.82	c	
9	92.74	189.36	589	101	73	780	1.46	d	
10	105.60	215.01	59	74	59	559	1.24	a	NET< CL
11	109.02	221.85	80	54	42	349	0.83	b	
12	129.01	261.71	76	56	44	383	0.75	a	
13	168.36	340.21	51	49	38	293	0.84	a	
14	186.03	375.46	272	64	45	377	0.99	a	
15	198.36	400.06	52	54	43	335	0.96	a	
16	209.33	421.94	118	52	39	308	0.89	a	
17	238.67	480.48	1379	88	39	281	1.00	a	
18	241.63	486.37	304	79	58	468	1.56	b	
19	270.42	543.80	102	58	45	317	1.24	a	
20	277.22	557.37	45	40	31	198	0.76	a	
21	295.30	593.44	467	61	36	234	1.02	a	

181816D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	300.18	603.17	96	47	36	234	1.05	b	
23	316.09	634.92	30	41	33	197	0.93	a	NET< CL
24	327.98	658.64	81	48	37	233	1.11	a	
25	338.51	679.63	235	50	33	199	1.02	a	
26	352.12	706.79	748	70	35	212	1.10	a	
27	463.44	928.84	78	41	30	170	1.30	a	
28	511.16	1024.03	510	72	46	280	2.34	a	Wide Pk
29	558.87	1119.21	58	31	22	101	1.04	a	
30	569.49	1140.40	31	36	28	148	1.29	a	
31	583.48	1168.30	430	54	29	154	1.31	a	
32	609.65	1220.51	525	58	29	159	1.32	a	
33	697.67	1396.08	26	26	19	86	0.85	a	
34	727.62	1455.84	88	35	25	112	1.29	a	
35	768.47	1537.32	34	24	18	71	0.85	a	
36	795.33	1590.90	35	26	19	74	1.16	a	
37	803.19	1606.57	19	25	19	74	1.20	b	NET< CL
38	861.06	1722.01	30	24	17	70	1.02	a	
39	911.43	1822.51	264	43	23	100	1.66	a	
40	934.51	1868.53	27	23	17	59	1.31	a	
41	969.17	1937.67	134	32	18	74	1.11	a	
42	1120.45	2239.46	117	34	22	85	1.84	a	
43	1377.61	2752.45	23	18	13	35	1.53	a	
44	1460.70	2918.20	825	61	17	50	2.09	a	
45	1764.16	3523.53	94	24	11	25	1.84	a	

181816D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET091128.BKG (112818-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.32	176	65	49	76	86	69	
2	63.21	246	56	38	145	75	58	
3	66.41	74	49	38	48	82	66	NET<CL
4	74.76	698	93	63	639	102	73	
5	77.05	1073	94	55	1011	105	69	
6	84.22	192	78	60	168	94	75	
7	87.09	452	84	60	426	94	70	
9	92.74	589	101	73	406	112	86	
14	186.03	272	64	45	181	76	59	
15	198.36	52	54	43	-9	67	55	NET<CL
17	238.67	1379	88	39	1300	97	53	
19	270.42	102	58	45	90	69	55	
21	295.30	467	61	36	444	70	46	
24	327.98	81	48	37	70	54	42	
25	338.51	235	50	33	224	55	38	
26	352.12	748	70	35	697	78	47	
28	511.16	510	72	46	44	102	83	NET<CL
29	558.87	58	31	22	1	43	36	NET<CL
30	569.49	31	36	28	8	52	43	NET<CL
31	583.48	430	54	29	398	63	40	
32	609.65	525	58	29	494	66	40	
37	803.19	19	25	19	-6	35	29	NET<CL
39	911.43	264	43	23	248	46	28	
44	1460.70	825	61	17	779	65	27	
45	1764.16	94	24	11	83	31	20	

181816D09.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-20 GS181103-1

Sampling Start: 10/25/2018 12:00:00	Counting Start: 12/04/2018 14:50:45
Sampling Stop: 10/25/2018 12:00:00	Decay Time. . . . . 9.63e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 18000 Sec
Sample Size . . . . . 2.18e+002 g	Real Time . . . . . 18064 Sec
Collection Efficiency 1.0000	Spectrum File 181816D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.47E+01 +1.58E+01*L +-5.94E+00*L^2 +6.70E-01*L^3] 11/06/2018

Eff.=10^[-4.97E+00 +4.67E+00*L +-1.91E+00*L^2 +2.19E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52		7.49E-01 +- 8.39E-01	1.38E+00	6.76E-01	1.79E+05
U-238	Average:x		9.96E-01 +- 4.91E-01	. . . .	. . . .	3.92E+13
	63.29		9.96E-01 +- 5.15E-01	8.22E-01	4.02E-01	3.92E+13
	92.60		9.96E-01 +- 1.61E+00	2.35E+00	1.17E+00	3.92E+13
Pa-234	Average:x		6.21E-02 +- 9.44E-02	. . . .	. . . .	3.95E+13
	111.00		2.01E-01 +- 1.36E-01	2.17E-01	1.05E-01	3.95E+13
	699.10		4.59E-01 +- 4.54E-01	7.35E-01	3.43E-01	3.95E+13
	946.00	N	-1.22E-01 +- 1.38E-01	2.57E-01	1.21E-01	3.95E+13
	94.67		2.11E-01 +- 1.20E+00	2.45E-01	1.21E-01	3.95E+13
Ra-226	186.10		1.43E+00 +- 6.04E-01	9.51E-01	4.65E-01	1.40E+07
Pb-212	Average:x		1.08E+00 +- 7.96E-02	. . . .	. . . .	5.04E+04
	238.63		1.08E+00 +- 8.03E-02	9.06E-02	4.42E-02	5.04E+04
	300.09		1.22E+00 +- 6.00E-01	9.34E-01	4.50E-01	5.04E+04
Ra-223	269.39		2.67E-01 +- 2.06E-01	3.33E-01	1.63E-01	2.87E+08
Tl-208	Average:x		3.21E-01 +- 4.91E-02	. . . .	. . . .	5.04E+04
	277.36		2.98E-01 +- 2.64E-01	4.28E-01	2.05E-01	5.04E+04
	583.14		3.27E-01 +- 5.16E-02	6.79E-02	3.28E-02	5.04E+04
	860.47		2.49E-01 +- 1.95E-01	3.08E-01	1.43E-01	5.04E+04
Ac-228	Average:x		8.61E-01 +- 1.09E-01	. . . .	. . . .	5.04E+04
	338.40		8.46E-01 +- 2.08E-01	2.97E-01	1.44E-01	5.04E+04
	911.07		8.86E-01 +- 1.66E-01	2.09E-01	9.98E-02	5.04E+04

181816D09.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	968.90		8.38E-01 +- 2.02E-01	2.48E-01	1.16E-01	5.04E+04
Pb-214	Average:x		8.97E-01 +- 9.83E-02	. . . .	. . . .	1.40E+07
	351.92		8.96E-01 +- 1.00E-01	1.24E-01	6.05E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
	295.21		9.33E-01 +- 5.22E-01	7.13E-01	3.53E-01	1.40E+07
Bi-214	Average:x		8.21E-01 +- 9.19E-02	. . . .	. . . .	1.40E+07
	609.31		7.98E-01 +- 1.06E-01	1.33E-01	6.41E-02	1.40E+07
	768.36		6.27E-01 +- 4.48E-01	6.98E-01	3.24E-01	1.40E+07
	934.06		9.28E-01 +- 7.97E-01	1.27E+00	5.86E-01	1.40E+07
	1120.29		9.62E-01 +- 2.83E-01	3.84E-01	1.81E-01	1.40E+07
	1377.67		8.63E-01 +- 6.81E-01	1.06E+00	4.79E-01	1.40E+07
	1764.49		9.55E-01 +- 3.53E-01	4.98E-01	2.33E-01	1.40E+07
Bi-212	727.17		6.36E-01 +- 2.55E-01	3.76E-01	1.78E-01	5.04E+04
Tl-210	Average:x		3.19E-02 +- 2.39E-02	. . . .	. . . .	1.40E+07
	795.00		3.18E-02 +- 2.40E-02	3.78E-02	1.77E-02	1.40E+07
	296.00		3.62E-02 +- 2.55E-01	5.38E-02	2.61E-02	1.40E+07
K-40	1460.75		1.11E+01 +- 9.26E-01	8.19E-01	3.90E-01	1.12E+13
Ra-224	241.00		9.78E-01 +- 4.42E+00	1.10E+00	5.37E-01	5.04E+04
Tl-201	70.82	N	-1.64E+01 +- 3.08E+02	5.19E+02	2.54E+02	7.35E+01
U-235	143.76	N	-6.45E-02 +- 1.54E-01	2.62E-01	1.28E-01	3.33E+10
Ir-192	316.49	N	2.68E-02 +- 3.17E-02	5.21E-02	2.51E-02	1.78E+03
Be-7	477.56	N	2.10E-01 +- 3.16E-01	5.24E-01	2.49E-01	1.28E+03
Sc-46	889.26	N	-7.13E-03 +- 3.58E-02	6.36E-02	2.99E-02	2.01E+03
Na-22	1274.54	N	1.28E-02 +- 3.10E-02	5.29E-02	2.45E-02	2.28E+04

MEASURED TOTAL: 2.05E+01 +- 8.67E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
3	66.41	136.85	48	82	66	355	0.54	Deleted
4	74.76	153.50	639	102	73	733	0.97	Unknown
5	77.05	158.07	1011	105	69	611	0.88	Unknown
6	84.22	172.38	168	94	75	607	1.21	Unknown
7	87.09	178.10	426	94	70	607	1.14	Unknown
8	89.91	183.73	252	65	46	433	0.82	Unknown
9	92.74	189.36	406	112	86	780	1.46	SPLIT
10	105.60	215.01	59	74	59	559	1.24	Deleted
12	129.01	261.71	76	56	44	383	0.75	Unknown
13	168.36	340.21	51	49	38	293	0.84	Unknown
15	198.36	400.06	-9	67	55	335	0.96	Deleted
16	209.33	421.94	118	52	39	308	0.89	Unknown
18	241.63	486.37	304	79	58	468	1.56	SPLIT

181816D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	295.30	593.44	444	70	46	234	1.02	SPLIT
23	316.09	634.92	30	41	33	197	0.93	Deleted
24	327.98	658.64	70	54	42	233	1.11	Unknown
27	463.44	928.84	78	41	30	170	1.30	Unknown
28	511.16	1024.03	44	102	83	280	2.34	Deleted
29	558.87	1119.21	1	43	36	101	1.04	Deleted
30	569.49	1140.40	8	52	43	148	1.29	Deleted
37	803.19	1606.57	-6	35	29	74	1.20	Deleted

c:\SEEKER\BIN\181816d09.res Analysis Results Saved.

181957D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-21 GS181103-2

Sampling Start:	10/26/2018 12:00:00	Counting Start:	12/05/2018 08:31:38
Sampling Stop:	10/26/2018 12:00:00	Decay Time.	9.57E+002 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	2.34E+002 g	Real Time	7255 Sec
Collection Efficiency	1.0000	Spc. File	.181957D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.26 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018

FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018

Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.20	96.65	79	26	15	64	0.40	a	
2	63.11	130.38	78	44	33	222	0.78	a	
3	73.05	150.21	45	43	33	224	0.79	a	
4	74.69	153.48	260	47	28	179	0.73	b	
5	76.99	158.07	363	51	28	179	0.72	c	
6	84.33	172.69	67	49	38	251	1.14	a	
7	87.15	178.33	97	37	25	143	0.65	b	
8	89.76	183.54	74	31	21	108	0.57	c	
9	92.76	189.52	214	55	38	251	1.08	d	
10	99.25	202.46	26	30	23	117	0.72	a	
11	109.23	222.36	20	25	19	90	0.45	a	
12	129.09	261.96	46	34	26	136	0.85	a	
13	139.77	283.26	29	25	18	82	0.45	a	
14	185.64	374.75	98	45	33	187	1.10	a	
15	209.38	422.09	44	36	28	141	0.97	a	
16	238.58	480.34	513	53	22	98	0.89	a	
17	241.74	486.63	122	47	34	176	1.55	b	
18	277.01	556.97	66	46	35	152	1.99	a	Wide Pk
19	295.20	593.24	140	36	23	94	0.94	a	
20	300.05	602.92	30	26	20	78	0.85	b	
21	328.02	658.70	29	19	13	42	0.54	a	

181957D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	338.44	679.49	71	34	24	100	1.10	a	
23	351.91	706.35	301	42	19	65	1.03	a	
24	409.65	821.51	29	34	26	104	1.51	a	
25	462.96	927.82	40	31	24	97	1.43	a	
26	511.18	1024.00	259	48	29	116	2.34	a	Wide Pk
27	558.60	1118.56	21	17	12	34	0.65	a	
28	583.47	1168.17	164	35	20	66	1.42	a	
29	609.48	1220.04	214	37	18	61	1.35	a	
30	727.54	1455.48	28	27	20	71	1.42	a	
31	795.27	1590.57	16	14	10	24	0.90	a	
32	911.17	1821.72	70	26	17	53	1.69	a	
33	968.97	1936.98	55	23	15	44	1.37	a	
34	1120.19	2238.56	40	20	13	32	1.70	a	
35	1460.49	2917.26	362	40	10	17	2.02	a	
36	1763.91	3522.39	43	16	7	10	2.06	a	

181957D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET081128.BKG (112818-8 LONG BKG CAL)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.20	79	26	15	38	31	23	
2	63.11	78	44	33	8	49	40	NET<CL
3	73.05	45	43	33	14	46	37	NET<CL
5	76.99	363	51	28	331	55	34	
6	84.33	67	49	38	44	55	44	
7	87.15	97	37	25	86	41	30	
9	92.76	214	55	38	121	59	45	
10	99.25	26	30	23	24	34	27	NET<CL
11	109.23	20	25	19	18	27	21	NET<CL
13	139.77	29	25	18	-1	32	26	NET<CL
14	185.64	98	45	33	60	47	37	
16	238.58	513	53	22	472	56	29	
19	295.20	140	36	23	123	40	27	
22	338.44	71	34	24	63	37	28	
23	351.91	301	42	19	277	44	23	
26	511.18	259	48	29	48	57	45	
27	558.60	21	17	12	-7	22	18	NET<CL
28	583.47	164	35	20	152	38	24	
29	609.48	214	37	18	191	41	25	
32	911.17	70	26	17	61	28	19	
34	1120.19	40	20	13	37	22	15	
35	1460.49	362	40	10	337	41	15	
36	1763.91	43	16	7	38	17	10	

181957D08.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-21 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 08:31:38
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.57e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.34e+002 g	Real Time . . . . . 7255 Sec
Collection Efficiency 1.0000	Spectrum File 181957D08.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 8 (Detector 8)

Efficiency File: (D08)(Sh17).EFF (Geo 17 Eff Cal)
Eff.=1/[5.03E-02*En^-2.20E+00 + 1.32E+02*En^8.10E-01] 05/17/2018

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52		8.21E-01 +- 6.78E-01	1.09E+00	5.14E-01	1.79E+05
U-238	92.60		1.00E+00 +- 4.91E-01	7.73E-01	3.75E-01	3.92E+13
Ra-226	186.10		9.95E-01 +- 7.82E-01	1.26E+00	6.08E-01	1.40E+07
Pb-212	Average:x		7.59E-01 +- 8.90E-02	. . . .	. . . .	5.04E+04
	238.63		7.59E-01 +- 8.99E-02	9.74E-02	4.65E-02	5.04E+04
	300.09		7.67E-01 +- 6.63E-01	1.06E+00	4.96E-01	5.04E+04
Tl-208	Average:x		2.53E-01 +- 6.10E-02	. . . .	. . . .	5.04E+04
	277.36		7.91E-01 +- 5.45E-01	8.70E-01	4.19E-01	5.04E+04
	583.14		2.46E-01 +- 6.14E-02	8.11E-02	3.84E-02	5.04E+04
Pb-214	Average:x		6.58E-01 +- 9.42E-02	. . . .	. . . .	1.40E+07
	295.21		5.33E-01 +- 1.72E-01	2.47E-01	1.18E-01	1.40E+07
	351.92		7.11E-01 +- 1.13E-01	1.28E-01	6.03E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		4.91E-01 +- 1.38E-01	. . . .	. . . .	5.04E+04
	338.40		4.71E-01 +- 2.78E-01	4.34E-01	2.07E-01	5.04E+04
	911.07		4.17E-01 +- 1.94E-01	2.85E-01	1.33E-01	5.04E+04
	968.90		6.64E-01 +- 2.78E-01	3.84E-01	1.76E-01	5.04E+04
Bi-214	Average:x		6.26E-01 +- 1.15E-01	. . . .	. . . .	1.40E+07
	609.31		6.08E-01 +- 1.29E-01	1.64E-01	7.79E-02	1.40E+07
	1120.29		5.80E-01 +- 3.39E-01	5.05E-01	2.31E-01	1.40E+07
	1764.49		8.34E-01 +- 3.70E-01	4.76E-01	2.09E-01	1.40E+07
Bi-212	727.17		3.98E-01 +- 3.77E-01	6.07E-01	2.85E-01	5.04E+04

181957D08.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Tl-210	795.00		2.79E-02 +- 2.51E-02	3.93E-02	1.72E-02	1.40E+07
K-40	1460.75		9.10E+00 +- 1.11E+00	8.81E-01	4.04E-01	1.12E+13
Ra-224	241.00		9.13E-01 +- 5.14E+00	1.28E+00	6.17E-01	5.04E+04
Tl-201	70.82	N	5.57E+01 +- 3.86E+02	6.55E+02B	3.15E+02	7.35E+01
U-235	143.76	N	-2.97E-03 +- 1.80E-01	3.10E-01	1.48E-01	3.33E+10
Ra-223	269.39	N	2.37E-01 +- 1.61E-01	2.51E-01	1.18E-01	2.87E+08
Ir-192	316.49	N	2.12E-03 +- 4.20E-02	7.27E-02	3.45E-02	1.78E+03
Be-7	477.56	N	2.86E-02 +- 4.06E-01	7.15E-01	3.32E-01	1.28E+03
Sc-46	889.26	N	0.00E+00 +- 4.87E-02	8.73E-02	4.00E-02	2.01E+03
Pa-234	946.00	N	4.06E-02 +- 1.75E-01	3.07E-01	1.40E-01	3.95E+13
Na-22	1274.54	N	2.66E-03 +- 4.16E-02	7.51E-02	3.39E-02	2.28E+04

MEASURED TOTAL: 7.20E+01 +- 3.96E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	63.11	130.38	8	49	40	222	0.78	Deleted
3	73.05	150.21	14	46	37	224	0.79	Deleted
4	74.69	153.48	260	47	28	179	0.73	Unknown
5	76.99	158.07	331	55	34	179	0.72	Unknown
6	84.33	172.69	44	55	44	251	1.14	Unknown
7	87.15	178.33	86	41	30	143	0.65	Unknown
8	89.76	183.54	74	31	21	108	0.57	Unknown
10	99.25	202.46	24	34	27	117	0.72	Deleted
11	109.23	222.36	18	27	21	90	0.45	Deleted
12	129.09	261.96	46	34	26	136	0.85	Unknown
13	139.77	283.26	-1	32	26	82	0.45	Deleted
15	209.38	422.09	44	36	28	141	0.97	Unknown
17	241.74	486.63	122	47	34	176	1.55	SPLIT
21	328.02	658.70	29	19	13	42	0.54	Unknown
24	409.65	821.51	29	34	26	104	1.51	Unknown
25	462.96	927.82	40	31	24	97	1.43	Unknown
26	511.18	1024.00	48	57	45	116	2.34	Unknown
27	558.60	1118.56	-7	22	18	34	0.65	Deleted

c:\SEEKER\BIN\181957d08.res Analysis Results Saved.

182002D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-22 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/06/2018 08:01:02
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.80E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.10E+002 g	Real Time . . . . . 7269 Sec
Collection Efficiency 1.0000	Spc. File 182002D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.05 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	45.88	95.66	61	57	45	378	1.04	a
2	63.11	130.03	69	46	36	281	0.69	a
3	66.10	136.00	86	54	42	352	0.89	b
4	74.65	153.06	442	87	62	615	1.26	a
5	77.03	157.81	546	83	56	538	1.07	b
6	86.97	177.64	163	65	49	440	1.05	a
7	89.85	183.39	79	40	30	220	0.55	b
8	92.67	189.01	264	81	61	587	1.23	c
9	105.21	214.04	61	52	41	314	0.96	a
10	128.85	261.22	50	50	40	318	0.81	a
11	139.66	282.79	53	54	43	342	0.95	a
12	143.79	291.03	42	47	38	285	0.75	b
13	185.81	374.89	318	70	49	446	1.24	a
14	198.34	399.89	111	46	34	264	0.82	a
15	209.02	421.21	79	44	33	251	0.87	a
16	238.55	480.12	1172	87	45	368	1.27	a
17	241.72	486.46	366	79	57	506	1.75	b
18	270.26	543.40	107	49	36	262	1.21	a
19	275.66	554.17	30	37	29	187	0.80	b
20	277.31	557.46	60	51	40	299	1.26	c
21	295.19	593.16	640	68	38	265	1.25	a

182002D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	299.93	602.60	75	61	48	364	1.84	b	
23	327.94	658.50	62	58	45	340	1.65	a	
24	338.44	679.45	223	57	40	280	1.43	a	
25	351.89	706.29	1065	80	39	261	1.42	a	
26	463.41	928.82	46	61	49	319	2.30	a	NET< CL
27	511.11	1024.01	712	78	47	315	2.56	a	Wide Pk
28	558.47	1118.53	63	33	24	127	1.19	a	
29	570.18	1141.89	39	33	25	139	1.14	a	
30	583.38	1168.24	413	56	31	182	1.58	a	
31	609.47	1220.29	884	77	40	285	1.73	a	
32	662.14	1325.39	32	34	27	147	1.25	a	
33	727.51	1455.84	105	42	31	164	1.76	a	
34	768.20	1537.05	39	37	29	167	1.58	a	
35	786.05	1572.67	38	30	22	110	1.33	a	
36	795.35	1591.22	17	23	18	80	0.95	a	NET< CL
37	802.96	1606.41	63	33	24	119	1.51	b	
38	860.57	1721.36	42	28	21	96	1.25	a	
39	911.37	1822.72	306	45	23	111	1.65	a	
40	969.13	1937.99	145	40	27	143	1.71	a	
41	1120.39	2239.83	162	40	25	106	2.54	a	
42	1238.19	2474.90	59	37	28	129	2.52	a	
43	1376.54	2750.98	47	50	40	149	5.75	a	Wide Pk
44	1460.50	2918.52	1067	71	23	78	2.95	a	
45	1509.07	3015.44	21	28	22	75	2.85	a	NET< CL
46	1729.77	3455.85	26	24	18	51	2.67	a	
47	1763.82	3523.80	166	33	17	41	3.08	a	

182002D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET101128.BKG (112818-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	45.88	61	57	45	26	75	61	NET<CL
2	63.11	69	46	36	14	62	51	NET<CL
3	66.10	86	54	42	10	64	52	NET<CL
4	74.65	442	87	62	353	96	73	
5	77.03	546	83	56	433	91	67	
6	86.97	163	65	49	138	70	54	
8	92.67	264	81	61	121	90	72	
11	139.66	53	54	43	-8	62	51	NET<CL
12	143.79	42	47	38	24	57	46	NET<CL
13	185.81	318	70	49	158	80	63	
14	198.34	111	46	34	-0	56	46	NET<CL
16	238.55	1172	87	45	1046	93	55	
17	241.72	366	79	57	269	85	65	
18	270.26	107	49	36	95	54	41	
21	295.19	640	68	38	451	76	52	
24	338.44	223	57	40	200	61	44	
25	351.89	1065	80	39	689	89	59	
27	511.11	712	78	47	117	94	75	
28	558.47	63	33	24	-28	41	35	NET<CL
29	570.18	39	33	25	1	43	35	NET<CL
30	583.38	413	56	31	343	62	41	
31	609.47	884	77	40	605	86	58	
34	768.20	39	37	29	-2	47	39	NET<CL
37	802.96	63	33	24	2	40	32	NET<CL
38	860.57	42	28	21	33	34	26	
39	911.37	306	45	23	258	49	31	
40	969.13	145	40	27	116	44	32	
41	1120.39	162	40	25	93	45	33	
42	1238.19	59	37	28	40	41	32	
43	1376.54	47	50	40	33	52	42	NET<CL
44	1460.50	1067	71	23	921	74	36	
45	1509.07	21	28	22	11	30	24	NET<CL
46	1729.77	26	24	18	9	29	24	NET<CL
47	1763.82	166	33	17	102	37	26	

182002D10.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-22 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/06/2018 08:01:02
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.80e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.10e+002 g	Real Time . . . . . 7269 Sec
Collection Efficiency 1.0000	Spectrum File 182002D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)
Efficiency File: (D10)(Sh17).eff (Geo 17 Eff Cal)
*Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018
Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV
Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52	N	2.22E+00 +- 6.50E+00	1.08E+01	5.29E+00	1.79E+05
U-238	92.60		8.58E-01 +- 6.39E-01	1.04E+00	5.10E-01	3.92E+13
Ra-226	186.10		1.53E+00 +- 7.78E-01	1.24E+00	6.08E-01	1.40E+07
Pb-212	Average:x		9.33E-01 +- 8.28E-02	. . . .	. . . .	5.04E+04
	238.63		9.33E-01 +- 8.32E-02	1.01E-01	4.94E-02	5.04E+04
	300.09		1.02E+00 +- 8.40E-01	1.36E+00	6.63E-01	5.04E+04
Ra-223	269.39		2.78E-01 +- 1.58E-01	2.50E-01	1.21E-01	2.87E+08
Tl-208	Average:x		2.40E-01 +- 4.19E-02	. . . .	. . . .	5.04E+04
	277.36		3.77E-01 +- 3.20E-01	5.20E-01	2.51E-01	5.04E+04
	583.14		2.38E-01 +- 4.30E-02	5.86E-02	2.84E-02	5.04E+04
	860.47		2.20E-01 +- 2.23E-01	3.62E-01	1.72E-01	5.04E+04
Pb-214	Average:x		9.14E-01 +- 9.39E-02	. . . .	. . . .	1.40E+07
	295.21		9.91E-01 +- 1.67E-01	2.34E-01	1.14E-01	1.40E+07
	351.92		8.78E-01 +- 1.14E-01	1.54E-01	7.55E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		7.05E-01 +- 1.06E-01	. . . .	. . . .	5.04E+04
	338.40		7.62E-01 +- 2.31E-01	3.46E-01	1.68E-01	5.04E+04
	911.07		7.37E-01 +- 1.41E-01	1.84E-01	8.82E-02	5.04E+04
	968.90		5.76E-01 +- 2.19E-01	3.29E-01	1.58E-01	5.04E+04
Bi-214	Average:x		7.92E-01 +- 1.01E-01	. . . .	. . . .	1.40E+07
	609.31		8.21E-01 +- 1.17E-01	1.61E-01	7.86E-02	1.40E+07

182002D10.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	1120.29		5.99E-01 +- 2.89E-01	4.47E-01	2.15E-01	1.40E+07
	1238.11		6.90E-01 +- 7.18E-01	1.17E+00	5.62E-01	1.40E+07
	1764.49		8.30E-01 +- 3.02E-01	4.40E-01	2.09E-01	1.40E+07
Bi-212	Average:x		6.62E-01 +- 2.45E-01	. . . .	. . . .	5.04E+04
	727.17		6.23E-01 +- 2.51E-01	3.78E-01	1.81E-01	5.04E+04
	785.42		1.42E+00 +- 1.10E+00	1.75E+00	8.25E-01	5.04E+04
K-40	1460.75		9.74E+00 +- 7.87E-01	7.80E-01	3.75E-01	1.12E+13
Ra-224	241.00		8.80E-01 +- 5.13E+00	1.31E+00	6.42E-01	5.04E+04
Tl-201	70.82	N	1.07E+02 +- 9.86E+02	1.65E+03B	8.08E+02	7.35E+01
U-235	143.76	N	5.49E-02 +- 1.80E-01	3.02E-01b	1.47E-01	3.33E+10
Ir-192	316.49	N	-1.05E-02 +- 3.38E-02	5.84E-02	2.82E-02	1.78E+03
Be-7	477.56	N	-2.32E-01 +- 3.29E-01	5.84E-01	2.81E-01	1.28E+03
Tl-210	795.00	N	-2.36E-02 +- 2.74E-02	4.91E-02B	2.35E-02	1.40E+07
Sc-46	889.26	N	-2.48E-02 +- 3.50E-02	6.32E-02	3.01E-02	2.01E+03
Pa-234	946.00	N	1.16E-01 +- 1.34E-01	2.19E-01	1.04E-01	3.95E+13
Na-22	1274.54	N	1.66E-02 +- 3.29E-02	5.51E-02	2.61E-02	2.28E+04

MEASURED TOTAL: 1.27E+02 +- 1.00E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	63.11	130.03	14	62	51	281	0.69	Deleted
3	66.10	136.00	10	64	52	352	0.89	Deleted
4	74.65	153.06	353	96	73	615	1.26	Unknown
5	77.03	157.81	433	91	67	538	1.07	Unknown
6	86.97	177.64	138	70	54	440	1.05	Unknown
7	89.85	183.39	79	40	30	220	0.55	Unknown
9	105.21	214.04	61	53	41	314	0.96	Unknown
10	128.85	261.22	50	50	40	318	0.81	Unknown
11	139.66	282.79	-8	62	51	342	0.95	Deleted
12	143.79	291.03	24	57	46	285	0.75	Deleted
14	198.34	399.89	-0	56	46	264	0.82	Deleted
15	209.02	421.21	79	44	33	251	0.87	Unknown
17	241.72	486.46	269	85	65	506	1.75	SPLIT
19	275.66	554.17	30	37	29	187	0.80	Unknown
23	327.94	658.50	62	58	46	340	1.65	Unknown
26	463.41	928.82	46	61	49	319	2.30	Deleted
27	511.11	1024.01	117	94	75	315	2.56	Unknown
28	558.47	1118.53	-28	41	35	127	1.19	Deleted
29	570.18	1141.89	1	43	35	139	1.14	Deleted
32	662.14	1325.39	32	34	27	147	1.25	Unknown
34	768.20	1537.05	-2	47	39	167	1.58	Deleted

182002D10.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
36	795.35	1591.22	17	23	18	80	0.95	Deleted
37	802.96	1606.41	2	40	32	119	1.51	Deleted
43	1376.54	2750.98	33	52	42	149	5.75	Deleted
45	1509.07	3015.44	11	30	24	75	2.85	Deleted
46	1729.77	3455.85	9	29	24	51	2.67	Deleted

c:\SEEKER\BIN\182002d10.res Analysis Results Saved.

182023D07.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-23 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:37
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.69E+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spc. File 182023D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.43 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.48	97.51	70	86	69	1057	0.61	a	
2	66.55	137.51	105	74	59	844	0.44	a	
3	74.80	153.97	678	118	87	1531	0.84	a	
4	77.00	158.36	1176	139	100	1837	0.93	b	
5	84.28	172.87	411	141	111	1940	1.24	a	
6	87.16	178.62	680	132	100	1698	1.13	b	
7	89.83	183.92	426	128	100	1698	1.10	c	
8	92.77	189.80	1126	150	111	1940	1.38	d	
9	105.25	214.67	117	109	88	1424	1.03	a	
10	112.64	229.41	53	69	55	750	0.46	a	NET< CL
11	128.97	261.96	270	100	77	1206	0.85	a	
12	139.75	283.47	151	83	65	947	0.71	a	
13	143.76	291.44	141	109	88	1420	0.92	b	
14	145.83	295.59	93	82	65	947	0.64	c	
15	153.98	311.82	93	95	77	1186	0.77	a	
16	185.83	375.32	1026	133	96	1576	1.19	a	
17	198.47	400.53	224	153	123	2112	1.68	a	Wide Pk
18	209.14	421.81	364	109	84	1296	0.91	a	
19	238.58	480.50	4969	177	88	1320	1.07	a	
20	241.63	486.58	1131	136	98	1508	1.33	b	
21	270.17	543.47	393	112	86	1165	1.25	a	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	277.41	557.91	193	98	77	1023	1.10	a	
23	287.76	578.54	54	52	41	418	0.55	a	
24	295.17	593.33	1897	127	76	982	1.07	a	
25	300.00	602.94	215	77	59	702	0.85	b	
26	328.06	658.90	282	93	72	879	1.14	a	
27	338.44	679.60	927	99	64	767	1.00	a	
28	352.00	706.62	3158	144	74	859	1.25	a	
29	356.48	715.55	33	99	81	966	1.42	b	NET< CL
30	409.47	821.19	111	61	47	505	0.80	a	
31	463.02	927.97	303	80	60	617	1.40	a	
32	511.07	1023.76	2188	151	98	1178	2.56	a	Wide Pk
33	558.78	1118.89	165	70	53	522	1.24	a	
34	570.04	1141.34	70	55	43	398	1.00	a	
35	583.46	1168.08	1608	107	58	583	1.47	a	
36	596.75	1194.60	112	75	59	611	1.44	a	
37	609.56	1220.13	2381	125	64	704	1.44	a	
38	618.44	1237.83	43	76	62	629	1.63	a	NET< CL
39	665.31	1331.27	41	78	64	628	1.76	a	NET< CL
40	694.35	1389.17	114	135	110	1278	3.28	a	Wide Pk
41	727.50	1455.27	273	61	42	346	1.15	a	
42	768.55	1537.11	240	69	50	447	1.81	a	
43	772.35	1544.69	48	46	36	284	1.16	b	
44	786.22	1572.34	106	58	45	369	1.66	a	
45	795.22	1590.29	133	63	48	406	1.73	a	
46	803.28	1606.35	90	48	36	280	1.08	a	
47	839.99	1679.54	52	54	43	381	1.24	a	
48	860.81	1721.05	180	59	43	341	1.65	a	
49	911.36	1821.82	1050	84	45	349	1.85	a	
50	934.22	1867.42	85	45	34	238	1.28	a	
51	964.53	1927.84	272	105	82	703	4.11	a	Wide Pk
52	969.11	1936.98	614	71	42	309	1.81	b	
53	1078.95	2155.95	55	47	37	239	1.84	a	
54	1120.55	2238.90	479	67	41	318	1.98	a	
55	1156.29	2310.16	62	52	41	295	2.10	a	
56	1238.40	2473.85	176	53	38	266	2.05	a	
57	1377.91	2752.00	105	42	31	172	1.91	a	
58	1408.05	2812.09	60	36	27	143	1.61	a	
59	1460.66	2916.99	1862	95	32	176	2.33	a	
60	1509.29	3013.93	33	37	29	159	1.93	a	
61	1588.34	3171.54	86	38	28	135	2.15	a	
62	1729.27	3452.52	63	31	22	95	1.86	a	
63	1764.12	3522.00	365	50	26	118	2.22	a	
64	1847.37	3687.97	33	28	21	83	1.74	a	

182023D07.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET071128.BKG (112818-7 LONG BKG CAL)

Bkg.File Detector #: 7

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.48	70	86	69	-19	209	172	NET<CL
2	66.55	105	74	59	-81	176	145	NET<CL
3	74.80	678	118	87	538	181	144	
4	77.00	1176	139	100	1046	227	179	
5	84.28	411	141	111	338	231	187	
8	92.77	1126	150	111	768	229	182	
12	139.75	151	83	65	18	178	146	NET<CL
14	145.83	93	82	65	61	126	102	NET<CL
16	185.83	1026	133	96	762	197	156	
17	198.47	224	153	123	-52	220	182	NET<CL
19	238.58	4969	177	88	4690	228	150	
24	295.17	1897	127	76	1795	175	126	
27	338.44	927	99	64	888	136	101	
28	352.00	3158	144	74	2980	185	123	
32	511.07	2188	151	98	509	292	238	
33	558.78	165	70	53	-53	135	112	NET<CL
34	570.04	70	55	43	-39	125	103	NET<CL
35	583.46	1608	107	58	1454	168	123	
36	596.75	112	75	59	44	156	128	NET<CL
37	609.56	2381	125	64	2230	182	128	
38	618.44	43	76	62	-6	144	119	NET<CL
40	694.35	114	135	110	74	163	133	NET<CL
41	727.50	273	61	42	215	108	85	
46	803.28	90	48	36	-19	103	85	NET<CL
49	911.36	1050	84	45	965	127	91	
59	1460.66	1862	95	32	1596	133	87	
63	1764.12	365	50	26	321	72	51	

182023D07.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 1810627-23 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:37
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.69e+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spectrum File 182023D07.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 7 (Detector 7)

Efficiency File: (D07)(Sh17).EFF (DET 7 GEO 17 Eff Cal)

Eff=10^[-1.18E+02 +1.52E+02*L +-6.65E+01*L^2 +9.63E+00*L^3] 09/25/2018

Eff.=10^[9.78E-01 +-1.35E+00*L +1.03E-01*L^2 +-1.37E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		2.58E+00 +- 7.67E-01	1.23E+00	6.12E-01	3.92E+13
U-235	143.76		1.53E-01 +- 1.18E-01	1.92E-01	9.47E-02	3.33E+10
Ra-223	Average:x		3.60E-01 +- 1.03E-01	. . . .	. . . .	2.87E+08
	154.18		1.90E-01 +- 1.95E-01	3.20E-01	1.57E-01	2.87E+08
	269.39		4.25E-01 +- 1.21E-01	1.88E-01	9.27E-02	2.87E+08
Ra-226	186.10		2.70E+00 +- 6.99E-01	1.11E+00	5.52E-01	1.40E+07
Pb-212	Average:x		1.54E+00 +- 7.45E-02	. . . .	. . . .	5.04E+04
	238.63		1.57E+00 +- 7.61E-02	1.01E-01	5.00E-02	5.04E+04
	300.09		1.00E+00 +- 3.60E-01	5.61E-01	2.74E-01	5.04E+04
Tl-208	Average:x		4.48E-01 +- 5.02E-02	. . . .	. . . .	5.04E+04
	277.36		4.43E-01 +- 2.25E-01	3.62E-01	1.78E-01	5.04E+04
	583.14		4.48E-01 +- 5.18E-02	7.67E-02	3.79E-02	5.04E+04
	860.47		4.48E-01 +- 5.09E-01	6.78E-01	3.35E-01	5.04E+04
Pb-214	Average:x		1.43E+00 +- 7.49E-02	. . . .	. . . .	1.40E+07
	295.21		1.42E+00 +- 1.39E-01	2.02E-01	9.97E-02	1.40E+07
	351.92		1.43E+00 +- 8.90E-02	1.20E-01	5.91E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		1.32E+00 +- 9.80E-02	. . . .	. . . .	5.04E+04
	338.40		1.25E+00 +- 1.91E-01	2.87E-01	1.42E-01	5.04E+04
	911.07		1.25E+00 +- 1.66E-01	2.41E-01	1.19E-01	5.04E+04
	964.60		1.96E+00 +- 7.56E-01	1.20E+00	5.90E-01	5.04E+04

182023D07.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	968.90		1.39E+00 +- 1.61E-01	1.96E-01	9.49E-02	5.04E+04
Bi-214	Average:x		1.36E+00 +- 8.55E-02	. . . .	. . . .	1.40E+07
	609.31		1.35E+00 +- 1.10E-01	1.57E-01	7.75E-02	1.40E+07
	768.36		1.63E+00 +- 4.66E-01	7.02E-01	3.42E-01	1.40E+07
	934.06		1.06E+00 +- 5.67E-01	8.86E-01	4.26E-01	1.40E+07
	1120.29		1.41E+00 +- 1.97E-01	2.52E-01	1.22E-01	1.40E+07
	1238.11		1.41E+00 +- 4.27E-01	6.31E-01	3.04E-01	1.40E+07
	1377.67		1.36E+00 +- 5.50E-01	8.28E-01	3.96E-01	1.40E+07
	1764.49		1.28E+00 +- 2.86E-01	4.19E-01	2.04E-01	1.40E+07
Bi-212	Average:x		6.74E-01 +- 2.77E-01	. . . .	. . . .	5.04E+04
	727.17		5.77E-01 +- 2.89E-01	4.64E-01	2.28E-01	5.04E+04
	785.42		1.78E+00 +- 9.76E-01	1.55E+00	7.51E-01	5.04E+04
Tl-210	Average:x		4.64E-02 +- 2.10E-02	. . . .	. . . .	1.40E+07
	795.00		4.45E-02 +- 2.10E-02	3.31E-02	1.61E-02	1.40E+07
	860.00		1.59E-01 +- 1.82E+00	4.51E-01	2.18E-01	1.40E+07
	1410.00		6.23E-01 +- 3.71E-01	5.79E-01	2.75E-01	1.40E+07
K-40	1460.75		7.93E+00 +- 6.60E-01	8.80E-01	4.33E-01	1.12E+13
Ra-224	241.00		1.42E+00 +- 3.09E+00	7.34E-01	3.62E-01	5.04E+04
Pb-210	46.52	N	3.96E+01 +- 3.68E+01	6.03E+01	2.96E+01	1.79E+05
Tl-201	70.82	N	4.63E+02 +- 1.85E+03	3.06E+03B	1.52E+03	7.35E+01
Ir-192	316.49	N	-8.78E-04 +- 2.30E-02	3.87E-02	1.90E-02	1.78E+03
Be-7	477.56	N	-1.06E-01 +- 2.57E-01	4.38E-01	2.14E-01	1.28E+03
Sc-46	889.26	N	-2.45E-02 +- 2.58E-02	4.54E-02	2.20E-02	2.01E+03
Pa-234	946.00	N	7.47E-02 +- 8.90E-02	1.46E-01	7.05E-02	3.95E+13
Na-22	1274.54	N	-1.19E-02 +- 2.05E-02	3.60E-02	1.74E-02	2.28E+04

MEASURED TOTAL: 5.25E+02 +- 1.89E+03 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.48	97.51	-19	209	172	1057	0.61	Deleted
2	66.55	137.51	-81	176	145	844	0.44	Deleted
3	74.80	153.97	538	181	144	1531	0.84	Unknown
4	77.00	158.36	1046	227	179	1837	0.93	Unknown
5	84.28	172.87	338	231	187	1940	1.24	Unknown
6	87.16	178.62	680	132	100	1698	1.13	Unknown
7	89.83	183.92	426	128	100	1698	1.10	Unknown
9	105.25	214.67	117	109	88	1424	1.03	Unknown
10	112.64	229.41	53	69	55	750	0.46	Deleted
11	128.97	261.96	270	100	77	1206	0.85	Unknown
12	139.75	283.47	18	178	146	947	0.71	Deleted
14	145.83	295.59	61	126	102	947	0.64	Deleted

182023D07.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
17	198.47	400.53	-52	220	182	2112	1.68	Deleted
18	209.14	421.81	364	109	84	1296	0.91	Unknown
20	241.63	486.58	1131	136	98	1508	1.33	SPLIT
23	287.76	578.54	54	52	41	418	0.55	Unknown
26	328.06	658.90	282	93	72	879	1.14	Unknown
29	356.48	715.55	33	99	81	966	1.42	Deleted
30	409.47	821.19	111	61	47	505	0.80	Unknown
31	463.02	927.97	303	80	60	617	1.40	Unknown
32	511.07	1023.76	509	292	238	1178	2.56	Unknown
33	558.78	1118.89	-53	135	112	522	1.24	Deleted
34	570.04	1141.34	-39	125	103	398	1.00	Deleted
36	596.75	1194.60	44	156	128	611	1.44	Deleted
38	618.44	1237.83	-6	144	119	629	1.63	Deleted
39	665.31	1331.27	41	78	64	628	1.76	Deleted
40	694.35	1389.17	74	163	133	1278	3.28	Deleted
43	772.35	1544.69	48	46	36	284	1.16	Unknown
46	803.28	1606.35	-19	103	85	280	1.08	Deleted
47	839.99	1679.54	52	54	43	381	1.24	Unknown
48	860.81	1721.05	180	59	43	341	1.65	SPLIT
53	1078.95	2155.95	55	47	37	239	1.84	Unknown
55	1156.29	2310.16	62	52	41	295	2.10	Unknown
60	1509.29	3013.93	33	37	29	159	1.93	Unknown
61	1588.34	3171.54	86	38	28	135	2.15	Unknown
62	1729.27	3452.52	63	31	22	95	1.86	Unknown
64	1847.37	3687.97	33	28	21	83	1.74	Unknown

c:\SEEKER\BIN\182023d07.res Analysis Results Saved.

181959D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-24 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:45
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.35E+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spc. File 181959D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.26 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.41	97.07	528	91	65	925	0.64	a	
2	49.61	103.45	50	66	53	694	0.42	b	NET< CL
3	53.18	110.57	198	109	87	1387	1.04	c	
4	63.18	130.52	1060	118	81	1328	0.78	a	Wide Pk
5	66.34	136.81	371	213	172	3454	2.07	b	
6	69.58	143.28	238	144	116	2125	1.23	c	
7	72.42	148.94	649	242	194	3985	2.39	d	
8	74.76	153.61	2241	137	81	1328	0.83	e	
9	77.01	158.10	3187	150	81	1328	0.81	f	
10	79.00	162.06	84	100	81	1328	0.76	g	
11	84.11	172.25	476	128	99	1664	1.10	a	HiResid
12	87.13	178.29	1169	127	88	1426	1.02	b	HiResid
13	89.83	183.66	748	108	77	1188	0.88	c	HiResid
14	92.72	189.43	1792	136	88	1426	1.06	d	HiResid
15	99.33	202.62	123	112	90	1380	1.08	a	
16	105.25	214.42	181	113	90	1391	1.17	a	
17	108.78	221.46	80	87	70	993	0.74	b	
18	112.77	229.43	93	63	49	596	0.43	c	
19	128.97	261.73	236	90	69	969	0.74	a	
20	139.73	283.20	146	77	60	796	0.73	a	
21	143.62	290.95	116	76	60	796	0.67	b	

181959D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	153.99	311.63	90	61	48	564	0.45	a	
23	163.45	330.50	75	93	75	1048	0.90	a	NET< CL
24	170.20	343.95	61	94	77	1083	0.92	a	NET< CL
25	173.73	351.00	12	57	47	542	0.46	b	NET< CL
26	177.24	358.00	14	57	47	542	0.46	c	NET< CL
27	185.87	375.21	1041	112	75	1040	0.93	a	
28	198.33	400.05	316	106	82	1160	1.18	a	
29	209.33	421.99	333	84	62	770	0.85	a	
30	236.10	475.38	132	95	76	984	1.09	a	
31	238.60	480.37	3880	144	59	703	0.87	b	
32	241.70	486.56	973	120	84	1124	1.28	c	
33	270.30	543.60	331	101	78	957	1.38	a	
34	277.40	557.75	204	72	54	588	0.86	a	
35	295.25	593.35	1429	99	53	563	0.87	a	HiResid
36	300.23	603.28	245	80	60	675	0.96	b	HiResid
37	328.06	658.79	144	68	53	561	0.89	a	
38	338.42	679.45	744	87	56	577	1.06	a	
39	352.02	706.56	2479	119	54	542	1.04	a	
40	401.85	805.94	32	49	39	335	0.58	a	NET< CL
41	409.50	821.20	132	73	57	550	1.18	a	
42	463.13	928.16	164	58	43	383	1.04	a	
43	511.10	1023.83	2067	140	87	981	2.45	a	Wide Pk
44	537.95	1077.38	33	38	30	223	0.64	a	
45	558.65	1118.66	172	55	40	337	0.94	a	
46	570.13	1141.55	94	60	47	436	1.07	a	
47	583.44	1168.11	1111	87	47	427	1.10	a	
48	598.16	1197.46	78	96	78	850	2.14	a	Wide Pk
49	609.61	1220.29	1858	109	54	547	1.30	a	
50	665.59	1331.95	43	58	47	406	1.27	a	NET< CL
51	727.64	1455.70	233	56	39	300	1.09	a	
52	768.47	1537.13	121	57	43	339	1.27	a	
53	785.68	1571.44	72	42	31	227	1.04	a	
54	795.07	1590.17	123	48	35	258	1.35	a	
55	802.91	1605.81	169	54	39	291	1.49	b	
56	806.30	1612.57	68	43	32	226	1.14	c	
57	835.69	1671.19	48	42	32	241	0.92	a	
58	860.72	1721.11	109	39	27	175	0.87	a	
59	898.05	1795.54	53	55	44	336	1.74	a	
60	911.33	1822.03	751	70	36	251	1.48	a	
61	934.12	1867.48	80	41	30	200	1.15	a	
62	962.30	1923.68	74	41	31	198	1.25	a	
63	964.72	1928.51	148	57	42	296	1.97	b	
64	969.19	1937.42	470	62	37	247	1.58	c	
65	1001.31	2001.49	37	30	22	124	0.85	a	
66	1120.49	2239.17	325	56	35	235	1.54	a	
67	1238.02	2473.57	119	45	32	210	1.59	a	

181959D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
68	1377.59	2751.91	86	40	29	161	1.77	a
69	1407.48	2811.52	39	28	21	102	1.12	a
70	1460.51	2917.29	1185	75	25	118	1.94	a
71	1509.15	3014.30	49	30	22	101	1.55	a
72	1630.41	3256.14	28	26	19	79	1.52	a
73	1763.98	3522.51	275	43	23	96	1.92	a
74	1846.54	3687.17	46	42	32	140	3.40	a

181959D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET081128.BKG (112818-8 LONG BKG CAL)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.41	529	91	65	184	172	140	
3	53.18	198	109	87	103	219	179	NET<CL
4	63.18	1060	118	81	478	219	177	
5	66.34	371	213	172	200	270	220	NET<CL
6	69.58	238	144	116	212	182	148	
8	74.76	2241	137	81	1984	199	147	
9	77.01	3187	150	81	2922	224	161	
11	84.11	476	128	99	281	233	190	
12	87.13	1169	127	88	1082	196	152	
14	92.72	1792	136	88	1011	228	180	
15	99.33	123	112	90	105	176	144	NET<CL
17	108.78	80	87	70	63	131	107	NET<CL
18	112.77	93	63	49	78	134	109	NET<CL
20	139.73	146	77	60	-101	189	156	NET<CL
21	143.62	116	76	60	-40	185	152	NET<CL
27	185.87	1041	112	75	725	172	134	
28	198.33	316	106	82	92	178	145	NET<CL
31	238.60	3880	144	59	3535	213	145	
35	295.25	1429	99	53	1286	168	125	
38	338.42	744	87	56	673	150	116	
39	352.02	2479	119	54	2277	167	113	
43	511.10	2067	140	87	305	289	236	
45	558.65	172	55	40	-66	125	104	NET<CL
46	570.13	94	60	47	-16	116	95	NET<CL
47	583.44	1111	87	47	1010	151	112	
49	609.61	1858	109	54	1669	182	134	
55	802.91	169	54	39	-4	109	90	NET<CL
59	898.05	53	55	44	-39	162	134	NET<CL
60	911.33	751	70	36	673	106	76	
62	962.30	74	41	31	6	96	79	NET<CL
66	1120.49	325	56	35	300	82	61	
70	1460.51	1185	75	25	982	112	76	
73	1763.98	275	43	23	231	64	46	

181959D08.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-24 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:45
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.35e+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spectrum File 181959D08.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 8 (Detector 8)

Efficiency File: (D08)(Sh17).EFF (Geo 17 Eff Cal)
Eff.=1/[5.03E-02*En^-2.20E+00 + 1.32E+02*En^8.10E-01] 05/17/2018

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NE T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52		8.36E-01 +- 7.84E-01	1.29E+00	6.37E-01	1.79E+05
U-238	Average:	x	1.68E+00 +- 3.40E-01	. . . .	. . . .	3.92E+13
	63.29		1.48E+00 +- 6.77E-01	1.10E+00	5.46E-01	3.92E+13
	92.60		1.74E+00 +- 3.93E-01	6.25E-01	3.10E-01	3.92E+13
Ra-223	Average:	x	2.77E-01 +- 8.25E-02	. . . .	. . . .	2.87E+08
	154.18		1.73E-01 +- 1.18E-01	1.89E-01	9.19E-02	2.87E+08
	269.39		3.79E-01 +- 1.16E-01	1.81E-01	8.90E-02	2.87E+08
Ra-226	186.10		2.48E+00 +- 5.89E-01	9.30E-01	4.60E-01	1.40E+07
Pb-212	Average:	x	1.19E+00 +- 7.03E-02	. . . .	. . . .	5.04E+04
	238.63		1.18E+00 +- 7.13E-02	9.82E-02	4.86E-02	5.04E+04
	300.09		1.28E+00 +- 4.18E-01	6.47E-01	3.17E-01	5.04E+04
Tl-208	Average:	x	3.53E-01 +- 4.84E-02	. . . .	. . . .	5.04E+04
	277.36		5.06E-01 +- 1.78E-01	2.75E-01	1.34E-01	5.04E+04
	583.14		3.40E-01 +- 5.08E-02	7.66E-02	3.79E-02	5.04E+04
	860.47		3.53E-01 +- 3.73E-01	5.04E-01	2.48E-01	5.04E+04
Pb-214	Average:	x	1.20E+00 +- 7.70E-02	. . . .	. . . .	1.40E+07
	295.21		1.16E+00 +- 1.52E-01	2.28E-01	1.13E-01	1.40E+07
	351.92		1.22E+00 +- 8.94E-02	1.22E-01	6.04E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:	x	1.07E+00 +- 9.63E-02	. . . .	. . . .	5.04E+04
	338.40		1.05E+00 +- 2.35E-01	3.68E-01	1.82E-01	5.04E+04
	911.07		9.64E-01 +- 1.52E-01	2.22E-01	1.09E-01	5.04E+04

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	964.60		1.18E+00 +- 4.51E-01	6.92E-01	3.35E-01	5.04E+04
	968.90		1.18E+00 +- 1.55E-01	1.90E-01	9.14E-02	5.04E+04
Bi-212	Average:x		7.13E-01 +- 1.62E-01	. . . .	. . . .	5.04E+04
	727.17		6.84E-01 +- 1.65E-01	2.37E-01	1.14E-01	5.04E+04
	785.42		1.33E+00 +- 7.67E-01	1.20E+00	5.77E-01	5.04E+04
Bi-214	Average:x		1.03E+00 +- 1.44E-01	. . . .	. . . .	1.40E+07
	768.36		9.02E-01 +- 4.21E-01	6.58E-01	3.19E-01	1.40E+07
	934.06		1.11E+00 +- 5.66E-01	8.75E-01	4.19E-01	1.40E+07
	1120.29		9.83E-01 +- 2.67E-01	4.07E-01	1.99E-01	1.40E+07
	1238.11		1.07E+00 +- 4.03E-01	6.03E-01	2.89E-01	1.40E+07
	1377.67		1.26E+00 +- 5.81E-01	8.85E-01	4.23E-01	1.40E+07
	1764.49		1.05E+00 +- 2.91E-01	4.33E-01	2.10E-01	1.40E+07
	609.31		1.03E+00 +- 4.56E-01	6.68E-01	3.33E-01	1.40E+07
Tl-210	Average:x		4.53E-02 +- 1.78E-02	. . . .	. . . .	1.40E+07
	795.00		4.53E-02 +- 1.78E-02	2.70E-02	1.30E-02	1.40E+07
	860.00		1.24E-02 +- 1.33E+00	3.13E-01	1.49E-01	1.40E+07
Pa-234	Average:x		1.06E-02 +- 8.97E-02	. . . .	. . . .	3.95E+13
	808.10		5.16E-01 +- 3.23E-01	5.10E-01	2.45E-01	3.95E+13
	946.00	N	-3.17E-02 +- 9.34E-02	1.62E-01	7.80E-02	3.95E+13
K-40	1460.75		5.51E+00 +- 6.27E-01	8.69E-01	4.27E-01	1.12E+13
Ra-224	241.00		1.29E+00 +- 2.75E+00	6.38E-01	3.14E-01	5.04E+04
Tl-201	70.82	N	-4.18E+02 +- 3.82E+02	6.49E+02r	3.22E+02	7.35E+01
U-235	143.76	N	1.51E-01 +- 8.63E-02	1.39E-01	6.80E-02	3.33E+10
Ir-192	316.49	N	3.64E-03 +- 2.37E-02	3.97E-02	1.94E-02	1.78E+03
Be-7	477.56	N	1.82E-01 +- 2.37E-01	3.90E-01	1.90E-01	1.28E+03
Sc-46	889.26	N	-2.13E-02 +- 2.71E-02	4.75E-02	2.30E-02	2.01E+03
Na-22	1274.54	N	2.77E-03 +- 2.17E-02	3.70E-02	1.78E-02	2.28E+04

MEASURED TOTAL: 1.80E+01 +- 6.24E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	49.61	103.45	50	66	53	694	0.42	Deleted
3	53.18	110.57	103	219	179	1387	1.04	Deleted
5	66.34	136.81	200	270	220	3454	2.07	Deleted
6	69.58	143.29	212	182	148	2125	1.23	Unknown
7	72.42	148.94	649	242	194	3985	2.39	Unknown
8	74.76	153.61	1984	199	147	1328	0.83	Unknown
9	77.01	158.10	2922	224	161	1328	0.81	Unknown
10	79.00	162.06	84	100	81	1328	0.76	Unknown
11	84.11	172.25	281	233	190	1664	1.10	Unknown
12	87.13	178.29	1082	196	152	1426	1.02	Unknown

181959D08.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
13	89.83	183.66	748	108	77	1188	0.88	Unknown
15	99.33	202.62	105	176	144	1380	1.08	Deleted
16	105.25	214.42	181	113	90	1391	1.17	Unknown
17	108.78	221.46	63	131	107	993	0.74	Deleted
18	112.77	229.43	78	134	109	596	0.43	Deleted
19	128.97	261.73	236	90	69	969	0.74	Unknown
20	139.73	283.20	-101	189	156	796	0.73	Deleted
21	143.62	290.95	-40	185	152	796	0.67	Deleted
23	163.46	330.50	75	93	75	1048	0.90	Deleted
24	170.20	343.95	61	94	77	1083	0.92	Deleted
25	173.73	351.00	12	57	47	542	0.46	Deleted
26	177.24	358.00	14	57	47	542	0.46	Deleted
28	198.33	400.05	92	178	145	1160	1.18	Deleted
29	209.33	421.99	333	84	62	770	0.85	Unknown
30	236.10	475.38	132	95	76	984	1.09	Unknown
32	241.70	486.56	973	120	84	1124	1.28	SPLIT
37	328.06	658.79	144	68	53	561	0.89	Unknown
40	401.85	805.94	32	49	39	335	0.58	Deleted
41	409.50	821.20	132	73	57	550	1.18	Unknown
42	463.13	928.16	164	58	43	383	1.04	Unknown
43	511.10	1023.83	305	289	236	981	2.45	Unknown
44	537.95	1077.38	33	38	30	223	0.64	Unknown
45	558.65	1118.66	-66	125	104	337	0.94	Deleted
46	570.13	1141.55	-16	116	95	436	1.07	Deleted
48	598.16	1197.46	78	96	78	850	2.14	Unknown
49	609.61	1220.29	1669	182	134	547	1.30	SPLIT
50	665.59	1331.95	43	58	47	406	1.27	Deleted
55	802.91	1605.81	-4	109	90	291	1.49	Deleted
57	835.69	1671.19	48	42	32	241	0.92	Unknown
58	860.72	1721.11	109	39	27	175	0.87	SPLIT
59	898.05	1795.54	-39	162	134	336	1.74	Deleted
62	962.30	1923.68	6	96	79	198	1.25	Deleted
65	1001.31	2001.49	37	30	22	124	0.85	Unknown
69	1407.48	2811.52	39	28	21	102	1.12	Unknown
71	1509.15	3014.30	49	30	22	101	1.55	Unknown
72	1630.41	3256.14	28	26	19	79	1.52	Unknown
74	1846.54	3687.17	46	42	32	140	3.40	Unknown
78	609.61	1220.29	109	1427	134	547	1.30	1120SEsc

c:\SEEKER\BIN\181959d08.res Analysis Results Saved.

181821D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-25 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:53
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.21E+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spc. File 181821D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.21 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.36	96.87	560	98	71	1005	0.81	a	
2	53.16	110.45	98	64	50	612	0.51	a	
3	63.17	130.41	839	115	81	1334	0.85	a	
4	66.14	136.33	190	130	105	1868	1.19	b	
5	73.14	150.29	181	120	96	1698	1.02	a	
6	74.73	153.48	1922	134	84	1415	0.88	b	
7	76.98	157.96	3070	151	84	1415	0.87	c	
8	84.19	172.34	523	131	101	1624	1.32	a	HiResid
9	87.17	178.28	1149	120	81	1218	1.05	b	HiResid
10	89.81	183.55	619	100	71	1015	0.85	c	HiResid
11	92.71	189.34	1658	148	101	1624	1.24	d	HiResid
12	94.62	193.15	106	125	101	1624	1.34	e	HiResid
13	98.35	200.59	112	113	91	1421	1.15	f	HiResid
14	105.48	214.81	209	107	85	1225	1.15	a	Wide Pk
15	109.01	221.85	85	127	103	1575	1.50	b	NET< CL
16	115.37	234.53	71	60	47	545	0.46	a	
17	129.02	261.77	235	87	67	906	0.84	a	
18	139.84	283.35	175	106	85	1227	1.07	a	
19	143.52	290.68	88	71	56	701	0.73	b	
20	153.51	310.62	62	70	56	698	0.72	a	
21	159.51	322.58	55	56	45	489	0.47	a	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	185.89	375.21	917	124	89	1245	1.28	a	
23	198.92	401.20	137	140	114	1687	1.82	a	Wide Pk
24	209.31	421.92	271	90	69	883	0.93	a	
25	229.43	462.05	46	81	65	790	0.91	a	NET< CL
26	238.63	480.41	3457	142	65	791	0.99	a	
27	241.69	486.50	840	132	98	1318	1.57	b	
28	270.26	543.49	259	94	72	829	1.26	a	
29	277.49	557.92	122	90	72	820	1.36	a	
30	295.27	593.38	1362	106	62	665	1.12	a	
31	300.07	602.96	223	89	69	760	1.33	b	
32	327.97	658.61	120	73	57	610	1.05	a	
33	338.44	679.49	717	91	60	624	1.14	a	
34	352.01	706.56	2272	118	57	548	1.15	a	
35	409.55	821.34	74	56	44	385	0.84	a	
36	463.01	927.98	190	67	50	470	1.34	a	
37	472.88	947.65	20	57	47	430	1.15	a	NET< CL
38	511.13	1023.96	1714	132	85	919	2.43	a	Wide Pk
39	558.57	1118.59	133	57	43	366	1.08	a	
40	570.08	1141.54	110	63	49	416	1.41	a	
41	583.48	1168.27	1011	83	44	357	1.29	a	
42	609.61	1220.40	1574	99	49	438	1.32	a	
43	658.02	1316.96	51	56	44	343	1.42	a	
44	693.21	1387.16	71	64	50	442	1.49	a	
45	727.62	1455.78	182	50	35	242	1.22	a	
46	768.63	1537.59	96	44	32	219	1.03	a	
47	795.16	1590.50	91	43	31	194	1.13	a	
48	803.26	1606.66	99	48	36	240	1.27	a	
49	860.93	1721.70	98	54	42	307	1.78	a	
50	911.44	1822.47	599	63	33	211	1.44	a	
51	933.60	1866.66	85	53	41	277	1.97	a	
52	962.58	1924.47	97	53	40	272	1.92	a	
53	965.07	1929.43	80	40	30	182	1.28	b	
54	969.20	1937.67	348	54	32	204	1.41	c	
55	1064.02	2126.80	46	47	37	242	1.79	a	
56	1120.41	2239.29	256	50	32	186	1.67	a	
57	1238.19	2474.22	134	47	34	191	1.99	a	
58	1377.58	2752.27	104	37	26	127	1.85	a	
59	1407.95	2812.85	32	29	22	102	1.44	a	
60	1460.67	2918.01	963	71	28	137	2.07	a	
61	1592.70	3181.36	29	35	28	143	1.91	a	
62	1729.17	3453.59	43	27	20	71	2.01	a	
63	1764.01	3523.08	239	41	22	87	2.08	a	

181821D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET091128.BKG (112818-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.36	560	98	71	228	210	171	
2	53.16	98	64	50	20	153	126	NET<CL
3	63.17	839	115	81	502	203	163	
4	66.14	190	130	105	104	254	208	NET<CL
5	73.14	181	120	96	-15	181	149	NET<CL
7	76.98	3070	151	84	2863	217	156	
8	84.19	523	131	101	442	222	179	
9	87.17	1149	120	81	1063	185	143	
11	92.71	1658	148	101	1047	222	175	
18	139.84	175	106	85	55	167	137	NET<CL
19	143.52	88	71	56	-9	131	108	NET<CL
22	185.89	917	124	89	613	186	147	
23	198.92	137	140	114	-69	192	159	NET<CL
26	238.63	3457	142	65	3194	196	132	
28	270.26	259	94	72	218	156	126	
30	295.27	1362	106	62	1282	154	113	
32	327.97	120	73	57	83	105	85	NET<CL
33	338.44	717	91	60	682	118	87	
34	352.01	2272	118	57	2100	166	114	
38	511.13	1714	132	85	159	275	225	NET<CL
39	558.57	133	57	43	-57	117	97	NET<CL
40	570.08	110	63	49	33	141	116	NET<CL
41	583.48	1011	83	44	907	134	99	
42	609.61	1574	99	49	1469	142	98	
44	693.21	71	64	50	3	179	147	NET<CL
48	803.26	99	48	36	15	94	77	NET<CL
50	911.44	599	63	33	545	85	58	
52	962.58	97	53	40	70	87	70	
60	1460.67	963	71	28	809	103	71	
63	1764.01	239	41	22	200	76	58	

181821D09.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 1810627-25 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/05/2018 14:09:53
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.62e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.21e+002 g	Real Time . . . . . 60220 Sec
Collection Efficiency 1.0000	Spectrum File 181821D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.47E+01 +1.58E+01*L +-5.94E+00*L^2 +6.70E-01*L^3] 11/06/2018
Eff.=10^[-4.97E+00 +4.67E+00*L +-1.91E+00*L^2 +2.19E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pb-210	46.52		1.21E+00 +- 1.11E+00	1.83E+00	9.07E-01	1.79E+05
U-238	Average:	x	2.11E+00 +- 3.98E-01	. . . .	. . . .	3.92E+13
	63.29		1.86E+00 +- 7.52E-01	1.22E+00	6.04E-01	3.92E+13
	92.60		2.21E+00 +- 4.68E-01	7.43E-01	3.68E-01	3.92E+13
Pa-234	Average:	x	5.13E-02 +- 4.26E-02	. . . .	. . . .	3.95E+13
	94.67		8.01E-02 +- 9.43E-02	1.55E-01	7.65E-02	3.95E+13
	98.44		5.19E-02 +- 5.24E-02	8.60E-02	4.24E-02	3.95E+13
	946.00	N	5.70E-03 +- 1.16E-01	1.97E-01	9.48E-02	3.95E+13
Ra-223	Average:	x	2.06E-01 +- 1.37E-01	. . . .	. . . .	2.87E+08
	154.18		1.45E-01 +- 1.64E-01	2.69E-01	1.31E-01	2.87E+08
	269.39		3.50E-01 +- 2.51E-01	4.10E-01	2.03E-01	2.87E+08
Ra-226	186.10		2.62E+00 +- 7.93E-01	1.27E+00	6.28E-01	1.40E+07
Pb-212	Average:	x	1.43E+00 +- 8.67E-02	. . . .	. . . .	5.04E+04
	238.63		1.43E+00 +- 8.76E-02	1.19E-01	5.89E-02	5.04E+04
	300.09		1.52E+00 +- 6.09E-01	9.63E-01	4.72E-01	5.04E+04
Tl-208	Average:	x	4.03E-01 +- 5.84E-02	. . . .	. . . .	5.04E+04
	277.36		4.32E-01 +- 3.19E-01	5.18E-01	2.54E-01	5.04E+04
	583.14		4.02E-01 +- 5.96E-02	8.88E-02	4.38E-02	5.04E+04
	860.47		4.03E-01 +- 6.94E-01	9.22E-01	4.55E-01	5.04E+04
Ac-228	Average:	x	1.15E+00 +- 1.06E-01	. . . .	. . . .	5.04E+04
	338.40		1.39E+00 +- 2.40E-01	3.60E-01	1.77E-01	5.04E+04

181821D09.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	911.07		1.05E+00 +- 1.64E-01	2.30E-01	1.12E-01	5.04E+04
	964.60		8.61E-01 +- 4.35E-01	6.71E-01	3.21E-01	5.04E+04
	968.90		1.18E+00 +- 1.83E-01	2.28E-01	1.10E-01	5.04E+04
Pb-214	Average:x		1.46E+00 +- 1.13E-01	. . . .	. . . .	1.40E+07
	351.92		1.46E+00 +- 1.15E-01	1.60E-01	7.88E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
	295.21		1.53E+00 +- 6.18E-01	8.37E-01	4.17E-01	1.40E+07
Bi-212	727.17		7.12E-01 +- 1.97E-01	2.84E-01	1.37E-01	5.04E+04
Bi-214	Average:x		1.23E+00 +- 1.58E-01	. . . .	. . . .	1.40E+07
	768.36		9.49E-01 +- 4.35E-01	6.67E-01	3.20E-01	1.40E+07
	934.06		1.59E+00 +- 9.82E-01	1.56E+00	7.57E-01	1.40E+07
	1120.29		1.14E+00 +- 2.23E-01	2.95E-01	1.41E-01	1.40E+07
	1238.11		1.64E+00 +- 5.76E-01	8.58E-01	4.13E-01	1.40E+07
	1377.67		2.07E+00 +- 7.45E-01	1.08E+00	5.14E-01	1.40E+07
	1764.49		1.25E+00 +- 4.72E-01	7.38E-01	3.61E-01	1.40E+07
	609.31		1.23E+00 +- 4.84E-01	7.17E-01	3.57E-01	1.40E+07
Tl-210	Average:x		4.47E-02 +- 2.09E-02	. . . .	. . . .	1.40E+07
	795.00		4.47E-02 +- 2.09E-02	3.22E-02	1.54E-02	1.40E+07
	860.00		5.43E-02 +- 2.48E+00	6.47E-01	3.14E-01	1.40E+07
	296.00		3.91E-02 +- 3.02E-01	7.01E-02	3.46E-02	1.40E+07
K-40	1460.75		6.22E+00 +- 7.93E-01	1.11E+00	5.44E-01	1.12E+13
Ra-224	241.00		1.25E+00 +- 4.03E+00	9.87E-01	4.87E-01	5.04E+04
Tl-201	70.82	N	4.56E+02 +- 4.25E+02	6.88E+02R	3.40E+02	7.35E+01
U-235	143.76	N	9.96E-02 +- 1.13E-01	1.86E-01b	9.14E-02	3.33E+10
Ir-192	316.49	N	2.97E-02 +- 2.88E-02	4.71E-02	2.30E-02	1.78E+03
Be-7	477.56	N	8.35E-02 +- 2.91E-01	4.88E-01	2.37E-01	1.28E+03
Sc-46	889.26	N	6.57E-03 +- 3.20E-02	5.42E-02	2.61E-02	2.01E+03
Na-22	1274.54	N	-3.79E-03 +- 2.80E-02	4.84E-02	2.32E-02	2.28E+04

MEASURED TOTAL: 4.76E+02 +- 4.33E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	53.16	110.44	20	153	126	612	0.51	Deleted
4	66.14	136.33	104	254	208	1868	1.19	Deleted
5	73.14	150.29	-15	181	149	1698	1.02	Deleted
6	74.73	153.48	1922	134	84	1415	0.88	Unknown
7	76.98	157.96	2863	217	156	1415	0.87	Unknown
8	84.19	172.34	442	222	179	1624	1.32	Unknown
9	87.17	178.28	1063	185	143	1218	1.05	Unknown
10	89.81	183.55	619	100	71	1015	0.85	Unknown
14	105.48	214.81	209	107	85	1225	1.15	Unknown

181821D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
15	109.01	221.85	85	127	103	1575	1.50	Deleted
16	115.37	234.53	71	60	47	545	0.46	Unknown
17	129.02	261.77	235	87	67	906	0.84	Unknown
18	139.84	283.35	55	167	137	1227	1.07	Deleted
19	143.52	290.68	-9	131	108	701	0.73	Deleted
21	159.51	322.58	55	56	45	489	0.47	Unknown
23	198.92	401.20	-69	192	159	1687	1.82	Deleted
24	209.31	421.92	271	90	69	883	0.93	Unknown
25	229.43	462.05	46	81	65	790	0.91	Deleted
27	241.69	486.50	840	132	98	1318	1.57	SPLIT
30	295.27	593.38	1282	154	113	665	1.12	SPLIT
32	327.97	658.61	83	105	85	610	1.05	Deleted
35	409.55	821.34	74	56	44	385	0.84	Unknown
36	463.01	927.98	190	67	50	470	1.34	Unknown
37	472.88	947.65	20	57	47	430	1.15	Deleted
38	511.13	1023.96	159	275	225	919	2.43	Deleted
39	558.57	1118.59	-57	117	97	366	1.08	Deleted
40	570.08	1141.54	33	141	116	416	1.41	Deleted
42	609.61	1220.40	1469	142	98	438	1.32	SPLIT
43	658.02	1316.96	51	56	44	343	1.42	Unknown
44	693.21	1387.16	3	179	147	442	1.49	Deleted
48	803.26	1606.66	15	94	77	240	1.27	Deleted
49	860.93	1721.70	98	54	42	307	1.78	SPLIT
52	962.58	1924.47	70	87	70	272	1.92	Unknown
55	1064.02	2126.80	46	47	37	242	1.79	Unknown
59	1407.95	2812.85	32	29	22	102	1.44	Unknown
61	1592.70	3181.36	29	35	28	143	1.91	Unknown
62	1729.17	3453.59	43	27	20	71	2.01	Unknown
67	609.61	1220.40	62	1146	98	438	1.32	1120SEsc

c:\SEEKER\BIN\181821d09.res Analysis Results Saved.

182683D03.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-26 GS181103-2

Sampling Start:	10/26/2018 12:00:00	Counting Start:	12/06/2018 14:04:20
Sampling Stop:	10/26/2018 12:00:00	Decay Time.	9.86E+002 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	60000 Sec
Sample Size	1.56E+002 g	Real Time	60064 Sec
Collection Efficiency	1.0000	Spc. File	.182683D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.44 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018
FWHM(keV) = 0.79 + 0.012*En + 1.05E-03*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

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PEAK SEARCH RESULTS

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PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.29	129.08	130	139	113	2015	1.27	a	
2	66.34	135.19	189	127	102	1763	1.12	b	
3	69.27	141.02	7	68	55	756	0.48	c	NET< CL
4	74.70	151.86	736	125	93	1599	1.06	a	
5	76.97	156.38	1167	132	93	1599	1.02	b	
6	84.32	171.04	254	129	103	1675	1.31	a	
7	87.08	176.53	662	135	103	1675	1.31	b	
8	89.83	182.03	347	107	82	1256	1.02	c	
9	92.76	187.86	971	151	113	1884	1.49	d	
10	105.18	212.64	144	131	106	1666	1.52	a	
11	108.86	219.97	126	120	97	1481	1.24	b	
12	128.91	259.96	144	100	80	1179	0.94	a	
13	185.80	373.41	796	119	86	1266	1.18	a	
14	198.27	398.28	155	96	76	1081	1.01	a	
15	209.20	420.08	327	107	83	1271	1.29	a	
16	238.57	478.66	3660	155	79	1163	1.28	a	
17	241.60	484.70	889	113	79	1163	1.35	b	
18	253.02	507.47	56	57	45	510	0.62	a	
19	270.26	541.84	307	111	86	1229	1.62	a	
20	277.82	556.92	162	84	66	852	1.14	a	
21	295.17	591.52	1538	119	73	932	1.49	a	

182683D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	299.97	601.10	343	110	86	1139	1.82 b	
23	327.99	656.97	161	79	62	746	1.09 a	
24	338.20	677.34	730	102	71	887	1.52 a	
25	351.79	704.45	2360	128	68	816	1.47 a	
26	409.75	820.03	86	87	70	811	1.60 a	
27	463.12	926.46	158	57	42	403	1.06 a	
28	511.18	1022.32	1742	132	84	957	2.79 a	Wide Pk
29	558.62	1116.91	122	60	46	433	1.36 a	
30	583.18	1165.90	1159	98	58	569	1.94 a	
31	609.28	1217.96	1810	118	67	750	2.04 a	
32	727.13	1452.97	222	67	49	449	2.04 a	
33	768.78	1536.04	165	72	56	509	2.46 a	
34	773.00	1544.45	64	49	38	305	1.45 b	
35	795.06	1588.44	41	47	38	297	1.48 a	
36	803.36	1605.00	91	46	35	264	1.37 b	
37	860.39	1718.73	128	56	43	335	2.03 a	
38	911.31	1820.28	658	77	48	389	2.35 a	
39	934.07	1865.67	48	51	40	300	1.94 a	
40	969.28	1935.89	323	64	43	365	1.81 a	
41	1120.60	2237.67	299	68	48	361	2.64 a	
42	1238.56	2472.91	112	53	40	278	2.24 a	
43	1377.73	2750.46	81	54	42	240	3.25 a	
44	1461.03	2916.58	1202	84	39	220	3.07 a	
45	1764.90	3522.59	258	53	35	158	3.53 a	

182683D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET031128.BKG (112818-3 LONG BKG CAL)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.29	130	139	113	34	205	168	NET<CL
2	66.34	189	127	102	-38	234	193	NET<CL
3	69.27	7	68	55	-52	163	135	NET<CL
5	76.97	1167	132	93	1105	216	169	
6	84.32	254	129	103	197	190	154	
9	92.76	971	151	113	653	223	178	
13	185.80	796	119	86	487	238	192	
14	198.27	155	96	76	-71	235	194	NET<CL
16	238.57	3660	155	79	3427	208	141	
17	241.60	889	113	79	826	205	162	
21	295.17	1538	119	73	1416	178	133	
24	338.20	730	102	71	697	153	118	
25	351.79	2360	128	68	2109	189	136	
28	511.18	1742	132	84	197	281	230	NET<CL
29	558.62	122	60	46	-30	121	100	NET<CL
30	583.18	1159	98	58	1028	169	129	
31	609.28	1810	118	67	1649	168	121	
36	803.36	91	46	35	-53	124	103	NET<CL
38	911.31	658	77	48	598	131	100	
44	1461.03	1202	84	39	1040	116	80	
45	1764.90	258	53	35	213	76	58	

182683D03.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-26 GS181103-2

Sampling Start: 10/26/2018 12:00:00	Counting Start: 12/06/2018 14:04:20
Sampling Stop: 10/26/2018 12:00:00	Decay Time. . . . . 9.86e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.56e+002 g	Real Time . . . . . 60064 Sec
Collection Efficiency 1.0000	Spectrum File 182683D03.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh17).eff (Geo 17 Eff Cal)

*Eff=10^[-8.15E+01 +1.04E+02*L +-4.49E+01*L^2 +6.40E+00*L^3] 11/01/2018

Eff.=10^[-2.02E-01 +-3.44E-01*L +-1.27E-01*L^2 +7.29E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		1.70E+00 +- 5.81E-01	9.38E-01	4.65E-01	3.92E+13
Ra-226	186.10		1.59E+00 +- 7.79E-01	1.27E+00	6.29E-01	1.40E+07
Pb-212	Average:x		1.10E+00 +- 6.57E-02	. . . .	. . . .	5.04E+04
	238.63		1.09E+00 +- 6.62E-02	9.08E-02	4.50E-02	5.04E+04
	300.09		1.62E+00 +- 5.21E-01	8.20E-01	4.03E-01	5.04E+04
Ra-223	269.39		3.30E-01 +- 1.19E-01	1.89E-01	9.28E-02	2.87E+08
Tl-208	Average:x		3.29E-01 +- 5.15E-02	. . . .	. . . .	5.04E+04
	277.36		3.74E-01 +- 1.94E-01	3.10E-01	1.52E-01	5.04E+04
	583.14		3.26E-01 +- 5.37E-02	8.26E-02	4.09E-02	5.04E+04
	860.47		3.29E-01 +- 5.23E-01	6.97E-01	3.44E-01	5.04E+04
Ac-228	Average:x		8.53E-01 +- 1.05E-01	. . . .	. . . .	5.04E+04
	338.40		9.90E-01 +- 2.18E-01	3.40E-01	1.68E-01	5.04E+04
	911.07		8.36E-01 +- 1.84E-01	2.84E-01	1.40E-01	5.04E+04
	968.90		7.94E-01 +- 1.57E-01	2.20E-01	1.07E-01	5.04E+04
Pb-214	Average:x		1.03E+00 +- 9.00E-02	. . . .	. . . .	1.40E+07
	351.92		1.03E+00 +- 9.19E-02	1.33E-01	6.60E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
	295.21		1.05E+00 +- 4.51E-01	6.15E-01	3.07E-01	1.40E+07
Bi-212	727.17		6.24E-01 +- 1.88E-01	2.85E-01	1.38E-01	5.04E+04
Bi-214	Average:x		9.98E-01 +- 1.49E-01	. . . .	. . . .	1.40E+07
	768.36		1.18E+00 +- 5.18E-01	8.16E-01	3.98E-01	1.40E+07

182683D03.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	934.06		6.43E-01 +- 6.87E-01	1.13E+00	5.44E-01	1.40E+07
	1120.29		9.75E-01 +- 2.20E-01	3.20E-01	1.56E-01	1.40E+07
	1238.11		1.01E+00 +- 4.82E-01	7.53E-01	3.64E-01	1.40E+07
	1377.67		1.20E+00 +- 8.00E-01	1.28E+00	6.20E-01	1.40E+07
	1764.49		1.02E+00 +- 3.64E-01	5.66E-01	2.77E-01	1.40E+07
	609.31		9.98E-01 +- 4.34E-01	6.50E-01	3.24E-01	1.40E+07
Tl-210	Average:x		1.45E-02 +- 1.67E-02	. . . .	. . . .	1.40E+07
	795.00		1.44E-02 +- 1.68E-02	2.75E-02	1.33E-02	1.40E+07
	860.00		1.35E-01 +- 1.87E+00	4.77E-01	2.31E-01	1.40E+07
	296.00		2.56E-02 +- 2.19E-01	5.10E-02	2.53E-02	1.40E+07
K-40	1460.75		5.99E+00 +- 6.70E-01	9.32E-01	4.58E-01	1.12E+13
Ra-224	241.00		8.64E-01 +- 4.41E+00	1.16E+00	5.74E-01	5.04E+04
Pb-210	46.52	N	-3.50E+00 +- 9.06E+00	1.52E+01	7.50E+00	1.79E+05
Tl-201	70.82	N	-3.63E+02 +- 1.27E+03	2.12E+03B	1.05E+03	7.35E+01
U-235	143.76	N	6.38E-03 +- 1.09E-01	1.82E-01	8.95E-02	3.33E+10
Ir-192	316.49	N	7.54E-03 +- 2.21E-02	3.69E-02	1.81E-02	1.78E+03
Be-7	477.56	N	2.01E-01 +- 2.44E-01	4.01E-01	1.95E-01	1.28E+03
Sc-46	889.26	N	2.16E-03 +- 3.00E-02	5.06E-02	2.46E-02	2.01E+03
Pa-234	946.00	N	-1.17E-02 +- 1.09E-01	1.85E-01	8.98E-02	3.95E+13
Na-22	1274.54	N	2.24E-03 +- 2.62E-02	4.44E-02	2.15E-02	2.28E+04

MEASURED TOTAL: 1.56E+01 +- 7.65E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.29	129.08	34	205	168	2015	1.27	Deleted
2	66.34	135.19	-38	234	193	1763	1.12	Deleted
3	69.27	141.02	-52	163	135	756	0.48	Deleted
4	74.70	151.86	736	125	93	1599	1.06	Unknown
5	76.97	156.38	1105	216	169	1599	1.02	Unknown
6	84.32	171.04	197	190	154	1675	1.31	Unknown
7	87.08	176.53	662	135	103	1675	1.31	Unknown
8	89.83	182.03	347	107	82	1256	1.02	Unknown
10	105.18	212.64	144	131	106	1667	1.52	Unknown
11	108.86	219.97	126	120	97	1481	1.24	Unknown
12	128.91	259.96	144	100	80	1179	0.94	Unknown
14	198.27	398.28	-71	235	194	1081	1.01	Deleted
15	209.20	420.08	327	107	83	1271	1.29	Unknown
17	241.60	484.70	826	205	162	1163	1.35	SPLIT
18	253.02	507.47	56	57	46	510	0.62	Unknown
21	295.17	591.52	1416	178	133	932	1.49	SPLIT
23	327.99	656.97	161	79	62	746	1.09	Unknown

182683D03.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
26	409.75	820.03	86	87	70	811	1.60	Unknown
27	463.12	926.46	158	57	42	403	1.06	Unknown
28	511.18	1022.32	197	281	230	957	2.79	Deleted
29	558.62	1116.91	-30	121	100	433	1.36	Deleted
31	609.28	1217.96	1649	168	121	750	2.04	SPLIT
34	773.00	1544.45	64	49	38	305	1.45	Unknown
36	803.36	1605.00	-53	124	103	264	1.37	Deleted
37	860.39	1718.73	128	56	43	335	2.03	SPLIT
49	609.28	1217.96	51	1429	121	750	2.04	1121SEsc

c:\SEEKER\BIN\182683d03.res Analysis Results Saved.

182192D02.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-27 GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/05/2018 08:31:12
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 8.85E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.36E+002 g	Real Time . . . . . 7306 Sec
Collection Efficiency 1.0000	Spc. File 182192D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.29 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	74.76	151.81	59	42	33	213	0.75	a	
2	77.07	156.42	127	51	37	256	1.05	b	
3	87.01	176.26	58	44	34	231	0.82	a	
4	92.44	187.11	54	38	29	181	0.70	a	
5	186.02	373.89	84	39	28	178	0.87	a	
6	209.09	419.96	31	38	30	185	1.05	a	
7	238.61	478.88	688	64	31	187	1.23	a	
8	241.84	485.31	129	47	34	214	1.27	b	
9	270.30	542.13	59	44	34	197	1.47	a	
10	295.20	591.83	174	40	24	125	0.96	a	
11	327.87	657.05	32	29	22	106	0.95	a	
12	338.28	677.84	108	34	22	103	0.98	a	
13	351.82	704.86	353	49	27	130	1.31	a	
14	444.07	889.01	25	24	18	67	1.04	a	
15	462.51	925.82	56	43	34	144	2.52	a	Wide Pk
16	488.06	976.80	19	25	19	73	1.13	a	NET< CL
17	510.79	1022.18	247	50	32	137	2.22	a	
18	583.10	1166.52	215	37	18	66	1.50	a	
19	609.33	1218.89	267	44	25	113	1.56	a	
20	726.96	1453.69	44	24	16	53	1.34	a	
21	794.58	1588.68	26	25	19	62	1.84	a	

182192D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	911.31	1821.69	139	29	14	42	1.70	a
23	968.85	1936.54	54	28	20	75	1.83	a
24	1119.90	2238.06	61	30	21	65	3.09	a
25	1378.16	2753.58	26	17	11	21	2.47	a
26	1460.69	2918.32	494	47	12	23	2.60	a
27	1764.05	3523.88	46	21	13	24	3.10	a

182192D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET021128.BKG (112818-2 LONG BKG CAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	74.76	59	42	33	31	65	53	NET<CL
4	92.44	54	38	29	28	43	35	NET<CL
5	186.02	84	39	28	39	44	35	
7	238.61	688	64	31	649	69	38	
10	295.20	174	40	24	165	43	28	
13	351.82	353	49	27	325	53	32	
17	510.79	247	50	32	50	59	47	
18	583.10	215	37	18	202	39	22	
19	609.33	267	44	25	249	48	30	
22	911.31	139	29	14	130	31	17	
26	1460.69	494	47	12	451	48	19	
27	1764.05	46	21	13	39	22	15	

182192D02.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-27 GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/05/2018 08:31:12
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 8.85e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 7200 Sec
Sample Size . . . . . 2.36e+002 g	Real Time . . . . . 7306 Sec
Collection Efficiency 1.0000	Spectrum File 182192D02.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.25E+02 +1.62E+02*L +-7.06E+01*L^2 +1.02E+01*L^3] 09/06/2018

Eff.=10^[-1.14E+01 +1.13E+01*L +-4.16E+00*L^2 +4.74E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60	N	4.55E-01 +- 7.00E-01	1.16E+00	5.59E-01	3.92E+13
Ra-226	186.10		6.50E-01 +- 7.38E-01	1.21E+00	5.82E-01	1.40E+07
Pb-212	238.63		1.02E+00 +- 1.08E-01	1.24E-01	6.00E-02	5.04E+04
Ra-223	269.39		3.01E-01 +- 2.22E-01	3.56E-01	1.71E-01	2.87E+08
Pb-214	Average:x		6.86E-01 +- 9.52E-02	. . . .	. . . .	1.40E+07
	295.21		6.11E-01 +- 1.58E-01	2.18E-01	1.04E-01	1.40E+07
	351.92		7.29E-01 +- 1.19E-01	1.50E-01	7.21E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		7.01E-01 +- 1.26E-01	. . . .	. . . .	5.04E+04
	338.40		7.14E-01 +- 2.24E-01	3.09E-01	1.46E-01	5.04E+04
	911.07		7.54E-01 +- 1.81E-01	2.18E-01	1.01E-01	5.04E+04
	968.90		5.50E-01 +- 2.86E-01	4.28E-01	2.00E-01	5.04E+04
Tl-208	583.14		2.74E-01 +- 5.26E-02	6.24E-02	2.94E-02	5.04E+04
Bi-214	Average:x		6.92E-01 +- 1.16E-01	. . . .	. . . .	1.40E+07
	609.31		6.66E-01 +- 1.28E-01	1.65E-01	7.89E-02	1.40E+07
	1120.29		8.18E-01 +- 4.03E-01	6.04E-01	2.84E-01	1.40E+07
	1377.67		1.53E+00 +- 1.02E+00	1.51E+00	6.73E-01	1.40E+07
	1764.49		7.02E-01 +- 3.99E-01	5.92E-01	2.72E-01	1.40E+07
Bi-212	727.17		5.19E-01 +- 2.79E-01	4.12E-01	1.90E-01	5.04E+04
Tl-210	795.00		3.81E-02 +- 3.70E-02	5.97E-02	2.78E-02	1.40E+07
K-40	1460.75		1.02E+01 +- 1.10E+00	9.32E-01	4.35E-01	1.12E+13

182192D02.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ra-224	241.00		9.22E-01 +- 4.99E+00	1.23E+00	5.93E-01	5.04E+04
Pb-210	46.52	N	3.98E+01 +- 1.10E+02	1.85E+02	8.94E+01	1.79E+05
Tl-201	70.82	N	-8.03E+02 +- 1.49E+03	2.55E+03B	1.24E+03	7.35E+01
U-235	143.76	N	2.10E-01 +- 2.26E-01	3.69E-01	1.78E-01	3.33E+10
Ir-192	316.49	N	4.89E-03 +- 4.04E-02	6.94E-02	3.30E-02	1.78E+03
Be-7	477.56	N	4.85E-02 +- 4.71E-01	8.11E-01	3.85E-01	1.28E+03
Sc-46	889.26	N	1.51E-02 +- 4.62E-02	7.95E-02	3.68E-02	2.01E+03
Pa-234	946.00	N	-1.29E-01 +- 1.73E-01	3.28E-01	1.52E-01	3.95E+13
Na-22	1274.54	N	-1.46E-02 +- 4.65E-02	8.49E-02	3.94E-02	2.28E+04

MEASURED TOTAL: 5.66E+01 +- 1.20E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.76	151.81	31	65	53	213	0.75	Deleted
2	77.07	156.42	127	51	37	256	1.05	Unknown
3	87.01	176.26	58	44	34	231	0.82	Unknown
6	209.09	419.96	31	38	30	185	1.05	Unknown
8	241.84	485.31	129	47	34	214	1.27	SPLIT
11	327.87	657.05	32	29	22	106	0.95	Unknown
14	444.07	889.01	25	24	18	67	1.04	Unknown
15	462.51	925.82	56	43	34	144	2.52	Unknown
16	488.06	976.80	19	25	19	73	1.13	Deleted
17	510.79	1022.18	50	59	47	137	2.22	Unknown

c:\SEEKER\BIN\182192d02.res Analysis Results Saved.

182732D04.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-28 GS181103-2

Sampling Start:	10/29/2018 12:00:00	Counting Start:	12/06/2018 14:59:29
Sampling Stop:	10/29/2018 12:00:00	Decay Time.	9.15E+002 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	60000 Sec
Sample Size	1.72E+002 g	Real Time	60060 Sec
Collection Efficiency	1.0000	Spc. File	.182732D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.48 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	53.75	110.25	128	111	89	1609	0.75	a	
2	63.17	129.05	298	117	92	1693	0.80	a	
3	74.74	152.15	2028	206	153	3441	1.41	a	HiResid
4	77.01	156.66	2759	158	97	1912	0.84	b	HiResid
5	84.19	171.00	224	131	105	2036	1.05	a	
6	87.15	176.90	1183	159	118	2375	1.21	b	
7	89.85	182.31	631	122	92	1697	0.90	c	
8	92.80	188.19	1419	176	131	2715	1.25	d	
9	99.44	201.44	16	95	78	1357	0.57	e	NET< CL
10	105.47	213.47	58	80	64	1018	0.55	f	NET< CL
11	115.38	233.25	104	102	82	1363	0.87	a	
12	124.25	250.95	108	116	94	1629	1.06	a	
13	129.06	260.55	363	120	94	1629	0.98	b	
14	139.89	282.18	123	103	83	1388	0.81	a	
15	143.85	290.09	262	148	118	2221	1.29	b	
16	154.11	310.56	171	130	105	1884	1.17	a	
17	185.83	373.86	1320	134	93	1695	1.21	a	
18	198.53	399.21	134	79	62	952	0.73	a	
19	209.25	420.61	514	108	80	1364	1.04	a	
20	238.57	479.14	6808	198	89	1477	1.34	a	
21	241.66	485.29	1671	153	106	1846	1.62	b	

182732D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	249.73	501.41	42	65	52	670	0.65	a	NET< CL
23	270.11	542.10	543	127	97	1544	1.61	a	
24	277.49	556.81	168	87	68	983	0.92	a	
25	295.17	592.10	2472	137	77	1096	1.38	a	
26	299.96	601.66	390	110	84	1233	1.46	b	
27	327.97	657.56	289	82	61	793	1.03	a	
28	338.15	677.89	1117	111	73	995	1.26	a	HiResid
29	351.81	705.15	4012	153	71	926	1.35	a	HiResid
30	389.47	780.31	39	91	75	966	1.41	a	NET< CL
31	409.77	820.84	80	61	48	524	0.85	a	
32	438.77	878.73	53	72	58	682	1.35	a	NET< CL
33	462.96	927.01	346	86	64	755	1.57	a	
34	510.94	1022.78	1783	135	87	1116	2.46	a	
35	558.29	1117.28	96	65	51	536	1.23	a	
36	583.17	1166.94	1796	115	64	711	1.77	a	
37	609.23	1218.96	2732	127	59	680	1.54	a	HiResid
38	664.95	1330.16	70	68	54	541	1.65	a	
39	693.62	1387.39	70	64	51	533	1.39	a	
40	727.31	1454.63	310	66	46	449	1.48	a	
41	768.55	1536.95	93	49	37	332	1.00	a	
42	794.59	1588.92	197	69	52	493	2.01	a	
43	803.10	1605.89	112	51	39	329	1.31	b	
44	835.96	1671.50	57	47	36	306	1.21	a	
45	860.41	1720.28	163	58	43	374	1.60	a	
46	911.23	1821.73	1156	89	48	418	2.04	a	
47	933.95	1867.07	149	50	36	274	1.44	a	
48	965.22	1929.49	170	65	49	442	2.04	a	
49	968.95	1936.93	610	77	49	442	2.00	b	
50	1014.79	2028.42	32	36	28	183	1.18	a	
51	1120.19	2238.80	556	77	50	415	2.51	a	
52	1238.02	2473.97	206	73	55	466	2.71	a	
53	1377.73	2752.83	168	58	42	257	3.17	a	
54	1385.76	2768.85	44	30	22	108	1.36	b	
55	1460.81	2918.65	2969	118	37	220	2.63	a	HiResid
56	1588.25	3173.01	46	34	25	137	1.39	a	
57	1729.79	3455.52	83	29	18	68	1.69	a	
58	1764.59	3524.99	430	53	27	117	2.69	a	
59	1847.89	3691.24	37	24	17	58	1.49	a	

182732D04.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET041128.BKG (112818-4 LONG BKG CAL)

Bkg.File Detector #: 4

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	53.75	128	111	89	-4	199	163	NET<CL
2	63.17	298	117	92	116	209	171	NET<CL
5	84.19	224	131	105	157	188	154	
8	92.80	1419	176	131	851	251	200	
14	139.89	123	103	83	-30	190	156	NET<CL
15	143.85	262	148	118	201	181	147	
17	185.83	1320	134	93	910	203	159	
18	198.53	134	79	62	-18	183	150	NET<CL
20	238.57	6808	198	89	6698	221	122	
25	295.17	2472	137	77	2392	184	128	
29	351.81	4012	153	71	3884	200	128	
34	510.94	1783	135	87	477	268	217	
35	558.29	96	65	51	-65	131	109	NET<CL
36	583.17	1796	115	64	1749	151	104	
37	609.23	2732	127	59	2615	182	124	
39	693.62	70	64	51	3	129	106	NET<CL
43	803.10	112	51	39	2	100	82	NET<CL
55	1460.81	2969	118	37	2829	138	73	

182732D04.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-28 GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/06/2018 14:59:29
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 9.15e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.72e+002 g	Real Time . . . . . 60060 Sec
Collection Efficiency 1.0000	Spectrum File 182732D04.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh17).eff (Geo 17 Eff Cal)

*Eff=10^[-7.41E+01 +9.43E+01*L +-4.05E+01*L^2 +5.76E+00*L^3] 09/25/2018

Eff.=10^[-8.67E+00 +8.41E+00*L +-3.13E+00*L^2 +3.49E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		1.80E+00 +- 5.30E-01	8.53E-01	4.24E-01	3.92E+13
U-235	143.76		1.68E-01 +- 1.52E-01	2.49E-01	1.23E-01	3.33E+10
Ra-223	Average:x		4.58E-01 +- 1.05E-01	. . . .	. . . .	2.87E+08
	154.18		2.75E-01 +- 2.09E-01	3.42E-01	1.69E-01	2.87E+08
	269.39		5.19E-01 +- 1.21E-01	1.88E-01	9.28E-02	2.87E+08
Ra-226	186.10		2.58E+00 +- 5.74E-01	9.09E-01	4.51E-01	1.40E+07
Pb-212	Average:x		1.88E+00 +- 6.16E-02	. . . .	. . . .	5.04E+04
	238.63		1.88E+00 +- 6.21E-02	6.95E-02	3.44E-02	5.04E+04
	300.09		1.75E+00 +- 4.93E-01	7.69E-01	3.78E-01	5.04E+04
Tl-208	Average:x		4.99E-01 +- 4.16E-02	. . . .	. . . .	5.04E+04
	277.36		3.46E-01 +- 1.80E-01	2.87E-01	1.41E-01	5.04E+04
	583.14		5.09E-01 +- 4.41E-02	6.12E-02	3.02E-02	5.04E+04
	860.47		4.88E-01 +- 1.75E-01	2.66E-01	1.29E-01	5.04E+04
Pb-214	Average:x		1.77E+00 +- 7.56E-02	. . . .	. . . .	1.40E+07
	295.21		1.78E+00 +- 1.37E-01	1.93E-01	9.54E-02	1.40E+07
	351.92		1.76E+00 +- 9.06E-02	1.18E-01	5.83E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07
Ac-228	Average:x		1.48E+00 +- 8.04E-02	. . . .	. . . .	5.04E+04
	338.40		1.49E+00 +- 1.48E-01	1.99E-01	9.77E-02	5.04E+04
	911.07		1.51E+00 +- 1.17E-01	1.28E-01	6.23E-02	5.04E+04
	964.60		1.25E+00 +- 4.78E-01	7.39E-01	3.60E-01	5.04E+04

182732D04.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	968.90		1.41E+00 +- 1.78E-01	2.32E-01	1.13E-01	5.04E+04
Bi-214	Average:x		1.54E+00 +- 8.37E-02	. . . .	. . . .	1.40E+07
	609.31		1.50E+00 +- 1.04E-01	1.44E-01	7.10E-02	1.40E+07
	768.36		6.20E-01 +- 3.23E-01	5.06E-01	2.44E-01	1.40E+07
	934.06		1.89E+00 +- 6.35E-01	9.47E-01	4.56E-01	1.40E+07
	1120.29		1.71E+00 +- 2.38E-01	3.18E-01	1.55E-01	1.40E+07
	1238.11		1.76E+00 +- 6.25E-01	9.69E-01	4.73E-01	1.40E+07
	1377.67		2.37E+00 +- 8.15E-01	1.24E+00	5.99E-01	1.40E+07
	1764.49		1.94E+00 +- 2.40E-01	2.58E-01	1.23E-01	1.40E+07
Bi-212	727.17		8.06E-01 +- 1.72E-01	2.47E-01	1.20E-01	5.04E+04
Tl-210	795.00		6.48E-02 +- 2.27E-02	3.49E-02	1.70E-02	1.40E+07
K-40	1460.75		1.55E+01 +- 7.58E-01	8.13E-01	3.99E-01	1.12E+13
Ra-224	241.00		1.79E+00 +- 2.92E+00	6.71E-01	3.31E-01	5.04E+04
Pb-210	46.52	N	2.25E+00 +- 6.66E+00	1.10E+01	5.45E+00	1.79E+05
Tl-201	70.82	N	8.19E+02 +- 3.87E+02	6.24E+02B	3.08E+02	7.35E+01
Ir-192	316.49	N	-1.49E-02 +- 2.26E-02	3.83E-02	1.88E-02	1.78E+03
Be-7	477.56	N	2.99E-02 +- 2.61E-01	4.37E-01	2.14E-01	1.28E+03
Sc-46	889.26	N	-1.41E-02 +- 2.85E-02	4.90E-02	2.38E-02	2.01E+03
Pa-234	946.00	N	-3.85E-02 +- 1.18E-01	2.02E-01	9.82E-02	3.95E+13
Na-22	1274.54	N	9.55E-03 +- 3.03E-02	5.08E-02	2.47E-02	2.28E+04

MEASURED TOTAL: 8.51E+02 +- 4.00E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	53.75	110.25	-4	199	163	1609	0.75	Deleted
2	63.17	129.05	116	209	171	1693	0.80	Deleted
3	74.74	152.15	2028	206	153	3441	1.41	Unknown
4	77.01	156.66	2759	158	97	1912	0.84	Unknown
5	84.19	171.00	157	188	154	2036	1.05	Unknown
6	87.15	176.90	1183	159	118	2375	1.21	Unknown
7	89.85	182.31	631	122	92	1697	0.90	Unknown
9	99.44	201.44	16	95	78	1357	0.57	Deleted
10	105.47	213.47	58	80	64	1018	0.55	Deleted
11	115.38	233.25	104	102	82	1363	0.87	Unknown
12	124.25	250.95	108	116	94	1629	1.06	Unknown
13	129.06	260.55	363	120	94	1629	0.98	Unknown
14	139.89	282.18	-30	190	156	1388	0.81	Deleted
18	198.53	399.21	-18	183	150	952	0.73	Deleted
19	209.25	420.61	514	108	80	1364	1.04	Unknown
21	241.66	485.29	1671	153	106	1846	1.62	SPLIT
22	249.73	501.41	42	65	52	670	0.65	Deleted

182732D04.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
27	327.97	657.56	289	82	61	793	1.03	Unknown
30	389.47	780.31	39	91	75	966	1.41	Deleted
31	409.77	820.84	80	61	48	524	0.85	Unknown
32	438.77	878.73	53	72	58	682	1.35	Deleted
33	462.96	927.01	346	86	64	755	1.57	Unknown
34	510.94	1022.78	477	268	217	1116	2.46	Unknown
35	558.29	1117.28	-65	131	109	536	1.23	Deleted
38	664.95	1330.16	70	68	54	541	1.65	Unknown
39	693.62	1387.39	3	129	106	533	1.39	Deleted
43	803.10	1605.89	2	100	82	329	1.31	Deleted
44	835.96	1671.50	57	47	36	306	1.21	Unknown
50	1014.79	2028.42	32	36	28	183	1.18	Unknown
54	1385.76	2768.85	44	30	22	108	1.36	Unknown
56	1588.25	3173.01	46	34	25	137	1.39	Unknown
57	1729.79	3455.52	83	29	18	68	1.69	Unknown
59	1847.89	3691.24	37	24	17	58	1.49	Unknown

c:\SEEKER\BIN\182732d04.res Analysis Results Saved.

181914D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-29 GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/06/2018 14:04:33
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 9.14E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.49E+002 g	Real Time . . . . . 60116 Sec
Collection Efficiency 1.0000	Spc. File 181914D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.66 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018

FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018

Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	63.18	127.52	168	95	75	1378	0.44	a	
2	66.42	133.99	154	132	107	2296	0.84	b	
3	74.80	150.74	1528	171	125	2894	0.99	a	
4	77.07	155.27	2645	168	109	2412	0.77	b	
5	84.25	169.61	440	147	116	2473	1.06	a	HiResid
6	87.16	175.43	1429	175	130	2885	1.09	b	HiResid
7	89.87	180.84	831	136	101	2061	0.80	c	HiResid
8	92.93	186.95	1558	177	130	2885	1.15	d	HiResid
9	94.68	190.44	103	88	71	1237	0.55	e	HiResid
10	99.54	200.15	224	120	95	1831	0.84	a	
11	105.45	211.96	300	156	125	2653	1.21	a	
12	128.94	258.89	542	127	97	1898	0.81	a	
13	139.80	280.59	147	87	69	1174	0.45	a	
14	143.98	288.94	246	157	127	2738	1.08	b	
15	154.06	309.07	372	200	161	3613	1.56	a	Wide Pk
16	157.59	316.13	115	133	108	2168	0.91	b	
17	185.83	372.54	1763	155	107	2118	0.92	a	HiResid
18	198.30	397.45	187	84	66	1058	0.53	a	
19	209.21	419.23	844	127	93	1729	0.84	a	
20	229.49	459.76	41	76	61	928	0.52	a	NET< CL
21	238.54	477.84	10717	238	97	1736	1.01	a	HiResid

181914D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	241.49	483.72	2386	176	121	2315	1.27	b	HiResid
23	252.53	505.77	82	97	79	1246	0.78	a	
24	270.02	540.72	856	152	115	1968	1.54	a	
25	277.31	555.27	352	99	76	1158	0.86	a	
26	287.57	575.78	129	174	142	2494	1.96	a	NET< CL Wide Pk
27	295.11	590.83	3702	165	91	1425	1.08	a	
28	299.97	600.55	663	122	91	1425	1.09	b	
29	327.97	656.48	598	120	90	1512	1.31	a	
30	338.22	676.96	2062	135	82	1334	1.08	a	
31	351.83	704.14	6195	179	70	1022	1.06	a	HiResid
32	409.39	819.13	250	93	72	1029	1.09	a	
33	430.84	861.98	47	73	59	740	0.94	a	NET< CL
34	462.89	926.00	614	111	81	1090	1.69	a	
35	510.80	1021.70	2628	168	109	1603	2.37	a	Wide Pk
36	558.46	1116.91	118	59	45	510	0.85	a	
37	583.12	1166.18	3285	136	61	752	1.37	a	
38	596.75	1193.41	161	108	87	1261	1.89	a	
39	598.87	1197.65	111	87	70	946	1.50	b	
40	609.28	1218.43	4761	163	71	984	1.54	a	HiResid
41	665.28	1330.30	53	51	40	397	0.82	a	
42	727.33	1454.27	671	90	60	669	1.71	a	
43	768.27	1536.05	368	74	52	546	1.32	a	
44	772.22	1543.94	61	48	37	342	0.89	b	
45	785.77	1570.99	72	57	45	441	1.20	a	Wide Pk
46	794.80	1589.04	307	79	58	630	1.62	b	
47	804.42	1608.25	182	136	110	1386	3.65	c	
48	835.49	1670.33	166	79	61	664	1.84	a	
49	839.36	1678.06	127	88	70	785	2.06	b	
50	860.65	1720.58	397	68	45	428	1.41	a	
51	911.21	1821.59	2154	116	58	614	1.90	a	
52	934.13	1867.37	224	66	48	450	1.76	a	
53	964.68	1928.39	481	97	71	743	2.99	a	
54	969.06	1937.14	1302	93	49	454	1.76	b	
55	1001.31	2001.57	61	45	35	288	1.20	a	
56	1094.45	2187.64	78	65	52	455	2.32	a	
57	1120.34	2239.36	1007	92	55	515	2.24	a	
58	1155.86	2310.31	92	60	47	409	1.92	a	
59	1238.32	2475.04	363	72	51	456	2.08	a	
60	1280.90	2560.09	46	38	29	198	1.14	a	
61	1377.71	2753.50	271	56	37	249	2.18	a	
62	1384.95	2767.96	56	43	33	211	1.77	b	
63	1401.21	2800.42	99	78	62	474	3.97	a	Wide Pk
64	1408.19	2814.38	111	48	36	237	1.90	b	
65	1460.85	2919.58	3352	129	47	359	2.40	a	HiResid
66	1509.62	3017.00	87	45	34	214	1.96	a	

181914D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
67	1588.37	3174.30	148	53	39	267	2.05	a	
68	1619.43	3236.36	120	76	60	392	4.74	a	HiResid Wide Pk
69	1629.16	3255.80	56	104	85	581	6.96	b	NET< CL HiResid
70	1661.53	3320.45	49	36	27	137	1.89	a	
71	1729.74	3456.72	133	46	33	186	2.27	a	
72	1764.75	3526.65	717	70	37	207	2.75	a	
73	1847.27	3691.50	91	42	31	156	2.48	a	

181914D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET051128.BKG (112818-5 LONG BKG CAL)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	63.18	168	95	75	85	199	163	NET<CL
2	66.42	154	132	107	-74	244	201	NET<CL
3	74.80	1528	171	125	1457	226	175	
8	92.93	1558	177	130	1356	250	197	
10	99.54	224	120	95	190	171	139	
12	128.94	542	127	97	503	191	153	
13	139.80	147	87	69	-79	177	146	NET<CL
17	185.83	1763	155	107	1469	230	179	
18	198.30	187	84	66	-82	176	145	NET<CL
21	238.54	10717	238	97	10518	279	155	
27	295.11	3702	165	91	3624	207	138	
30	338.22	2062	135	82	1997	183	132	
31	351.83	6195	179	70	6009	214	121	
35	510.80	2628	168	109	891	311	251	
36	558.46	118	59	46	-68	137	114	NET<CL
37	583.12	3285	136	61	3197	165	99	
38	596.75	161	108	87	-28	182	150	NET<CL
40	609.28	4761	163	71	4574	226	149	
47	804.42	182	136	110	2	171	141	NET<CL
51	911.21	2154	116	58	2092	137	84	
54	969.06	1302	93	49	1277	131	90	
57	1120.34	1007	92	55	973	117	81	
65	1460.85	3352	129	47	2912	167	105	
72	1764.75	717	70	37	682	92	63	

181914D05.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-29 GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/06/2018 14:04:33
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 9.14e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.49e+002 g	Real Time . . . . . 60116 Sec
Collection Efficiency 1.0000	Spectrum File 181914D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)

Efficiency File: (D05)(Sh17).eff (Geo 17 Eff Cal)

*Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018

Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		3.88E+00 +- 7.16E-01	1.13E+00	5.63E-01	3.92E+13
Pa-234	Average:x		8.19E-02 +- 5.38E-02	. . . .	. . . .	3.95E+13
	94.67		1.00E-01 +- 8.61E-02	1.41E-01	6.90E-02	3.95E+13
	98.44		1.04E-01 +- 9.41E-02	1.54E-01	7.64E-02	3.95E+13
	946.00	N	3.08E-02 +- 1.01E-01	1.69E-01	8.22E-02	3.95E+13
U-235	143.76		2.23E-01 +- 1.42E-01	2.31E-01	1.15E-01	3.33E+10
Ra-223	Average:x		7.52E-01 +- 1.27E-01	. . . .	. . . .	2.87E+08
	154.18		6.32E-01 +- 3.40E-01	5.54E-01	2.74E-01	2.87E+08
	269.39		7.71E-01 +- 1.37E-01	2.10E-01	1.04E-01	2.87E+08
Ra-226	186.10		4.26E+00 +- 6.68E-01	1.04E+00	5.18E-01	1.40E+07
Pb-212	Average:x		2.89E+00 +- 7.59E-02	. . . .	. . . .	5.04E+04
	238.63		2.88E+00 +- 7.63E-02	8.58E-02	4.25E-02	5.04E+04
	300.09		3.97E+00 +- 7.32E-01	1.11E+00	5.46E-01	5.04E+04
Tl-208	Average:x		7.91E-01 +- 3.86E-02	. . . .	. . . .	5.04E+04
	277.36		6.77E-01 +- 1.91E-01	2.97E-01	1.46E-01	5.04E+04
	583.14		7.86E-01 +- 4.06E-02	4.94E-02	2.44E-02	5.04E+04
	860.47		9.47E-01 +- 1.61E-01	2.21E-01	1.07E-01	5.04E+04
Pb-214	Average:x		2.83E+00 +- 8.59E-02	. . . .	. . . .	1.40E+07
	295.21		2.44E+00 +- 1.39E-01	1.88E-01	9.30E-02	1.40E+07
	351.92		3.07E+00 +- 1.09E-01	1.25E-01	6.18E-02	1.40E+07
	241.98		I.D.	. . . .	. . . .	1.40E+07

181914D05.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NE T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Ac-228	Average:x		2.37E+00 +- 1.10E-01	. . . .	. . . .	5.04E+04
	338.40		3.10E+00 +- 2.85E-01	4.13E-01	2.04E-01	5.04E+04
	911.07		2.18E+00 +- 1.43E-01	1.78E-01	8.77E-02	5.04E+04
	964.60		2.80E+00 +- 5.64E-01	8.42E-01	4.13E-01	5.04E+04
	968.90		2.33E+00 +- 2.39E-01	3.34E-01	1.64E-01	5.04E+04
Bi-214	Average:x		2.23E+00 +- 9.01E-02	. . . .	. . . .	1.40E+07
	609.31		2.19E+00 +- 1.08E-01	1.44E-01	7.15E-02	1.40E+07
	768.36		1.97E+00 +- 3.93E-01	5.65E-01	2.75E-01	1.40E+07
	934.06		2.26E+00 +- 6.63E-01	9.99E-01	4.86E-01	1.40E+07
	1120.29		2.37E+00 +- 2.85E-01	4.03E-01	1.98E-01	1.40E+07
	1238.11		2.44E+00 +- 4.87E-01	7.00E-01	3.41E-01	1.40E+07
	1377.67		2.99E+00 +- 6.20E-01	8.56E-01	4.13E-01	1.40E+07
	1764.49		2.31E+00 +- 3.12E-01	4.33E-01	2.12E-01	1.40E+07
Bi-212	Average:x		1.23E+00 +- 6.02E-01	. . . .	. . . .	5.04E+04
	785.42		9.54E-01 +- 7.58E-01	1.23E+00	5.95E-01	5.04E+04
	1620.56		2.17E+00 +- 1.38E+00	2.22E+00	1.09E+00	5.04E+04
	727.17		1.23E+00 +- 1.43E+00	2.30E+00	1.15E+00	5.04E+04
Tl-210	Average:x		8.32E-02 +- 2.09E-02	. . . .	. . . .	1.40E+07
	795.00		8.10E-02 +- 2.09E-02	3.15E-02	1.54E-02	1.40E+07
	1410.00		9.75E-01 +- 4.26E-01	6.55E-01	3.15E-01	1.40E+07
K-40	1460.75		1.23E+01 +- 7.07E-01	8.99E-01	4.44E-01	1.12E+13
Ra-224	241.00		1.76E+00 +- 3.29E+00	7.43E-01	3.67E-01	5.04E+04
Pb-210	46.52	N	1.20E+01 +- 2.67E+01	4.42E+01	2.18E+01	1.79E+05
Tl-201	70.82	N	5.37E+02 +- 8.58E+02	1.41E+03	7.00E+02	7.35E+01
Ir-192	316.49	N	6.51E-03 +- 3.09E-02	5.15E-02	2.53E-02	1.78E+03
Be-7	477.56	N	-5.74E-02 +- 2.86E-01	4.80E-01	2.36E-01	1.28E+03
Sc-46	889.26	N	3.20E-03 +- 2.77E-02	4.65E-02	2.27E-02	2.01E+03
Na-22	1274.54	N	-8.32E-04 +- 2.37E-02	4.02E-02B	1.95E-02	2.28E+04

MEASURED TOTAL: 5.85E+02 +- 8.91E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	63.18	127.52	85	199	163	1378	0.44	Deleted
2	66.42	133.99	-74	244	201	2296	0.84	Deleted
3	74.80	150.74	1457	226	175	2894	0.99	Unknown
4	77.07	155.27	2645	168	109	2412	0.77	Unknown
5	84.25	169.61	440	147	116	2473	1.06	Unknown
6	87.16	175.43	1429	175	130	2885	1.09	Unknown
7	89.87	180.84	831	136	101	2061	0.80	Unknown
11	105.45	211.96	300	156	125	2653	1.21	Unknown
12	128.94	258.89	503	191	153	1898	0.81	Unknown

181914D05.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
13	139.80	280.59	-79	177	146	1174	0.45	Deleted
16	157.59	316.13	115	133	108	2168	0.91	Unknown
18	198.30	397.45	-82	176	145	1058	0.53	Deleted
19	209.21	419.23	844	127	93	1729	0.84	Unknown
20	229.49	459.76	41	76	61	928	0.52	Deleted
22	241.49	483.72	2386	176	121	2315	1.27	SPLIT
23	252.53	505.77	82	97	79	1246	0.78	Unknown
26	287.57	575.78	129	174	142	2494	1.96	Deleted
29	327.97	656.48	598	120	90	1512	1.31	Unknown
32	409.39	819.13	250	93	72	1029	1.09	Unknown
33	430.84	861.98	47	73	59	740	0.94	Deleted
34	462.89	926.00	614	111	81	1090	1.69	Unknown
35	510.80	1021.70	891	311	251	1603	2.37	Unknown
36	558.46	1116.91	-68	137	114	510	0.85	Deleted
38	596.75	1193.41	-28	182	150	1261	1.89	Deleted
39	598.87	1197.65	111	87	70	946	1.50	1619DEsc
41	665.28	1330.30	53	51	40	397	0.82	Unknown
42	727.33	1454.27	671	90	60	669	1.71	SPLIT
44	772.22	1543.94	61	48	37	342	0.89	Unknown
47	804.42	1608.25	2	171	141	1386	3.65	Deleted
48	835.49	1670.33	166	79	61	664	1.84	Unknown
49	839.36	1678.06	127	88	70	785	2.06	Unknown
55	1001.31	2001.57	61	45	35	288	1.20	Unknown
56	1094.45	2187.64	78	65	52	455	2.32	Unknown
58	1155.86	2310.31	92	60	47	409	1.92	Unknown
60	1280.90	2560.09	46	38	29	198	1.14	Unknown
62	1384.95	2767.96	56	43	33	211	1.77	Unknown
63	1401.21	2800.42	99	78	62	474	3.97	Unknown
66	1509.62	3017.00	87	45	34	214	1.96	Unknown
67	1588.37	3174.30	148	53	39	267	2.05	Unknown
69	1629.16	3255.80	56	104	85	581	6.96	Deleted
70	1661.53	3320.45	49	36	27	137	1.89	Unknown
71	1729.74	3456.72	133	46	33	186	2.27	Unknown
73	1847.27	3691.50	91	42	31	156	2.48	Unknown
75	727.33	1454.27	83	1374	60	669	1.71	1238SEsc

c:\SEEKER\BIN\181914d05.res Analysis Results Saved.

182032D07.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-29D GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/06/2018 14:04:44
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 9.14E+002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.61E+002 g	Real Time . . . . . 60205 Sec
Collection Efficiency 1.0000	Spc. File 182032D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.40 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	66.48	137.34	119	102	82	1494	0.65	a	
2	74.74	153.80	1204	154	113	2358	0.92	a	
3	77.02	158.35	1983	149	99	1965	0.88	b	
4	84.32	172.91	335	147	117	2343	1.22	a	
5	87.10	178.45	1071	157	117	2343	1.08	b	
6	89.73	183.71	703	152	117	2343	1.16	c	
7	92.81	189.83	1573	177	130	2677	1.37	d	
8	98.90	201.98	169	154	125	2469	1.32	a	
9	105.10	214.34	248	170	138	2804	1.49	a	
10	108.74	221.60	78	93	75	1246	0.63	b	
11	115.30	234.69	50	79	64	995	0.47	a	NET< CL
12	128.97	261.93	421	102	77	1301	0.74	a	
13	139.60	283.14	111	112	91	1660	0.84	a	
14	143.65	291.21	142	144	117	2324	1.11	b	
15	150.49	304.86	78	111	90	1634	0.77	a	NET< CL
16	159.50	322.82	37	76	62	933	0.48	a	NET< CL
17	163.52	330.83	47	123	100	1866	0.92	b	NET< CL
18	185.91	375.47	1602	158	112	2129	1.19	a	
19	198.50	400.58	169	76	59	857	0.51	a	
20	209.22	421.94	745	126	94	1621	0.98	a	
21	215.27	434.01	67	112	91	1542	1.00	a	NET< CL

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	238.59	480.50	8087	210	89	1453	1.06	a	
23	241.64	486.60	1922	172	121	2180	1.42	b	
24	258.65	520.51	79	86	70	977	0.78	a	
25	270.17	543.49	649	129	97	1496	1.33	a	
26	277.53	558.16	253	100	78	1122	0.91	a	
27	295.19	593.36	2989	149	83	1188	1.13	a	
28	300.06	603.08	466	90	65	848	0.90	b	
29	327.94	658.66	405	117	90	1288	1.29	a	
30	338.39	679.50	1611	136	90	1296	1.23	a	
31	351.94	706.53	5148	172	77	1024	1.19	a	
32	386.97	776.38	67	117	95	1405	1.74	a	NET< CL
33	409.56	821.40	193	78	60	752	1.01	a	
34	463.13	928.21	451	82	58	665	1.17	a	
35	511.02	1023.72	2502	163	106	1386	2.56	a	Wide Pk
36	558.64	1118.65	238	65	47	461	1.03	a	
37	562.98	1127.32	128	67	52	537	1.16	b	
38	570.20	1141.72	122	75	59	638	1.31	a	
39	572.73	1146.76	53	66	53	558	1.09	b	NET< CL
40	583.38	1167.98	2570	127	63	689	1.47	a	
41	597.37	1195.89	119	120	97	1211	2.52	a	Wide Pk
42	609.52	1220.10	3993	151	67	788	1.49	a	
43	618.46	1237.94	56	45	35	307	0.70	a	
44	633.70	1268.33	35	48	39	339	0.77	a	NET< CL
45	665.82	1332.37	83	63	49	477	1.18	a	
46	692.81	1386.19	44	43	34	282	0.74	a	
47	727.47	1455.29	541	84	57	539	1.61	a	
48	755.54	1511.26	73	67	53	526	1.58	a	
49	768.26	1536.62	345	77	55	539	1.85	a	
50	772.71	1545.49	125	71	55	539	1.77	b	
51	785.85	1571.70	86	53	41	368	1.07	a	
52	795.01	1589.97	327	69	49	435	1.66	a	
53	803.21	1606.31	154	56	41	346	1.39	a	
54	805.96	1611.80	94	49	37	303	1.10	b	
55	836.00	1671.69	30	44	35	309	0.80	a	NET< CL
56	860.68	1720.90	248	64	46	404	1.50	a	
57	888.08	1775.54	26	35	28	189	0.83	a	NET< CL
58	911.25	1821.73	1647	98	45	371	1.72	a	HiResid
59	933.94	1866.98	129	56	42	347	1.50	a	
60	964.92	1928.75	304	70	50	426	1.95	a	
61	969.08	1937.05	1075	87	47	391	1.87	b	
62	1000.72	2000.12	52	50	40	304	1.52	a	
63	1120.38	2238.72	763	76	43	349	1.86	a	
64	1155.25	2308.25	82	52	40	308	1.81	a	
65	1238.05	2473.35	285	67	47	394	2.06	a	
66	1281.09	2559.17	86	75	60	462	3.69	a	Wide Pk
67	1377.47	2751.34	192	50	34	219	2.05	a	

182032D07.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
68	1408.09	2812.38	64	47	36	235	2.13 a	
69	1460.50	2916.89	2362	107	37	227	2.47 a	HiResid
70	1509.29	3014.18	74	35	25	129	1.55 a	
71	1588.03	3171.18	141	45	31	176	2.14 a	
72	1591.59	3178.28	110	48	35	203	2.54 b	
73	1630.84	3256.53	35	30	23	110	1.42 a	
74	1661.10	3316.86	41	30	22	98	1.59 a	
75	1729.01	3452.27	127	37	25	112	1.99 a	
76	1763.85	3521.74	663	64	31	158	2.47 a	
77	1847.16	3687.85	89	33	22	93	1.80 a	

182032D07.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET071128.BKG (112818-7 LONG BKG CAL)

Bkg.File Detector #: 7

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	66.48	119	102	82	-66	189	156	NET<CL
2	74.74	1204	154	113	1064	206	161	
3	77.02	1983	149	99	1854	233	178	
4	84.32	335	147	117	262	235	191	
7	92.81	1573	177	130	1215	247	195	
13	139.60	111	112	91	-22	193	159	NET<CL
18	185.91	1602	158	112	1338	214	166	
19	198.50	169	76	59	-107	176	146	NET<CL
22	238.59	8087	210	89	7807	254	150	
27	295.19	2989	149	83	2887	192	131	
30	338.39	1611	136	90	1573	165	119	
31	351.94	5148	172	78	4970	208	125	
35	511.02	2502	163	106	823	299	241	
36	558.64	238	65	47	21	132	109	NET<CL
38	570.20	122	75	59	13	135	111	NET<CL
40	583.38	2570	127	63	2416	182	126	
41	597.37	119	120	97	51	182	149	NET<CL
42	609.52	3993	151	67	3842	201	130	
43	618.46	56	45	35	7	131	107	NET<CL
46	692.81	44	43	34	37	80	65	NET<CL
47	727.47	541	84	57	484	122	94	
53	803.21	154	56	41	45	107	87	NET<CL
58	911.25	1647	98	45	1562	137	92	
69	1460.50	2362	107	37	2095	142	89	
76	1763.85	663	64	31	620	82	54	

182032D07.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 1810627-29D GS181103-2

Sampling Start: 10/29/2018 12:00:00	Counting Start: 12/06/2018 14:04:44
Sampling Stop: 10/29/2018 12:00:00	Decay Time. . . . . 9.14e+002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.61e+002 g	Real Time . . . . . 60205 Sec
Collection Efficiency 1.0000	Spectrum File 182032D07.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 7 (Detector 7)

Efficiency File: (D07)(Sh17).eff (DET 7 GEO 17 Eff Cal)

*Eff=10^[-1.18E+02 +1.52E+02*L +-6.65E+01*L^2 +9.63E+00*L^3] 09/25/2018

Eff.=10^[9.78E-01 +-1.35E+00*L +1.03E-01*L^2 +-1.37E-03*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
U-238	92.60		4.28E+00 +- 8.70E-01	1.38E+00	6.86E-01	3.92E+13
Pa-234	Average:x		7.87E-02 +- 1.06E-01	. . . .	. . . .	3.95E+13
	99.70		5.94E-01 +- 5.42E-01	8.88E-01	4.39E-01	3.95E+13
	946.00	N	5.84E-02 +- 1.08E-01	1.79E-01	8.67E-02	3.95E+13
U-235	143.76		1.61E-01 +- 1.63E-01	2.68E-01	1.33E-01	3.33E+10
Ra-226	186.10		4.98E+00 +- 7.98E-01	1.24E+00	6.17E-01	1.40E+07
Pb-212	Average:x		2.72E+00 +- 8.73E-02	. . . .	. . . .	5.04E+04
	238.63		2.74E+00 +- 8.91E-02	1.06E-01	5.26E-02	5.04E+04
	300.09		2.27E+00 +- 4.39E-01	6.46E-01	3.17E-01	5.04E+04
Ra-223	269.39		7.36E-01 +- 1.46E-01	2.24E-01	1.10E-01	2.87E+08
Tl-208	Average:x		7.72E-01 +- 5.68E-02	. . . .	. . . .	5.04E+04
	277.36		6.11E-01 +- 2.41E-01	3.82E-01	1.88E-01	5.04E+04
	583.14		7.81E-01 +- 5.87E-02	8.21E-02	4.06E-02	5.04E+04
	860.47		7.72E-01 +- 5.80E-01	7.72E-01	3.82E-01	5.04E+04
Pb-214	Average:x		2.47E+00 +- 8.75E-02	. . . .	. . . .	1.40E+07
	295.21		2.40E+00 +- 1.59E-01	2.20E-01	1.09E-01	1.40E+07
	351.92		2.51E+00 +- 1.05E-01	1.28E-01	6.33E-02	1.40E+07
	241.98		I.D. . . .	. . . .	. . . .	1.40E+07
Ac-228	Average:x		2.32E+00 +- 1.17E-01	. . . .	. . . .	5.04E+04
	338.40		2.32E+00 +- 2.43E-01	3.55E-01	1.76E-01	5.04E+04
	911.07		2.13E+00 +- 1.86E-01	2.54E-01	1.25E-01	5.04E+04

182032D07.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
	964.60		2.31E+00 +- 5.35E-01	7.85E-01	3.82E-01	5.04E+04
	968.90		2.55E+00 +- 2.07E-01	2.30E-01	1.12E-01	5.04E+04
Bi-212	Average:x		1.38E+00 +- 3.23E-01	. . . .	. . . .	5.04E+04
	727.17		1.36E+00 +- 3.44E-01	5.35E-01	2.64E-01	5.04E+04
	785.42		1.52E+00 +- 9.41E-01	1.50E+00	7.26E-01	5.04E+04
Bi-214	Average:x		2.41E+00 +- 1.55E-01	. . . .	. . . .	1.40E+07
	768.36		2.46E+00 +- 5.48E-01	8.09E-01	3.95E-01	1.40E+07
	934.06		1.70E+00 +- 7.39E-01	1.15E+00	5.56E-01	1.40E+07
	1120.29		2.36E+00 +- 2.34E-01	2.72E-01	1.32E-01	1.40E+07
	1238.11		2.40E+00 +- 5.61E-01	8.18E-01	3.97E-01	1.40E+07
	1377.67		2.62E+00 +- 6.85E-01	9.76E-01	4.70E-01	1.40E+07
	1764.49		2.59E+00 +- 3.44E-01	4.62E-01	2.25E-01	1.40E+07
	609.31		2.41E+00 +- 4.88E-01	7.17E-01	3.58E-01	1.40E+07
Tl-210	Average:x		1.16E-01 +- 2.43E-02	. . . .	. . . .	1.40E+07
	795.00		1.15E-01 +- 2.43E-02	3.51E-02	1.71E-02	1.40E+07
	860.00		2.06E-02 +- 2.08E+00	5.01E-01	2.43E-01	1.40E+07
	1410.00		6.94E-01 +- 5.12E-01	8.21E-01	3.96E-01	1.40E+07
K-40	1460.75		1.09E+01 +- 7.41E-01	9.46E-01	4.66E-01	1.12E+13
Ra-224	241.00		2.67E+00 +- 4.07E+00	9.56E-01	4.73E-01	5.04E+04
Pb-210	46.52	N	-2.12E+01 +- 8.72E+01	1.45E+02	7.19E+01	1.79E+05
Tl-201	70.82	N	-2.44E+02 +- 1.30E+03	2.17E+03	1.07E+03	7.35E+01
Ir-192	316.49	N	-5.70E-03 +- 2.63E-02	4.42E-02	2.17E-02	1.78E+03
Be-7	477.56	N	1.49E-02 +- 2.90E-01	4.87E-01	2.38E-01	1.28E+03
Sc-46	889.26	N	2.32E-02 +- 3.00E-02	4.95E-02	2.40E-02	2.01E+03
Na-22	1274.54	N	2.39E-02 +- 3.47E-02	5.61E-02R	2.73E-02	2.28E+04

MEASURED TOTAL: 3.61E+01 +- 8.10E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	66.48	137.34	-66	189	156	1494	0.65	Deleted
2	74.74	153.80	1064	206	161	2358	0.92	Unknown
3	77.02	158.35	1854	233	178	1965	0.88	Unknown
4	84.32	172.91	262	235	191	2343	1.22	Unknown
5	87.10	178.45	1071	157	117	2343	1.08	Unknown
6	89.73	183.71	703	152	117	2343	1.16	Unknown
9	105.10	214.34	248	170	138	2804	1.49	Unknown
10	108.74	221.60	78	93	75	1246	0.63	Unknown
11	115.30	234.69	50	79	64	996	0.47	Deleted
12	128.97	261.93	421	102	77	1301	0.74	Unknown
13	139.60	283.14	-22	193	159	1660	0.84	Deleted
15	150.49	304.86	78	111	90	1634	0.77	Deleted

182032D07.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
16	159.50	322.82	37	76	62	933	0.48	Deleted
17	163.52	330.83	47	123	100	1866	0.92	Deleted
19	198.50	400.58	-107	176	146	857	0.51	Deleted
20	209.22	421.94	745	126	94	1621	0.98	Unknown
21	215.27	434.01	67	112	91	1542	1.00	Deleted
23	241.64	486.60	1922	172	121	2180	1.42	SPLIT
24	258.65	520.51	79	86	70	977	0.78	Unknown
29	327.94	658.66	405	117	90	1288	1.29	Unknown
32	386.97	776.38	67	117	95	1405	1.74	Deleted
33	409.56	821.40	193	78	60	752	1.01	Unknown
34	463.13	928.21	451	82	58	665	1.17	Unknown
35	511.02	1023.72	823	299	241	1386	2.56	Unknown
36	558.64	1118.65	21	132	109	461	1.03	Deleted
37	562.98	1127.32	128	67	52	537	1.16	Unknown
38	570.20	1141.72	13	135	111	638	1.31	Deleted
39	572.73	1146.76	53	66	53	558	1.09	Deleted
41	597.37	1195.89	51	182	149	1211	2.52	Deleted
42	609.52	1220.10	3842	201	130	788	1.49	SPLIT
43	618.46	1237.94	7	131	107	307	0.70	Deleted
44	633.70	1268.33	35	48	39	339	0.77	Deleted
45	665.82	1332.37	83	63	49	477	1.18	Unknown
46	692.81	1386.19	37	80	65	282	0.74	Deleted
48	755.54	1511.26	73	67	53	526	1.58	Unknown
50	772.71	1545.49	125	71	55	539	1.77	Unknown
53	803.21	1606.31	45	107	87	346	1.39	Deleted
54	805.96	1611.80	94	49	37	303	1.10	Unknown
55	836.00	1671.69	30	44	35	309	0.80	Deleted
56	860.68	1720.90	248	64	46	404	1.50	SPLIT
57	888.08	1775.54	26	35	28	189	0.83	Deleted
62	1000.72	2000.12	52	50	40	304	1.52	Unknown
64	1155.25	2308.25	82	52	40	308	1.81	Unknown
66	1281.09	2559.17	86	75	60	462	3.69	Unknown
70	1509.29	3014.18	74	35	25	129	1.55	Unknown
71	1588.03	3171.18	141	45	31	176	2.14	Unknown
72	1591.59	3178.28	110	48	35	203	2.54	Unknown
73	1630.84	3256.53	35	30	23	110	1.42	Unknown
74	1661.10	3316.86	41	30	22	98	1.59	Unknown
75	1729.01	3452.27	127	37	25	112	1.99	Unknown
77	1847.16	3687.85	89	33	22	93	1.80	Unknown
81	609.52	1220.10	52	1587	130	788	1.49	1120SEsc

c:\SEEKER\BIN\182032d07.res Analysis Results Saved.

182694D04.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: GS181103-1MB GS181103-1

Sampling Start: 12/05/2018 14:00:00	Counting Start: 12/05/2018 14:08:53
Sampling Stop: 12/05/2018 14:00:00	Decay Time. . . . . 1.48E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 60095 Sec
Collection Efficiency 1.0000	Spc. File 182694D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.45 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/05/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	53.67	110.00	108	89	71	858	1.17	a	
2	63.04	128.71	159	84	66	807	1.02	a	HiResid
3	66.36	135.33	54	51	40	404	0.52	b	HiResid
4	70.02	142.64	56	101	82	1076	1.30	c	NET< CL HiResid
5	74.82	152.22	70	92	74	942	1.11	d	NET< CL HiResid
6	84.55	171.64	60	76	61	690	0.97	a	NET< CL
7	92.48	187.47	604	95	67	763	1.21	a	
8	139.83	281.97	79	54	42	393	0.70	a	
9	143.82	289.92	72	71	57	590	0.91	b	
10	163.42	329.04	57	80	64	766	1.35	a	NET< CL
11	185.67	373.44	325	73	52	571	1.00	a	
12	198.37	398.80	94	66	52	560	0.99	a	
13	238.49	478.86	139	77	60	674	1.28	a	
14	266.90	535.55	39	42	33	266	0.66	a	
15	294.88	591.40	68	61	49	466	1.07	a	
16	351.78	704.95	142	58	43	370	1.20	a	
17	397.63	796.46	31	39	31	219	0.74	a	NET< CL
18	511.06	1022.84	1205	107	67	612	2.82	a	Wide Pk
19	558.42	1117.34	104	53	40	309	1.53	a	

182694D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
20	564.64	1129.76	19	41	33	240	1.19 b	NET< CL
21	569.77	1139.99	54	54	43	343	1.59 c	
22	583.08	1166.55	61	41	31	211	1.19 a	
23	609.17	1218.63	83	48	36	285	1.15 a	
24	693.68	1387.28	70	60	47	377	1.99 a	
25	803.16	1605.78	129	41	28	170	1.42 a	
26	911.17	1821.33	69	46	35	209	2.37 a	
27	1460.71	2918.05	164	41	26	108	2.56 a	
28	1764.79	3524.90	57	26	17	54	2.17 a	

182694D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET041128.BKG (112818-4 LONG BKG CAL)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	53.67	108	89	71	-24	187	154	NET<CL
2	63.04	159	84	66	-23	193	159	NET<CL
3	66.36	54	51	40	-11	118	97	NET<CL
6	84.55	60	76	61	-7	155	128	NET<CL
7	92.48	604	95	67	36	202	166	NET<CL
8	139.83	79	54	42	-73	168	139	NET<CL
9	143.82	72	71	57	11	127	104	NET<CL
11	185.67	325	73	52	-85	169	139	NET<CL
12	198.37	94	66	52	-58	177	146	NET<CL
13	238.49	139	77	60	30	126	103	NET<CL
15	294.88	68	61	49	-12	138	114	NET<CL
16	351.78	142	58	43	15	141	115	NET<CL
18	511.06	1205	107	67	-101	254	210	NET<CL
19	558.42	104	53	40	-58	126	104	NET<CL
21	569.77	54	54	43	14	91	75	NET<CL
22	583.08	61	41	31	14	107	88	NET<CL
23	609.17	83	48	36	-34	139	114	NET<CL
24	693.68	70	60	47	3	127	105	NET<CL
25	803.16	129	41	28	19	95	78	NET<CL
27	1460.71	164	41	26	24	83	68	NET<CL

182694D04.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: GS181103-1MB GS181103-1

Sampling Start: 12/05/2018 14:00:00	Counting Start: 12/05/2018 14:08:53
Sampling Stop: 12/05/2018 14:00:00	Decay Time. . . . . 1.48e-001 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 60095 Sec
Collection Efficiency 1.0000	Spectrum File 182694D04.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-7.41E+01 +9.43E+01*L +-4.05E+01*L^2 +5.76E+00*L^3] 09/25/2018

Eff.=10^[-8.67E+00 +8.41E+00*L +-3.13E+00*L^2 +3.49E-01*L^3] Above 300.00 keV

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
U-238	92.60	N	6.03E-02	+- 3.42E-01	5.66E-01	2.81E-01	3.92E+13
Ra-226	186.10	N	-1.93E-01	+- 3.82E-01	6.39E-01	3.16E-01	1.40E+07
Pb-212	238.63	N	6.70E-03	+- 2.80E-02	4.64E-02	2.29E-02	5.04E+04
Pb-214	351.92	N	5.37E-03	+- 5.11E-02	8.50E-02	4.20E-02	1.40E+07
Ac-228	911.07		7.16E-02	+- 4.73E-02	7.53E-02	3.62E-02	5.04E+04
K-40	1460.75	N	1.06E-01	+- 3.64E-01	6.07E-01	2.98E-01	1.12E+13
Bi-214	Average:x		5.59E-02	+- 2.84E-02	. . . .	. . . .	1.40E+07
	1764.49		2.08E-01	+- 9.43E-02	1.36E-01	6.33E-02	1.40E+07
	609.31	N	4.08E-02	+- 2.97E-02	4.81E-02	2.34E-02	1.40E+07
Pb-210	46.52	N	7.92E-01	+- 3.35E+00	5.59E+00	2.74E+00	1.79E+05
Tl-201	70.82	N	6.14E-02	+- 3.28E-02	5.25E-02	2.57E-02	7.35E+01
U-235	143.76	N	5.22E-02	+- 5.24E-02	8.58E-02	4.20E-02	3.33E+10
Ra-224	241.00	N	-4.70E-02	+- 1.88E-01	3.18E-01	1.56E-01	5.04E+04
Ra-223	269.39	N	1.92E-02	+- 7.15E-02	1.18E-01r	5.81E-02	2.87E+08
Ir-192	316.49	N	1.39E-03	+- 8.79E-03	1.48E-02	7.19E-03	1.78E+03
Be-7	477.56	N	-6.32E-02	+- 8.39E-02	1.46E-01	7.10E-02	1.28E+03
Tl-208	583.14	N	1.06E-02	+- 1.17E-02	1.91E-02	9.23E-03	5.04E+04
Bi-212	727.17	N	1.51E-02	+- 9.19E-02	1.56E-01	7.50E-02	5.04E+04
Tl-210	795.00	N	-7.92E-04	+- 1.12E-02	1.92E-02	9.23E-03	1.40E+07
Sc-46	889.26	N	2.65E-03	+- 1.21E-02	2.05E-02	9.83E-03	2.01E+03
Pa-234	946.00	N	6.09E-03	+- 6.32E-02	1.08E-01	5.17E-02	3.95E+13

182694D04.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Na-22	1274.54	N	8.27E-04	+- 1.45E-02	2.48E-02	1.18E-02	2.28E+04

MEASURED TOTAL: 1.27E+00 +- 4.57E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	53.67	110.00	-24	187	154	858	1.17	Deleted
2	63.04	128.71	-23	193	159	807	1.02	Deleted
3	66.36	135.33	-11	118	97	404	0.52	Deleted
4	70.02	142.64	56	101	82	1076	1.30	Deleted
5	74.82	152.22	70	92	74	942	1.11	Deleted
6	84.55	171.64	-7	155	128	690	0.97	Deleted
8	139.83	281.97	-73	168	139	393	0.70	Deleted
9	143.82	289.92	11	127	104	590	0.91	Deleted
10	163.42	329.04	57	80	64	766	1.35	Deleted
12	198.37	398.80	-58	177	146	560	0.99	Deleted
14	266.90	535.55	39	42	33	266	0.66	Unknown
15	294.88	591.40	-12	138	114	466	1.07	Deleted
17	397.63	796.46	31	39	31	219	0.74	Deleted
18	511.06	1022.84	-101	254	210	612	2.82	Deleted
19	558.42	1117.34	-58	126	104	309	1.53	Deleted
20	564.64	1129.76	19	41	33	240	1.19	Deleted
21	569.77	1139.99	14	91	75	343	1.59	Deleted
22	583.08	1166.55	14	107	88	211	1.19	Deleted
23	609.17	1218.63	-34	139	114	285	1.15	Deleted
24	693.68	1387.28	3	127	105	377	1.99	Deleted
25	803.16	1605.78	19	95	78	170	1.42	Deleted

c:\SEEKER\BIN\182694d04.res Analysis Results Saved.

181752D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: GS181103-1LCS GS181103-1

Sampling Start: 11/26/2018 14:00:00	Counting Start: 11/26/2018 14:33:18
Sampling Stop: 11/26/2018 14:00:00	Decay Time. . . . . 5.55E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1932 Sec
Collection Efficiency 1.0000	Spc. File 181752D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.15 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/26/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	43.14	90.30	275	189	153	3480	1.50	a	Wide Pk
2	49.28	102.54	1049	285	228	8230	1.29	a	
3	57.74	119.40	2852	468	375	15552	2.23	a	Wide Pk
4	59.45	122.82	58783	516	144	4175	0.86	b	
5	77.96	159.72	59	83	67	1113	0.44	a	NET< CL
6	88.01	179.76	13118	255	92	1713	0.87	a	
7	122.00	247.55	1482	119	75	1138	0.87	a	
8	136.41	276.27	206	93	73	1061	0.74	a	
9	228.57	460.03	78	92	75	1124	0.81	a	
10	418.67	839.09	81	75	60	733	0.79	a	
11	478.67	958.72	27	87	71	989	1.15	a	NET< CL
12	511.84	1024.87	60	105	85	1134	1.77	a	NET< CL
13	536.96	1074.96	49	62	50	524	0.97	a	NET< CL
14	661.99	1324.26	19615	288	56	578	1.39	a	
15	857.88	1714.86	86	103	84	983	2.11	a	
16	1104.72	2207.03	64	70	56	618	1.55	a	
17	1173.47	2344.13	14512	247	45	359	1.81	a	
18	1332.59	2661.39	13033	230	21	83	1.92	a	HiResid

181752D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET091114.BKG (111418-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
5	77.96	59	83	67	51	83	67	NET<CL
6	88.01	13118	255	92	13117	255	92	
9	228.57	78	92	75	76	93	75	
12	511.84	60	105	85	18	105	86	NET<CL

181752D09.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: GS181103-1LCS GS181103-1

Sampling Start: 11/26/2018 14:00:00	Counting Start: 11/26/2018 14:33:18
Sampling Stop: 11/26/2018 14:00:00	Decay Time. . . . . 5.55e-001 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1932 Sec
Collection Efficiency 1.0000	Spectrum File 181752D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.47E+01 +1.58E+01*L +-5.94E+00*L^2 +6.70E-01*L^3] 11/06/2018

Eff.=10^[-4.97E+00 +4.67E+00*L +-1.91E+00*L^2 +2.19E-01*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.71E+02 +- 4.13E+00	2.33E+00	1.15E+00	3.79E+06
Cd-109	88.02		7.87E+02 +- 1.53E+01	1.12E+01	5.53E+00	1.11E+04
Co-57	122.07		3.85E+00 +- 3.11E-01	3.98E-01	1.95E-01	6.50E+03
Cs-137	661.62		1.81E+02 +- 2.66E+00	1.06E+00	5.16E-01	2.64E+05
Co-60	Average:x		1.87E+02 +- 2.28E+00	. . . .	. . . .	4.62E+04
	1173.21		1.87E+02 +- 3.18E+00	1.20E+00	5.81E-01	4.62E+04
	1332.48		1.86E+02 +- 3.29E+00	6.45E-01	3.03E-01	4.62E+04
Ce-139	165.85		MDA	5.35E-01	2.63E-01	3.30E+03
Hg-203	279.18		MDA	8.46E-01	4.16E-01	1.12E+03
Sn-113	391.68		MDA	1.25E+00	6.14E-01	2.76E+03
Y-88	898.02		MDA	1.44E+00	7.06E-01	2.56E+03

MEASURED TOTAL: 1.63E+03 +- 2.47E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	43.14	90.30	275	189	153	3480	1.50	Unknown

181752D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	49.28	102.54	1049	285	228	8230	1.29	Unknown
3	57.74	119.40	2852	468	375	15552	2.23	Unknown
5	77.96	159.72	51	83	67	1113	0.44	Deleted
8	136.41	276.27	206	93	73	1061	0.74	Unknown
9	228.57	460.03	76	93	75	1124	0.81	Unknown
10	418.67	839.09	81	75	60	733	0.79	Unknown
11	478.67	958.72	27	87	71	989	1.15	Deleted
12	511.84	1024.87	18	105	86	1134	1.77	Deleted
13	536.96	1074.96	49	62	50	524	0.97	Deleted
15	857.88	1714.86	86	103	84	983	2.11	Unknown
16	1104.72	2207.03	64	70	56	618	1.55	Unknown

c:\SEEKER\BIN\181752d09.res Analysis Results Saved.

181830D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: GS181103-2MB GS181103-2

Sampling Start:	12/06/2018 14:00:00	Counting Start:	12/06/2018 14:04:56
Sampling Stop:	12/06/2018 14:00:00	Decay Time.	8.22E-002 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	60000 Sec
Sample Size	2.15E+002 g	Real Time	60202 Sec
Collection Efficiency	1.0000	Spc. File	.181830D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.21 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 12/06/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	44.24	92.67	44	60	48	507	0.57 a	NET< CL
2	46.23	96.64	295	68	48	507	0.62 b	
3	63.08	130.25	490	82	57	653	0.85 a	
4	66.18	136.44	176	74	57	653	0.80 b	
5	74.72	153.47	221	66	48	515	0.74 a	
6	76.98	157.98	186	74	57	644	0.82 b	
7	84.20	172.39	170	85	67	758	1.11 a	
8	87.21	178.39	73	56	44	433	0.69 b	
9	90.07	184.10	64	74	59	650	1.03 c	
10	92.46	188.87	755	98	67	758	1.13 d	
11	139.52	282.74	219	144	116	1415	2.50 a	Wide Pk
12	143.59	290.86	78	61	48	472	0.83 b	
13	154.10	311.82	40	68	55	564	0.91 a	NET< CL
14	158.92	321.45	40	43	34	282	0.48 b	
15	185.67	374.82	290	67	48	462	0.87 a	
16	198.20	399.80	220	76	58	574	1.19 a	
17	205.73	414.83	40	69	56	572	0.91 a	NET< CL
18	238.51	480.22	275	73	53	528	1.02 a	
19	295.16	593.24	93	68	53	483	1.14 a	
20	338.33	679.36	43	43	34	258	0.61 a	
21	351.90	706.42	173	66	50	420	1.18 a	

181830D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	374.86	752.22	47	109	89	800	2.57	a	NET< CL Wide Pk
23	511.06	1023.93	1471	113	69	606	2.48	a	Wide Pk
24	514.06	1029.93	47	48	38	283	1.11	b	
25	558.57	1118.71	173	50	35	246	1.15	a	
26	569.97	1141.45	56	37	28	179	0.86	a	
27	583.57	1168.59	79	50	38	272	1.30	a	
28	609.46	1220.24	97	48	36	272	0.90	a	
29	651.05	1303.21	34	41	33	211	1.09	a	
30	669.95	1340.91	29	40	32	197	1.12	a	NET< CL
31	803.15	1606.63	146	49	35	213	1.54	a	
32	911.10	1821.98	75	40	29	168	1.39	a	
33	962.35	1924.23	49	28	20	97	1.05	a	
34	969.60	1938.68	49	33	25	129	1.27	b	
35	1120.35	2239.43	37	31	24	117	1.24	a	
36	1460.22	2917.43	175	38	22	87	2.16	a	
37	1763.69	3522.83	44	30	22	74	2.77	a	

181830D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET091128.BKG (112818-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	46.23	295	68	48	-37	198	163	NET<CL
3	63.08	490	82	57	152	187	152	NET<CL
4	66.18	176	74	57	90	230	189	NET<CL
5	74.72	221	66	48	26	151	124	NET<CL
6	76.98	186	74	57	-21	173	143	NET<CL
7	84.20	170	85	67	88	198	162	NET<CL
8	87.21	73	56	44	-14	152	125	NET<CL
10	92.46	755	98	67	144	193	157	NET<CL
11	139.52	219	144	116	99	193	158	NET<CL
12	143.59	78	61	48	-18	126	104	NET<CL
15	185.67	290	67	48	-14	154	127	NET<CL
16	198.20	220	76	58	14	152	125	NET<CL
18	238.51	275	73	53	12	154	126	NET<CL
19	295.16	93	68	53	14	131	108	NET<CL
20	338.33	43	43	34	7	87	71	NET<CL
21	351.90	173	66	50	1	134	110	NET<CL
23	511.06	1471	113	69	-84	266	219	NET<CL
25	558.57	173	50	35	-17	114	94	NET<CL
26	569.97	56	37	28	-21	132	109	NET<CL
27	583.57	79	50	38	-25	117	96	NET<CL
28	609.46	97	48	36	-8	112	93	NET<CL
31	803.15	146	49	35	62	95	77	NET<CL
32	911.10	75	40	29	20	69	56	NET<CL
33	962.35	49	28	20	22	75	61	NET<CL
36	1460.22	176	38	22	21	84	69	NET<CL
37	1763.69	44	30	22	4	70	58	NET<CL

181830D09.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: GS181103-2MB GS181103-2

Sampling Start: 12/06/2018 14:00:00	Counting Start: 12/06/2018 14:04:56
Sampling Stop: 12/06/2018 14:00:00	Decay Time. . . . . 8.22e-002 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 60202 Sec
Collection Efficiency 1.0000	Spectrum File 181830D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)
Efficiency File: (D09)(Sh26).EFF (Geo 26 Eff Cal)
Eff.= Spline Fit 11/01/2018

Library File: TIDEWATER_GREATKILLS. (Tidewater Great Kills)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Pb-210	46.52	N	-1.25E-01	+- 6.73E-01	1.12E+00	5.55E-01	1.79E+05
U-238	92.60	N	3.25E-01	+- 4.33E-01	7.13E-01	3.54E-01	3.92E+13
Ra-226	186.10	N	-5.18E-02	+- 5.64E-01	9.38E-01	4.64E-01	1.40E+07
Pb-212	238.63	N	4.00E-03	+- 4.99E-02	8.29E-02	4.10E-02	5.04E+04
Pb-214	351.92	N	6.18E-04	+- 7.01E-02	1.17E-01	5.77E-02	1.40E+07
Bi-214	Average:x		4.12E-02	+- 6.36E-02	. . . .	. . . .	1.40E+07
	609.31	N	-5.74E-03	+- 7.93E-02	1.33E-01	6.53E-02	1.40E+07
	1120.29		1.26E-01	+- 1.06E-01	1.71E-01	8.07E-02	1.40E+07
Ac-228	Average:x		8.79E-02	+- 6.70E-02	. . . .	. . . .	5.04E+04
	911.07	N	3.07E-02	+- 1.04E-01	1.74E-01	8.51E-02	5.04E+04
	968.90		1.28E-01	+- 8.75E-02	1.38E-01	6.55E-02	5.04E+04
K-40	1460.75	N	1.38E-01	+- 5.50E-01	9.18E-01	4.50E-01	1.12E+13
Tl-201	70.82	N	1.19E-03	+- 2.10E-02	3.53E-02	1.73E-02	7.35E+01
U-235	143.76	N	1.48E-01	+- 1.19E-01	1.89E-01r	9.29E-02	3.33E+10
Ra-224	241.00	N	-1.55E-01	+- 2.45E-01	4.20E-01	2.05E-01	5.04E+04
Ra-223	269.39	N	-5.04E-02	+- 1.53E-01	2.55E-01	1.26E-01	2.87E+08
Ir-192	316.49	N	-1.21E-03	+- 1.25E-02	2.11E-02	1.03E-02	1.78E+03
Be-7	477.56	N	-8.88E-02	+- 1.07E-01	1.89E-01	9.11E-02	1.28E+03
Tl-208	583.14	N	3.33E-02	+- 1.78E-02	2.79E-02	1.35E-02	5.04E+04
Bi-212	727.17	N	-1.17E-02	+- 1.43E-01	2.45E-01	1.18E-01	5.04E+04
Tl-210	795.00	N	-9.30E-03	+- 1.71E-02	2.98E-02	1.44E-02	1.40E+07
Sc-46	889.26	N	2.72E-03	+- 1.66E-02	2.83E-02	1.36E-02	2.01E+03

181830D09.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Pa-234	946.00	N	-3.37E-02 +- 8.03E-02	1.41E-01	6.75E-02	3.95E+13
Na-22	1274.54	N	7.96E-03 +- 1.80E-02	3.03E-02	1.44E-02	2.28E+04

MEASURED TOTAL: 7.90E-01 +- 1.43E+00 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	44.24	92.67	44	60	48	507	0.57	Deleted
3	63.08	130.25	152	187	152	653	0.85	Deleted
4	66.18	136.44	90	230	189	653	0.80	Deleted
5	74.72	153.47	26	151	124	515	0.74	Deleted
6	76.98	157.98	-21	173	143	644	0.82	Deleted
7	84.20	172.39	88	198	162	758	1.11	Deleted
8	87.21	178.39	-14	152	125	433	0.69	Deleted
9	90.07	184.10	64	74	59	650	1.03	Unknown
11	139.52	282.74	99	193	158	1415	2.50	Deleted
12	143.59	290.86	-18	126	104	472	0.83	Deleted
13	154.10	311.82	40	68	55	564	0.91	Deleted
14	158.92	321.45	40	43	34	282	0.48	Unknown
16	198.20	399.80	14	152	125	574	1.19	Deleted
17	205.73	414.83	40	69	56	572	0.91	Deleted
19	295.16	593.24	14	131	108	483	1.14	Deleted
20	338.33	679.36	7	87	71	258	0.61	Deleted
22	374.86	752.22	47	109	89	800	2.57	Deleted
23	511.06	1023.93	-84	266	219	606	2.48	Deleted
24	514.06	1029.93	47	48	38	283	1.11	Unknown
25	558.57	1118.71	-17	114	94	246	1.15	Deleted
26	569.97	1141.45	-21	132	109	179	0.86	Deleted
27	583.57	1168.59	-25	117	96	272	1.30	Deleted
29	651.05	1303.21	34	41	33	211	1.09	Unknown
30	669.95	1340.91	29	40	32	197	1.12	Deleted
31	803.15	1606.63	62	95	77	213	1.54	Deleted
33	962.35	1924.23	22	75	61	97	1.05	Deleted
37	1763.69	3522.83	4	70	58	74	2.77	Deleted

c:\SEEKER\BIN\181830d09.res Analysis Results Saved.

181935D10.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: GS181103-2LCS GS181103-2

Sampling Start:	11/27/2018 08:00:00	Counting Start:	11/27/2018 08:35:13
Sampling Stop:	11/27/2018 08:00:00	Decay Time.	5.87E-001 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	1800 Sec
Sample Size	2.15E+002 g	Real Time	1865 Sec
Collection Efficiency	1.0000	Spc. File	.181935D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.03 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/27/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	57.91	119.64	1388	357	287	11410	1.70	a	
2	59.40	122.60	38357	445	174	5569	1.02	b	
3	66.63	137.02	57	158	129	3091	1.00	a	NET< CL
4	87.92	179.52	17604	316	141	3685	1.06	a	
5	121.94	247.41	2879	191	130	2871	1.18	a	
6	136.34	276.14	443	176	141	3137	1.32	a	
7	165.62	334.58	115	137	112	2299	1.02	a	
8	352.27	707.05	118	116	93	1839	0.91	a	
9	393.18	788.69	93	140	114	2394	1.24	a	NET< CL
10	553.72	1109.06	83	114	93	1675	1.50	a	NET< CL
11	661.79	1324.74	62475	519	114	2167	1.99	a	HiResid
12	820.80	1642.05	91	102	83	1440	1.47	a	
13	1173.26	2345.42	49173	459	98	1516	2.69	a	HiResid
14	1332.43	2663.07	44620	445	116	2062	2.80	a	HiResid

181935D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET101114.BKG (111418-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	66.63	57	158	129	29	158	130	NET<CL
4	87.92	17604	316	141	17595	316	141	
8	352.27	118	116	93	23	116	95	NET<CL

181935D10.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: GS181103-2LCS GS181103-2

Sampling Start: 11/27/2018 08:00:00	Counting Start: 11/27/2018 08:35:13
Sampling Stop: 11/27/2018 08:00:00	Decay Time. . . . . 5.87e-001 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1865 Sec
Collection Efficiency 1.0000	Spectrum File 181935D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)
Efficiency File: (D10)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018
Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV
Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.73E+02 +- 5.48E+00	4.31E+00	2.14E+00	3.79E+06
Cd-109	88.02		7.82E+02 +- 1.40E+01	1.27E+01	6.28E+00	1.11E+04
Co-57	122.07		4.20E+00 +- 2.78E-01	3.82E-01	1.89E-01	6.50E+03
Ce-139	165.85		1.81E-01 +- 2.16E-01	3.55E-01	1.75E-01	3.30E+03
Cs-137	661.62		1.84E+02 +- 1.53E+00	6.78E-01	3.35E-01	2.64E+05
Co-60	Average:x		1.87E+02 +- 1.28E+00	. . . .	. . . .	4.62E+04
	1173.21		1.89E+02 +- 1.76E+00	7.61E-01	3.75E-01	4.62E+04
	1332.48		1.86E+02 +- 1.86E+00	9.81E-01	4.85E-01	4.62E+04
Hg-203	279.18		MDA	4.99E-01	2.47E-01	1.12E+03
Sn-113	391.68		MDA	7.19E-01	3.56E-01	2.76E+03
Y-88	898.02		MDA	7.55E-01	3.73E-01	2.56E+03

MEASURED TOTAL: 1.63E+03 +- 2.28E+01 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	57.91	119.64	1388	357	287	11410	1.70	Unknown

181935D10.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
3	66.63	137.02	29	158	130	3091	1.00	Deleted
6	136.34	276.14	443	176	141	3137	1.32	Unknown
8	352.27	707.05	23	116	95	1839	0.91	Deleted
9	393.18	788.69	93	140	114	2394	1.24	Deleted
10	553.72	1109.06	83	114	93	1675	1.50	Deleted
12	820.80	1642.05	91	102	83	1440	1.47	1332SEsc

c:\SEEKER\BIN\181935d10.res Analysis Results Saved.

Gamma Spectrometer Run Log

Date: 11/26/18 Reviewed By/Date: SG 11/26/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
1810627-1	SG	7	17hc	30	12:29	SG	181947D07	SG
-2		8					181888D08	SG
-3		9					181750D09	SG
-3D		10					181928D10	SG
-4	SG	1			13:07	SG	182087D01	SG
-5		2					182122D02	SG
-6		3					182010D03	SG
-7		4					182003D04	SG
-8		5					181843D05	SG
-9		7					181949D07	SG
-10		8					181888D08	SG
-11		9					181757D09	SG
-12		10			13:08		181929D10	SG
-13	SG	1			13:49	SG	182088D01	SG
-14		2					182123D02	SG
-14D		3					182011D03	SG
-15		4					182004D04	SG
-16		10					181930D10	SG
-17		7					181949D07	SG
-18		8					181890D08	SG
-19	*	9					*	
-20	SG	5					181844D05	SG
GS181103-1MB		7	17hc		14:31	SG	181950D07	SG
LCS		89	17		14:33		181752D09	SG

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

* recount, did not save file

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

Gamma Spectrometer Run Log

Date: 11/27/18 Reviewed By/Date: SG 11/27/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
1810627-28	SG	5	17/24	30	8:34	SG	181948005	SG
↓ -29	↓	7	↓	↓	↓	↓	181954007	SG
↓ -29D	↓	8	↓	↓	↓	↓	181998008	SG
GS181103-2MB	↓	9	↓	↓	8:35	↓	181756009	SG
↓ LCS	↓	10	17	↓	↓	↓	181935010	SG
112718-4(1048)	SG	4	7*	30	9:07	SG	182609004	SG
112718-7(1096)	SG	7	↓	LCS	9:11	SG	181957007	SG
GS181103-2MLCS	SG	1	26	30	9:18	SG	182013001	SG
1811333-2	↓	2	11	↓	9:19	↓	182128002	SG
↓ -2D	↓	8	↓	↓	↓	↓	181996008	SG
1811254-1 ★	SG	3	13	30	9:18	SG	182616003	SG
1811321-1 ↓	↓	↓	↓	↓	↓	↓	182617003	SG
1811254-2 ★	↓	5	↓	↓	9:19	↓	181849005	SG
1811321-2 ↓	↓	↓	↓	↓	↓	↓	181850005	SG
1811332-3	SG	9	01	↓	9:19	SG	181757009	SG
-4	↓	10	↓	↓	↓	↓	181936010	SG
-5	SG	1	01	30	10:00	SG	182094001	SG
-7	↓	4	↓	↓	↓	↓	182610004	SG
-8	↓	9	↓	↓	10:01	↓	181758009	SG
↓ -9	↓	10	↓	↓	↓	↓	181937010	SG
GS181126-1LCS	SG	3	13	↓	10:02	SG	182619003	SG
1811357-1	↓	5	11	↓	10:01	↓	181951005	SG
GS181126-2MB AMB	↓	2	↓	↓	10:02	↓	182129002	SG
↓ LCS	↓	8	↓	↓	↓	↓	181997008	SG

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry. ★ same samp.

[3] Count duration.

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

481737 **B**

Gamma Spectrometer Run Log

Date: 12/4/18 Reviewed By/Date: SG 12/5/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
GS181130-345	SG	1	11	30	8:52	SG	182151D01	SG
120418-2(1096)	SG	2	6	40	8:55	SG	182182D02	SG
↓-4(1098)	SG	24	13	30	8:56	SG	182179D04	SG
120418-5(1092)	*	5	8	*	8:57	SG	*	
120418-7(1093)	SG	7	14	41	8:59	SG	182013D07	SG
120418-10(1097)	SG	10	9↑	15	9:01	SG	181989D10	SG
120418-4(1096)	SG	4	13	30	9:34	SG	182180D04	SG
120418-2(1048)	SG	2	6	30	9:48	SG	182183D02	SG
120418-1(1096)	SG	1	6	30	9:49	SG	182152D01	SG
120418-10(1047)	SG	10	9↑	30	9:52	SG	181990D10	SG
↓-7(1044)	SG	7	14	↓	9:54	SG	182014D07	SG
1810627-1	SG	3	17	155	10:18	SG	182168D03	SG
-2		4		400			182168D04	SG
-3	SG	5		90			181897D05	SG
-30	SG	8		75			181952D08	SG
-4	↓	9		120	↓	↓	181815D09	SG
-5	SG	2		120	10:25	SG	182197D02	SG
↓ -6	SG	10	↓	60	10:26	SG	181992D10	SG
120418-1(1048)	SG	1	6	30	10:27	SG	182153D01	SG
1810627-7	SG	7	17/20	300	~~10:30~~ 11:58	SG	182018D07	SG
-8	SG	1		90	10:59	SG	182154D01	SG
-9	↓	8		75	12:04		181953D08	SG
↓ -10	SG	10	↓	60	12:07	↓	181993D10	SG
GS181126-335	↓	5	01	30	12:18	SG	181898D05	SG

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

*recount for extended time low Am241 counts

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

Gamma Spectrometer Run Log

Date: 12/04/18/12/5/18 Reviewed By/Date: SG 12/5/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
GS181018-3ALCS	SG	2	20	30	12:55	SG	192182D02	SG
120418-1(1095)	SG	1	14	45	12:54	SG	192157D01	SG
↓-1(1044)	SG	1	↓	30	14:31	SG	192158D01	SG
18100627-11	↓	3	17/20	400	14:50	SG	192169D03	SG
-12		5	↓	↓	↓	↓	192179D05	SG
-13		2					192189D02	SG
-14*		8					181954D06	SG
-16↓		10		400	14:49		181994D10	SG
-20		9		360	14:50		192176D01	SG
-18		1		↓	15:05	SG	192159D01	SG
18100627-15	SG	10	17/20	120	8:31	↓	181997D10	SG
-17	↓	5	↓	↓	↓		181982D05	SG
-21		8				SG	181957D08	SG
-27		2				↓	192192D02	SG
GSB120S-1LCS	SG	1	7*	30	8:44	SG	192161D01	SG
↓-12LCS	↓	7	9↑	↓	↓	↓	192020D07	SG
120518-4(1093)	SG	4	14	62	8:47	SG	192190D04	SG
120518-4(1044)	↓	4	14	30	10:23	SG	192191D04	SG
181203S-1	SG	1	7*	60	11:22	SG	192162D01	SG
↓ -2	↓	10	↓	↓	11 31	↓	181998D10	SG
181203S-1		2	9↑		11 22		192193D02	SG
↓ -2		4	↓		↓		192192D04	SG
181203S-1		5					181903D05	SG
↓ -2	↓	7	↓	↓	11:23	↓	192021D07	SG

SG 12/5

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

recount for extended time.

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

Gamma Spectrometer Run Log

Date: 12/5/18/12/6/18 Reviewed By/Date: SG 12/6/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
1812037-3	SG	8	9↑	600	11:23	SG	181958D08	SG
↓ -4	↓	9	↓	↓	↓	↓	181820D09	SG
1812035-2D	SG	1	7*	600	12:33	SG	182163D01	SG
GS181205-16MB		10	↓	↓	↓	↓	181997D10	SG
1812036-2D		2	9↑	600	12:33	SG	182194D02	SG
1812037-4D		4			12:34		182093D04	SG
↓ -5		5			↓	↓	181904D05	SG
GS181205-12MB	↓	7	↓	↓	↓	↓	182022D07	SG
GS181130-3MB	SG	1	11	1000	14:08	SG	182164D01	SG
1810627-14		2	17/26		↓		182175D02	SG
↓ -14D		3	↓		↓		182172D03	SG
↓ -16		10			14:09		182000D10	SG
↓ -19		5			14:09		181905D05	SG
GS181103-1MB		4	↓		14:08		182094D04	SG
1810627-23		7	17/26		14:09		182023D07	SG
↓ -24		8	↓		↓		181959D08	SG
↓ -25	↓	9	↓	↓	↓	↓	181921D09	SG
1810627-22	SG	10	17/26	120	8:01	SG	182052D10	SG
1811150-13	SG	1	26	20	7:59	SG	182166D01	SG
1811153-B3 SS 12/4	↓	2	↓	↓	8:00	↓	182197D02	SG
↓ -4		4			↓		182096D04	SG
↓ -5		5					181907D05	SG
↓ -5D		7					182025D07	SG
↓ -6	↓	8	↓	↓	↓	↓	181961D08	SG

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

Gamma Spectrometer Run Log

Date: 12/6/18 Reviewed By/Date: SG 12/7/18

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID.SPC	Saved?
1811484-1	SG	4	NA	2	14:35	SG	192726D04	SG
1811532-2	↓	↓	↓	↓	14:38	↓	192727D04	↓
↓ -5					14:42		192728D04	
1812003-9			↓		14:45		192729D04	
TC181204-1MB			NA		14:49		192730D04	
↓ LCS			↓	↓	14:55	↓	192731D04	↓
REF 1	SG		NA	2	12:30	SG	192703D04	SG
REF 2	↓		↓	↓	12:41	↓	192704D04	↓
REF 3	↓	↓	↓	↓	12:52	↓	192705D04	↓
GS181109-2LCS	SG	8	26	30	13:05	SG	191908D08	SG
1811514-1 *	↓	10	13	1000	14:03	↓	192006D10	SG
↓ -1D		8	↓	↓	↓	↓	191909D08	SG
1811518-1 *	↓	10	↓	↓	↓	↓	192007D10	SG
1811375-1	SG	1	11	500	14:02	SG	192704D01	SG
↓ -1D	↓	2	↓	↓	14:03	↓	192705D02	SG
1810627-26	SG	3	17 ↑	1000	14:04	SG	192803D03	SG
↓ -28	↓	4	↓	↓	14:59	↓	192732D04	SG
↓ -29	↓	5	↓	↓	14:04	↓	191914D05	SG
↓ -29D	↓	7	↓	↓	↓	↓	192032D07	SG
GS181103-2MB	↓	9	↓	↓	↓	↓	191930D09	SG
		SG 12/7/18						

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry. Same sample

[3] Count duration.

KEY: * sample was counted on a puck
↑ sample was counted with air flow arrow pointing up

Technical Comments Regarding Analysis using the TIDEWATER_GREATKILLS.LIB Gamma Spectroscopy Library

Analysis using the **TIDEWATER_GREATKILLS.LIB** library is limited to the list of gamma emitting radionuclides specified by ALS Laboratory Group. ALS Laboratory Group specifies all values assigned to the nuclides in this library. In cases where multiple gamma emissions are used to quantify activity, the most abundant emission is used for quantification in the absence of any supporting gamma emissions. It should be noted that the current software program used for gamma spectroscopic analysis is limited to a +/- 2.0 keV photo-peak resolution tolerance. Thus, any gamma emissions occurring within the same +/- 2.0 keV range will suffer interference, consequently preventing accurate quantification. Nuclide specific information regarding analysis using the TIDEWATER_GREATKILLS library is as follows:

Nuclide: ^{212}Bi, ^{212}Pb, ^{208}Tl Energy: various Photon Abundance: various

All activity values for ^{212}Bi, ^{212}Pb, and ^{208}Tl are calculated using the half-life, $t_{1/2}$=1.91 years, of the long-lived ^{228}Th parent. It is assumed that secular equilibrium is achieved between the ^{228}Th parent and the ^{212}Bi, ^{212}Pb, and ^{208}Tl progeny.

Nuclide: ^{214}Bi, ^{214}Pb Energy: various Photon Abundance: various

All activity values for ^{214}Bi and ^{214}Pb are calculated using the half-life, $t_{1/2}$=1600 years, of the long-lived ^{226}Ra parent. It is assumed that secular equilibrium is achieved between the ^{226}Ra parent and the ^{214}Bi and ^{214}Pb progeny.

Nuclide: ^{40}K Energy: 1460.75 Photon Abundance: 0.1070

The only gamma emission useful for quantification of this nuclide suffers from possible resolution interference due to the ^{228}Ac gamma emission occurring at 1459.2 keV (0.0104, abundance). Therefore, a possibility of a high bias to the ^{40}K results may occur in the presence of elevated ^{228}Ac activity

Nuclide: ^{210}Pb Energy: 46.52 keV Photon Abundance: 0.0400

Activity calculations for ^{210}Pb should be considered to be estimated values, based upon an energy dependent efficiency calibration that is non-inclusive of the ^{210}Pb gamma emission energy of 46.50 keV.

Nuclide: ^{223}Ra Energy: Various Photon Abundance: various

All activity values for ^{223}Ra are calculated using the half-life, $t_{1/2}$=3.30E+04 years, for the long-lived ^{231}Pa parent. It is assumed that secular equilibrium is achieved between the ^{231}Pa parent and the ^{223}Ra progeny.

Nuclide: ^{226}Ra Energy: 186.10 Photon Abundance: 0.0350

Quantifying ^{226}Ra activity using the 186.10 keV photo-peak is vulnerable to a significant high bias due to interference from gamma emissions from ^{235}U occurring at 185.72 keV (0.5720, abundance). Therefore, this nuclide will always be "SI" flagged, indicating that significant spectral interference prohibits accurate quantification.

Nuclide: ^{228}Ra, ^{228}Ac Energy: various Photon Abundance: various

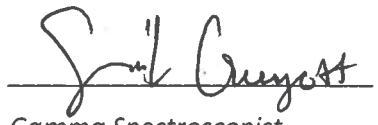
All activity values for ^{228}Ac are calculated using the half-life, $t_{1/2}$=5.75 years, of the long-lived ^{228}Ra parent. It is assumed that secular equilibrium is achieved between the ^{228}Ra parent and the ^{228}Ac progeny. If the requested analysis involves the quantification of both ^{228}Ac and ^{228}Ra, the reported results for each nuclide will be identical. The quantification will be obtained from the measurement of the observed ^{228}Ra photo-peaks with energies of 338.40, 911.07, and 968.90 and 964.6 keV.

Nuclide: ^{214}Pb Energy: 241.98 Photon Abundance: 0.0750

Quantifying ^{214}Pb activity using the 241.98 keV photo-peak is vulnerable to a significant high bias due to interference from gamma emissions from ^{224}Ra occurring at 241.00 keV (0.0390, abundance). Therefore, this emission will be used as an identifier only and not in the activity calculations for this nuclide.

Nuclide: ^{238}U Energy: Various Photon Abundance: Various

Uranium-238 does not emit any gamma photons that would be useful for quantification. U-238 activity is calculated based on the gamma emissions of the ^{234} Th progeny, assuming secular equilibrium with parent nuclide. The quantification will be obtained from the measurement of the observed ^{234}Th photo-peaks with energies of 63.29 and 92.60 keV. The half-life of ^{238}U (t1/2=4.468E+09 years) will be used in the activity calculations.



12/18/2018

Gamma Spectroscopist *Date*

Radiochemistry Instrumentation Laboratory

12-18-18

Radiochemistry Manager *Date*

Library File: Tidewater_GreatKills.LIB
File I.D.: Tidewater Great Kills

Pk. #	Energy (keV)	Isotope Name	2ndary Pk #	Type	Gamma Fraction	Halflife
1	46.52	Pb-210	0	NET	0.0400	2.0400E+01 yrs
2	63.29	U-238	6	QUANT	0.0390	4.4680E+09 yrs
3	68.89	Tl-201	4	QUANT	0.2890	3.0630E+00 dys
4	70.82	Tl-201	5	NET	0.4900	3.0630E+00 dys
5	80.20	Tl-201	15	QUANT	0.1690	3.0630E+00 dys
6	92.60	U-238	2	NET	0.0557	4.4680E+09 yrs
7	94.67	Pa-234	8	QUANT	0.1550	4.5100E+09 yrs
8	98.44	Pa-234	9	QUANT	0.2510	4.5100E+09 yrs
9	99.70	Pa-234	10	QUANT	0.0470	4.5100E+09 yrs
10	111.00	Pa-234	11	QUANT	0.0855	4.5100E+09 yrs
11	131.28	Pa-234	19	QUANT	0.2000	4.5100E+09 yrs
12	143.76	U-235	14	NET	0.1050	3.8000E+06 yrs
13	154.18	Ra-223	23	QUANT	0.0559	3.2760E+04 yrs
14	163.35	U-235	17	QUANT	0.0470	3.8000E+06 yrs
15	167.43	Tl-201	3	QUANT	0.1190	3.0630E+00 dys
16	186.10	Ra-226	0	NET	0.0350	1.6000E+03 yrs
17	205.31	U-235	12	QUANT	0.0470	3.8000E+06 yrs
18	205.78	Ir-192	28	QUANT	0.0349	7.4020E+01 dys
19	226.87	Pa-234	36	QUANT	0.0650	4.5100E+09 yrs
20	238.63	Pb-212	27	NET	0.4310	5.7500E+00 yrs
21	241.00	Ra-224	0	NET	0.0390	5.7500E+00 yrs
22	241.98	Pb-214	25	ID	0.0750	1.6000E+03 yrs
23	269.39	Ra-223	30	NET	0.1360	3.2760E+04 yrs
24	277.36	Tl-208	37	QUANT	0.0650	5.7500E+00 yrs
25	295.21	Pb-214	32	QUANT	0.1850	1.6000E+03 yrs
26	296.00	Tl-210	48	QUANT	0.8000	1.6000E+03 yrs
27	300.09	Pb-212	20	QUANT	0.0327	5.7500E+00 yrs
28	308.44	Ir-192	29	QUANT	0.3175	7.4020E+01 dys
29	316.49	Ir-192	33	NET	0.8704	7.4020E+01 dys
30	323.88	Ra-223	13	QUANT	0.0390	3.2760E+04 yrs
31	338.40	Ac-228	57	QUANT	0.1201	5.7500E+00 yrs
32	351.92	Pb-214	22	NET	0.3580	1.6000E+03 yrs
33	468.06	Ir-192	35	QUANT	0.5175	7.4020E+01 dys
34	477.56	Be-7	0	NET	0.1030	5.3400E+01 dys
35	484.54	Ir-192	38	QUANT	0.0335	7.4020E+01 dys
36	569.26	Pa-234	42	QUANT	0.1040	4.5100E+09 yrs
37	583.14	Tl-208	45	NET	0.8600	5.7500E+00 yrs
38	588.60	Ir-192	39	QUANT	0.0460	7.4020E+01 dys
39	604.40	Ir-192	41	QUANT	0.0890	7.4020E+01 dys
40	609.31	Bi-214	46	NET	0.4479	1.6000E+03 yrs
41	612.45	Ir-192	18	QUANT	0.0580	7.4020E+01 dys
42	699.10	Pa-234	44	QUANT	0.0460	4.5100E+09 yrs
43	727.17	Bi-212	47	NET	0.1180	5.7500E+00 yrs
44	733.00	Pa-234	49	QUANT	0.0850	4.5100E+09 yrs
45	763.30	Tl-208	52	QUANT	0.0170	5.7500E+00 yrs
46	768.36	Bi-214	59	QUANT	0.0480	1.6000E+03 yrs
47	785.42	Bi-212	74	QUANT	0.0200	5.7500E+00 yrs
48	795.00	Tl-210	51	NET	1.0000	1.6000E+03 yrs

Pk. #	Energy (keV)	Isotope Name	2ndary Pk #	Type	Gamma Fraction	Halflife
49	808.10	Pa-234	50	QUANT	0.0490	4.5100E+09 yrs
50	831.10	Pa-234	53	QUANT	0.0560	4.5100E+09 yrs
51	860.00	Tl-210	64	QUANT	0.0700	1.6000E+03 yrs
52	860.47	Tl-208	24	QUANT	0.1200	5.7500E+00 yrs
53	880.51	Pa-234	54	QUANT	0.0650	4.5100E+09 yrs
54	883.24	Pa-234	56	QUANT	0.1200	4.5100E+09 yrs
55	889.26	Sc-46	0	NET	0.9998	8.3850E+01 dys
56	898.60	Pa-234	58	QUANT	0.0400	4.5100E+09 yrs
57	911.07	Ac-228	62	NET	0.2900	5.7500E+00 yrs
58	926.70	Pa-234	60	QUANT	0.1100	4.5100E+09 yrs
59	934.06	Bi-214	65	QUANT	0.0303	1.6000E+03 yrs
60	946.00	Pa-234	61	NET	0.2000	4.5100E+09 yrs
61	949.00	Pa-234	71	QUANT	0.0780	4.5100E+09 yrs
62	964.60	Ac-228	63	QUANT	0.0545	5.7500E+00 yrs
63	968.90	Ac-228	31	QUANT	0.1746	5.7500E+00 yrs
64	1110.00	Tl-210	66	QUANT	0.0700	1.6000E+03 yrs
65	1120.29	Bi-214	67	QUANT	0.1480	1.6000E+03 yrs
66	1210.00	Tl-210	69	QUANT	0.1700	1.6000E+03 yrs
67	1238.11	Bi-214	70	QUANT	0.0586	1.6000E+03 yrs
68	1274.54	Na-22	0	NET	0.9994	2.6000E+00 yrs
69	1310.00	Tl-210	72	QUANT	0.2100	1.6000E+03 yrs
70	1377.67	Bi-214	75	QUANT	0.0392	1.6000E+03 yrs
71	1394.10	Pa-234	7	QUANT	0.0390	4.5100E+09 yrs
72	1410.00	Tl-210	26	QUANT	0.0500	1.6000E+03 yrs
73	1460.75	K-40	0	NET	0.1070	1.2800E+09 yrs
74	1620.56	Bi-212	43	QUANT	0.0275	5.7500E+00 yrs
75	1764.49	Bi-214	40	QUANT	0.1536	1.6000E+03 yrs

TECHNICAL BULLETIN ADDENDUM

The library used for analysis defines the gamma emission(s) to be used for analysis of each nuclide. If multiple gamma emissions are used for quantification, then a 'NET' quantification emission (or peak) must be defined in the library. This designation provides for the calculation of nuclide activity concentrations and detection limits in the case of non-presence of the nuclide. When the nuclide is not present, or the software is unable to resolve a peak at the library defined 'NET' energy, the software evaluates the 'NET' region of interest ('NET' peak energy +/- 2 keV) by performing a summation of the net counts above the background level. This 'NET' quantification can result in net negative, zero, or positive activity results, and is highly dependent on the spectral distribution in the region of interest of the 'NET' peak. In cases where only the 'NET' peak is found, and the software performs a net quantification, the nuclide result will be flagged with an 'NQ' qualifier on the final reports. This indicates that the nuclide is not detected or supported at any level above the reported MDC. Results are submitted without further qualification.

All nuclides specified in the library of analysis for gamma spectroscopy are evaluated for positive OR tentative identification on the following criteria:

- The individual abundances for the gamma emissions specified for each nuclide are summed to obtain a total nuclide abundance.
- From the total nuclide abundance, a positive identification criterion is set as 75% of this total nuclide abundance.
- For all nuclide peaks that are not net quantified, those peak abundances are summed. The total non-net quantified peak sum is compared to the calculated 75% abundance criterion. If this sum is greater than the 75% criterion, the nuclide is considered to be positively identified at the reported concentration. If the sum is less than the 75% criterion, the nuclide is tentatively identified at the reported concentration. These results will be flagged with a 'TI' qualifier on the final reports to indicate that the 75% abundance criterion was not met.

Section 6

QUALITY ASSURANCE SUMMARY REPORTS

No *NON-CONFORMANCE REPORTS* or *QUALITY ASSURANCE SUMMARY SHEETS* are included in this data package.

Section 7

LABORATORY BENCH SHEETS

7

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y / (N) NA

Prep Num	Lab ID / Collection Date	QC Type	Init Alq	Fin Alq	Units / Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-1 10/22/18 09:00	SMP	225.3	225.3	g 17	pCi/g	155	3	12/4/18							
1	1810627-2 10/22/18 10:10	SMP	159.7	159.7	g 17	pCi/g	400	4								
1	1810627-3 10/22/18 11:30	SMP	209.2	209.2	g 17	pCi/g	90	5								
1	1810627-3 10/22/18 11:30	DUP	217.5	217.5	g 17	pCi/g	75	8								
1	1810627-4 10/22/18 11:30	SMP	217.4	217.4	g 17	pCi/g	120	9								
1	1810627-5 10/22/18 14:35	SMP	213.5	213.5	g 17	pCi/g	↓	2								
1	1810627-6 10/23/18 08:35	SMP	254.2	254.2	g 17	pCi/g	600	10								
1	1810627-7 10/23/18 09:10	SMP	171.2	171.2	g 17	pCi/g	300	7								
1	1810627-8 10/23/18 10:45	SMP	258.5	258.5	g 17	pCi/g	90	1								
1	1810627-9 10/23/18 11:05	SMP	241.3	241.3	g 17	pCi/g	75	8								
1	1810627-10 10/23/18 11:20	SMP	272.9	272.9	g 17	pCi/g	60	10								
1	1810627-11 10/23/18 11:45	SMP	210.8	210.8	g 17	pCi/g	400	3								
1	1810627-12 10/23/18 11:45	SMP	202.3	202.3	g 17	pCi/g	300	5								
1	1810627-13 10/24/18 09:15	SMP	185.5	185.5	g 17	pCi/g	↓	2								
1	1810627-14 10/24/18 09:50	SMP	155	155	g 17	pCi/g	1000	2	12/5/18							
1	1810627-14 10/24/18 09:50	DUP	151.7	151.7	g 17	pCi/g	↓	3								
1	1810627-15 10/24/18 10:45	SMP	180.3	180.3	g 17	pCi/g	120	10								
1	1810627-16 10/24/18 11:30	SMP	82.9	82.9	g 17	pCi/g	1000	10								
1	1810627-17 10/25/18 11:10	SMP	212.6	212.6	g 17	pCi/g	120	5								
1	1810627-18 10/25/18 14:30	SMP	181.7	181.7	g 17	pCi/g	300	1	12/4/18							
1	1810627-19 10/25/18 15:10	SMP	159.6	159.6	g 17	pCi/g	1000	5	12/5/18							
1	1810627-20 10/25/18 15:45	SMP	217.7	217.7	g 17	pCi/g	300	9	12/4/18							
1	GS181103-1 11/03/18 11:06	MB	215	215	g 17	pCi/g	1000	4	12/5/18							
1	GS181103-1 11/03/18 11:06	LCS	215	215	g 17	pCi/g	30	9	11/20/18							

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SS 12/10/18

Tidewaters-Great Kills Bi214 >0.2
Pb214

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022		1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022	NA	420.158	DPM/g	11/03/18	215	g	N/A

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y / N N/A

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
		S1					Cs-137						1022			395.440 DPM/g 11/03/18 215 g N/A

Sample Barcodes

1810627-1 GS181103-1PS26	*GS181103-1PS26*	1810627-2 GS181103-1PS27	*GS181103-1PS27*	1810627-3 GS181103-1PS28	*GS181103-1PS28*
1810627-3DUP GS181103-1PS29	*GS181103-1PS29*	1810627-4 GS181103-1PS30	*GS181103-1PS30*	1810627-5 GS181103-1PS31	*GS181103-1PS31*
1810627-6 GS181103-1PS32	*GS181103-1PS32*	1810627-7 GS181103-1PS33	*GS181103-1PS33*	1810627-8 GS181103-1PS34	*GS181103-1PS34*
1810627-9 GS181103-1PS35	*GS181103-1PS35*	1810627-10 GS181103-1PS36	*GS181103-1PS36*	1810627-11 GS181103-1PS37	*GS181103-1PS37*
1810627-12 GS181103-1PS38	*GS181103-1PS38*	1810627-13 GS181103-1PS39	*GS181103-1PS39*	1810627-14 GS181103-1PS40	*GS181103-1PS40*
1810627-14DUP GS181103-1PS41	*GS181103-1PS41*	1810627-15 GS181103-1PS42	*GS181103-1PS42*	1810627-16 GS181103-1PS43	*GS181103-1PS43*
1810627-17 GS181103-1PS44	*GS181103-1PS44*	1810627-18 GS181103-1PS45	*GS181103-1PS45*	1810627-19 GS181103-1PS46	*GS181103-1PS46*
1810627-20 GS181103-1PS47	*GS181103-1PS47*	GS181103-1MB GS181103-1PS49	*GS181103-1PS49*	GS181103-1LCS GS181103-1PS50	*GS181103-1PS50*

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Reporting Units

LabID:	TstGrpName:	RptUnits:
1810627-1	Gamma_GKP_2018	pCi/g
1810627-2	Gamma_GKP_2018	pCi/g
1810627-3	Gamma_GKP_2018	pCi/g
1810627-4	Gamma_GKP_2018	pCi/g
1810627-5	Gamma_GKP_2018	pCi/g
1810627-6	Gamma_GKP_2018	pCi/g
1810627-7	Gamma_GKP_2018	pCi/g
1810627-8	Gamma_GKP_2018	pCi/g
1810627-9	Gamma_GKP_2018	pCi/g
1810627-10	Gamma_GKP_2018	pCi/g
1810627-11	Gamma_GKP_2018	pCi/g
1810627-12	Gamma_GKP_2018	pCi/g
1810627-13	Gamma_GKP_2018	pCi/g
1810627-14	Gamma_GKP_2018	pCi/g
1810627-15	Gamma_GKP_2018	pCi/g
1810627-16	Gamma_GKP_2018	pCi/g
1810627-17	Gamma_GKP_2018	pCi/g
1810627-18	Gamma_GKP_2018	pCi/g
1810627-19	Gamma_GKP_2018	pCi/g
1810627-20	Gamma_GKP_2018	pCi/g

Cnt 11/26

ALS -- Fort Collins

Radiochemistry Instrument Worksheet

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y (N) NA

Prep Num	Lab ID / Collection Date	QC Type	Init Alq	Fin Alq	Units / Geo.	Report Units	Cnt 1 File / Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File / Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File / Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-1 10/22/18 09:00	SMP	225.3	225.3	g 17	pCi/g	30 Δ	7	11/26/18	155	3	12/4/18				Δ recount to hit MDC of 0.2
1	1810627-2 10/22/18 10:10	SMP	159.7	159.7	g 17	pCi/g		8		400	4					
1	1810627-3 10/22/18 11:30	SMP	209.2	209.2	g 17	pCi/g		9		90	5					
1	1810627-3 10/22/18 11:30	DUP	217.5	217.5	g 17	pCi/g		10		75	6					
1	1810627-4 10/22/18 11:30	SMP	217.4	217.4	g 17	pCi/g		1		120	9					
1	1810627-5 10/22/18 14:35	SMP	213.5	213.5	g 17	pCi/g		2		120	2					
1	1810627-6 10/23/18 08:35	SMP	254.2	254.2	g 17	pCi/g		3		60	10					
1	1810627-7 10/23/18 09:10	SMP	171.2	171.2	g 17	pCi/g		4		300	7					
1	1810627-8 10/23/18 10:45	SMP	258.5	258.5	g 17	pCi/g		5		90	1					
1	1810627-9 10/23/18 11:05	SMP	241.3	241.3	g 17	pCi/g		7		75	8					
1	1810627-10 10/23/18 11:20	SMP	272.9	272.9	g 17	pCi/g		8		60	10					
1	1810627-11 10/23/18 11:45	SMP	210.8	210.8	g 17	pCi/g		9		400	3					
1	1810627-12 10/23/18 11:45	SMP	202.3	202.3	g 17	pCi/g		10		300	5					
1	1810627-13 10/24/18 09:15	SMP	185.5	185.5	g 17	pCi/g		1			2					
1	1810627-14 10/24/18 09:50	SMP	155	155	g 17	pCi/g		2			8 Δ		1000	2	12/5/18	recount for 1000 min
1	1810627-14 10/24/18 09:50	DUP	151.7	151.7	g 17	pCi/g		3		1000	3					
1	1810627-15 10/24/18 10:45	SMP	180.3	180.3	g 17	pCi/g		4		120	10	12/5/18				
1	1810627-16 10/24/18 11:30	SMP	82.9	82.9	g 17	pCi/g	432	10		400 Δ	10	12/4/18	1000	10	12/5/18	Δ recount for 1000 min
1	1810627-17 10/25/18 11:10	SMP	212.6	212.6	g 17	pCi/g		7		120	5	12/5/18				
1	1810627-18 10/25/18 14:30	SMP	181.7	181.7	g 17	pCi/g		8		300	1	12/4/18				
1	1810627-19 10/25/18 15:10	SMP	159.6	159.6	g 17	pCi/g	Δ	9 Δ		30	4	11/27/18	1000	8	12/5/18	recount, did not save
1	1810627-20 10/25/18 15:45	SMP	217.7	217.7	g 17	pCi/g	Δ	105		300	9	12/4/18				recount to hit MDC of .2
1	GS181103-1 11/03/18 11:06	MB	215	215	g 17	pCi/g		7		1000	4	12/5/18				
1	GS181103-1 11/03/18 11:06	LCS	215	215	g 17	pCi/g		89								

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Natural-LCS Cs-137 (0.5)

Ra226-LCS Ra226 (1)

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022		1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022	NA	420.158	DPM/g	11/03/18	215	g	N/A

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Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y / N

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
S1	Cs-137						1022									395.440 DPM/g 11/03/18 215 g N/A
S2	RA-226						144									1,039.475 DPM/g 11/03/18 215 g N/A

Sample Barcodes

1810627-1 GS181103-1PS1	1810627-2 GS181103-1PS2	1810627-3 GS181103-1PS3
1810627-3DUP GS181103-1PS4	1810627-4 GS181103-1PS5	1810627-5 GS181103-1PS6
1810627-6 GS181103-1PS7	1810627-7 GS181103-1PS8	1810627-8 GS181103-1PS9
1810627-9 GS181103-1PS10	1810627-10 GS181103-1PS11	1810627-11 GS181103-1PS12
1810627-12 GS181103-1PS13	1810627-13 GS181103-1PS14	1810627-14 GS181103-1PS15
1810627-14DUP GS181103-1PS16	1810627-15 GS181103-1PS17	1810627-16 GS181103-1PS18
1810627-17 GS181103-1PS19	1810627-18 GS181103-1PS20	1810627-19 GS181103-1PS21
1810627-20 GS181103-1PS22	GS181103-1MB GS181103-1PS24	GS181103-1LCS GS181103-1PS25

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Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: Ra_226/228

Analytical QASS / NCR? Y / N NA

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-1 10/22/18 09:00	SMP	225.3	225.3	g 26	pCi/g	See Gamma Scan									
1	1810627-2 10/22/18 10:10	SMP	159.7	159.7	g 26	pCi/g										
1	1810627-3 10/22/18 11:30	SMP	209.2	209.2	g 26	pCi/g										
1	1810627-3 10/22/18 11:30	DUP	217.5	217.5	g 26	pCi/g										
1	1810627-4 10/22/18 11:30	SMP	217.4	217.4	g 26	pCi/g										
1	1810627-5 10/22/18 14:35	SMP	213.5	213.5	g 26	pCi/g										
1	1810627-6 10/23/18 08:35	SMP	254.2	254.2	g 26	pCi/g										
1	1810627-7 10/23/18 09:10	SMP	171.2	171.2	g 26	pCi/g										
1	1810627-8 10/23/18 10:45	SMP	258.5	258.5	g 26	pCi/g										
1	1810627-9 10/23/18 11:05	SMP	241.3	241.3	g 26	pCi/g										
1	1810627-10 10/23/18 11:20	SMP	272.9	272.9	g 26	pCi/g										
1	1810627-11 10/23/18 11:45	SMP	210.8	210.8	g 26	pCi/g										
1	1810627-12 10/23/18 11:45	SMP	202.3	202.3	g 26	pCi/g										
1	1810627-13 10/24/18 09:15	SMP	185.5	185.5	g 26	pCi/g										
1	1810627-14 10/24/18 09:50	SMP	155	155	g 26	pCi/g										
1	1810627-14 10/24/18 09:50	DUP	151.7	151.7	g 26	pCi/g										
1	1810627-15 10/24/18 10:45	SMP	180.3	180.3	g 26	pCi/g										
1	1810627-16 10/24/18 11:30	SMP	82.9	82.9	g 26	pCi/g										
1	1810627-17 10/25/18 11:10	SMP	212.6	212.6	g 26	pCi/g										
1	1810627-18 10/25/18 14:30	SMP	181.7	181.7	g 26	pCi/g										
1	1810627-19 10/25/18 15:10	SMP	159.6	159.6	g 26	pCi/g										
1	1810627-20 10/25/18 15:45	SMP	217.7	217.7	g 26	pCi/g										
1	GS181103-1A 11/03/18 11:06	LCS	215	215	g 26	pCi/g	30		11/20/18							See Gamma Scan
1	GS181103-1 11/03/18 11:06	MB	215	215	g 26	pCi/g										

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022		1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022	NA	420.158	DPM/g	11/03/18	215	g	N/A

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: Ra_226/228

Analytical QASS / NCR? Y / N NA

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
S1	Cs-137						1022					395.440	DPM/g	11/03/18	215	g N/A
S2	RA-226						144					1,039.475	DPM/g	11/03/18	215	g N/A

Sample Barcodes

1810627-1 GS181103-1PS1	1810627-2 GS181103-1PS2	1810627-3 GS181103-1PS3
1810627-3DUP GS181103-1PS4	1810627-4 GS181103-1PS5	1810627-5 GS181103-1PS6
1810627-6 GS181103-1PS7	1810627-7 GS181103-1PS8	1810627-8 GS181103-1PS9
1810627-9 GS181103-1PS10	1810627-10 GS181103-1PS11	1810627-11 GS181103-1PS12
1810627-12 GS181103-1PS13	1810627-13 GS181103-1PS14	1810627-14 GS181103-1PS15
1810627-14DUP GS181103-1PS16	1810627-15 GS181103-1PS17	1810627-16 GS181103-1PS18
1810627-17 GS181103-1PS19	1810627-18 GS181103-1PS20	1810627-19 GS181103-1PS21
1810627-20 GS181103-1PS22	GS181103-1ALCS GS181103-1PS23	GS181103-1MB GS181103-1PS24

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Reporting Units

LabID:	TstGrpName:	RptUnits:
1810627-1	GAMMA_NP	pCi/g
1810627-1	GAMMA_Ra226	pCi/g
1810627-2	GAMMA_Ra226	pCi/g
1810627-2	GAMMA_NP	pCi/g
1810627-3	GAMMA_Ra226	pCi/g
1810627-3	GAMMA_NP	pCi/g
1810627-4	GAMMA_Ra226	pCi/g
1810627-4	GAMMA_NP	pCi/g
1810627-5	GAMMA_Ra226	pCi/g
1810627-5	GAMMA_NP	pCi/g
1810627-6	GAMMA_Ra226	pCi/g
1810627-6	GAMMA_NP	pCi/g
1810627-7	GAMMA_NP	pCi/g
1810627-7	GAMMA_Ra226	pCi/g
1810627-8	GAMMA_NP	pCi/g
1810627-8	GAMMA_Ra226	pCi/g
1810627-9	GAMMA_Ra226	pCi/g
1810627-9	GAMMA_NP	pCi/g
1810627-10	GAMMA_Ra226	pCi/g
1810627-10	GAMMA_NP	pCi/g
1810627-11	GAMMA_Ra226	pCi/g
1810627-11	GAMMA_NP	pCi/g
1810627-12	GAMMA_Ra226	pCi/g
1810627-12	GAMMA_NP	pCi/g
1810627-13	GAMMA_Ra226	pCi/g
1810627-13	GAMMA_NP	pCi/g
1810627-14	GAMMA_Ra226	pCi/g
1810627-14	GAMMA_NP	pCi/g
1810627-15	GAMMA_Ra226	pCi/g
1810627-15	GAMMA_NP	pCi/g
1810627-16	GAMMA_Ra226	pCi/g
1810627-16	GAMMA_NP	pCi/g
1810627-17	GAMMA_Ra226	pCi/g
1810627-17	GAMMA_NP	pCi/g
1810627-18	GAMMA_Ra226	pCi/g
1810627-18	GAMMA_NP	pCi/g
1810627-19	GAMMA_Ra226	pCi/g

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1810627-19	GAMMA_NP	pCi/g
1810627-20	GAMMA_NP	pCi/g
1810627-20	GAMMA_Ra226	pCi/g

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Reviewed By: smg SG **Review Date:** 12/7/2018

Non-Routine Pre-Treatment? Y (N) **Batch:** NA **Re-Prep?** Y (N) **Batch:** NA **Prep QASS / NCR?** Y (N) NA

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy SG for MRL
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-1	SMP	NA	225.3	225.3	Dry Weight	17	27.4	252.7		
2	1	1810627-2	SMP		159.7	159.7	Dry Weight	17	27.3	187		
3	1	1810627-3	SMP		209.2	209.2	Dry Weight	17	27.5	236.7		
4	1	1810627-3	DUP		217.5	217.5	Dry Weight	17	27.4	244.9		
5	1	1810627-4	SMP		217.4	217.4	Dry Weight	17	27.4	244.8		
6	1	1810627-5	SMP		213.5	213.5	Dry Weight	17	27.6	241.1		
7	1	1810627-6	SMP		254.2	254.2	Dry Weight	17	27.5	281.7		
8	1	1810627-7	SMP		171.2	171.2	Dry Weight	17	27.7	198.9		
9	1	1810627-8	SMP		258.5	258.5	Dry Weight	17	27.4	285.9		
10	1	1810627-9	SMP		241.3	241.3	Dry Weight	17	27.3	268.6		
11	1	1810627-10	SMP		272.9	272.9	Dry Weight	17	27.6	300.5		
12	1	1810627-11	SMP		210.8	210.8	Dry Weight	17	27.3	238.1		
13	1	1810627-12	SMP		202.3	202.3	Dry Weight	17	27.5	229.8		
14	1	1810627-13	SMP		185.5	185.5	Dry Weight	17	27.6	213.1		
15	1	1810627-14	SMP		155	155	Dry Weight	17	27.5	182.5		
16	1	1810627-14	DUP		151.7	151.7	Dry Weight	17	27.6	179.3		
17	1	1810627-15	SMP		180.3	180.3	Dry Weight	17	27.4	207.7		
18	1	1810627-16	SMP		82.9	82.9	Dry Weight	17	27.4	110.3		
19	1	1810627-17	SMP		212.6	212.6	Dry Weight	17	27.5	240.1		
20	1	1810627-18	SMP		181.7	181.7	Dry Weight	17	27.5	209.2		
21	1	1810627-19	SMP		159.6	159.6	Dry Weight	17	27.6	187.2		
22	1	1810627-20	SMP		217.7	217.7	Dry Weight	17	27.5	245.2		
23	1	GS181103-1	MB		215	215	Dry Weight	17				
24	1	GS181103-1	LCS		215	215	Dry Weight	17			S1	

SG 12/7/18

SG 12/7

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Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Reviewed By: smg SG **Review Date:** 12/7/2018

Non-Routine Pre-Treatment? Y (N) **Batch:** NA **Re-Prep?** Y / (N) **Batch:** NA **Prep QASS / NCR?** Y (N) NA

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy SG for mrl
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A

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Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Reviewed By: mrl mrl **Review Date:** 11/5/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy mrl
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-1	SMP	NA	225.3	225.3	Dry Weight	17	27.4	252.7		
2	1	1810627-2	SMP		159.7	159.7	Dry Weight	17	27.3	187	11/5/2018 mrl	
3	1	1810627-3	SMP		209.2	209.2	Dry Weight	17	27.5	236.7		11/5/2018 mrl
4	1	1810627-3	DUP		217.5	217.5	Dry Weight	17	27.4	244.9		
5	1	1810627-4	SMP		217.4	217.4	Dry Weight	17	27.4	244.8		
6	1	1810627-5	SMP		213.5	213.5	Dry Weight	17	27.6	241.1		
7	1	1810627-6	SMP		254.2	254.2	Dry Weight	17	27.5	281.7		
8	1	1810627-7	SMP		171.2	171.2	Dry Weight	17	27.7	198.9		
9	1	1810627-8	SMP		258.5	258.5	Dry Weight	17	27.4	285.9		
10	1	1810627-9	SMP		241.3	241.3	Dry Weight	17	27.3	268.6		
11	1	1810627-10	SMP		272.9	272.9	Dry Weight	17	27.6	300.5		
12	1	1810627-11	SMP		210.8	210.8	Dry Weight	17	27.3	238.1		
13	1	1810627-12	SMP		202.3	202.3	Dry Weight	17	27.5	229.8		
14	1	1810627-13	SMP		185.5	185.5	Dry Weight	17	27.6	213.1		
15	1	1810627-14	SMP		155	155	Dry Weight	17	27.5	182.5		
16	1	1810627-14	DUP		151.7	151.7	Dry Weight	17	27.6	179.3		
17	1	1810627-15	SMP		180.3	180.3	Dry Weight	17	27.4	207.7		
18	1	1810627-16	SMP		82.9	82.9	Dry Weight	17	27.4	110.3		
19	1	1810627-17	SMP		212.6	212.6	Dry Weight	17	27.5	240.1		
20	1	1810627-18	SMP		181.7	181.7	Dry Weight	17	27.5	209.2		
21	1	1810627-19	SMP		159.6	159.6	Dry Weight	17	27.6	187.2		
22	1	1810627-20	SMP		217.7	217.7	Dry Weight	17	27.5	245.2		
23	1	GS181103-1	MB		215	215	Dry Weight	17				
24	1	GS181103-1	LCS	✓	215	215	Dry Weight	17			S1	

11/5/2018 mrl

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Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: GAMMASCAN

Reviewed By: mrl **Review Date:** 11/5/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

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Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: Ra_226/228

Reviewed By: mrl **Review Date:** 11/5/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-1	SMP	NA	225.3	225.3	Dry Weight	26	27.4	252.7		
2	1	1810627-2	SMP		159.7	159.7	Dry Weight	26	27.3	187	11/5/2018 mrl	
3	1	1810627-3	SMP		209.2	209.2	Dry Weight	26	27.5	236.7		11/5/2018 mrl
4	1	1810627-3	DUP		217.5	217.5	Dry Weight	26	27.4	244.9		
5	1	1810627-4	SMP		217.4	217.4	Dry Weight	26	27.4	244.8		
6	1	1810627-5	SMP		213.5	213.5	Dry Weight	26	27.6	241.1		
7	1	1810627-6	SMP		254.2	254.2	Dry Weight	26	27.5	281.7		
8	1	1810627-7	SMP		171.2	171.2	Dry Weight	26	27.7	198.9		
9	1	1810627-8	SMP		258.5	258.5	Dry Weight	26	27.4	285.9		
10	1	1810627-9	SMP		241.3	241.3	Dry Weight	26	27.3	268.6		
11	1	1810627-10	SMP		272.9	272.9	Dry Weight	26	27.6	300.5		
12	1	1810627-11	SMP		210.8	210.8	Dry Weight	26	27.3	238.1		
13	1	1810627-12	SMP		202.3	202.3	Dry Weight	26	27.5	229.8		
14	1	1810627-13	SMP		185.5	185.5	Dry Weight	26	27.6	213.1		
15	1	1810627-14	SMP		155	155	Dry Weight	26	27.5	182.5		
16	1	1810627-14	DUP		151.7	151.7	Dry Weight	26	27.6	179.3		
17	1	1810627-15	SMP		180.3	180.3	Dry Weight	26	27.4	207.7		
18	1	1810627-16	SMP		82.9	82.9	Dry Weight	26	27.4	110.3		
19	1	1810627-17	SMP		212.6	212.6	Dry Weight	26	27.5	240.1		
20	1	1810627-18	SMP		181.7	181.7	Dry Weight	26	27.5	209.2		
21	1	1810627-19	SMP		159.6	159.6	Dry Weight	26	27.6	187.2		
22	1	1810627-20	SMP		217.7	217.7	Dry Weight	26	27.5	245.2		
23	1	GS181103-1A	LCS		215	215	Dry Weight	26			S2	
24	1	GS181103-1	MB		215	215	Dry Weight	26	11/5/2018 mrl		11/5/2018 mrl	

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-1

Prep Procedure: Ra_226/228

Reviewed By: mrl **Review Date:** 11/5/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 11:55:00 AM
Oven Out Date: 11/5/2018 12:00:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022		1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022	NA	395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

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Sample Condition Form (Solid)

Analyst: Mrl

Analysis Date: 11/5/2018 | Method: Prep

		Sample Condition (Visual Appearance of Analysis Aliquot at Time of Prep)		
Work Order	Sample ID	Dry/Wet/ Moist	Texture	Remarks
1810627	1	Dry	Sediment	Done
	2			
	3			
	4			
	5			
	6			
	7			
	8		Soil	
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			
	17			
	18			
	19			
	20			

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-2

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y / (N) NA

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-21 10/26/18 09:20	SMP	233.5	233.5	g 17	pCi/g	120	8	12/5/18							
1	1810627-22 10/26/18 09:20	SMP	209.6	209.6	g 17	pCi/g	↓	10	12/6/18							
1	1810627-23 10/26/18 11:00	SMP	169.1	169.1	g 17	pCi/g	1000	7	12/5/18							
1	1810627-24 10/26/18 14:45	SMP	134.7	134.7	g 17	pCi/g	↓	8	↓							
1	1810627-25 10/26/18 15:30	SMP	121	121	g 17	pCi/g	↓	9	↓							
1	1810627-26 10/26/18 16:35	SMP	155.6	155.6	g 17	pCi/g	↓	3	12/6/18							
1	1810627-27 10/29/18 10:10	SMP	235.5	235.5	g 17	pCi/g	120	2	12/5/18							
1	1810627-28 10/29/18 11:35	SMP	172.2	172.2	g 17	pCi/g	1000	4	12/6/18							
1	1810627-29 10/29/18 12:45	SMP	149	149	g 17	pCi/g	↓	5	↓							
1	1810627-29 10/29/18 12:45	DUP	161	161	g 17	pCi/g	↓	7	↓							
1	GS181103-2 11/03/18 11:09	MB	215	215	g 17	pCi/g	↓	9	↓							
1	GS181103-2 11/03/18 11:09	LCS	215	215	g 17	pCi/g	30	10	11/27/18							

1213

SG 12/12/18

Tidewater_Greatkills Pb214 Bi214 > 0.2

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A

Sample Barcodes

1810627-21 GS181103-2PS1	*GS181103-2PS1*	1810627-22 GS181103-2PS2	*GS181103-2PS2*	1810627-23 GS181103-2PS3	*GS181103-2PS3*
1810627-24 GS181103-2PS4	*GS181103-2PS4*	1810627-25 GS181103-2PS5	*GS181103-2PS5*	1810627-26 GS181103-2PS6	*GS181103-2PS6*
1810627-27 GS181103-2PS7	*GS181103-2PS7*	1810627-28 GS181103-2PS8	*GS181103-2PS8*	1810627-29 GS181103-2PS9	*GS181103-2PS9*
1810627-29DUP GS181103-2PS10	*GS181103-2PS10*	GS181103-2MB GS181103-2PS12	*GS181103-2PS12*	GS181103-2LCS GS181103-2PS13	*GS181103-2PS13*

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Reporting Units

LabID:	TstGrpName:	RptUnits:
1810627-21	Gamma_GKP_2018	pCi/g
1810627-22	Gamma_GKP_2018	pCi/g
1810627-23	Gamma_GKP_2018	pCi/g
1810627-24	Gamma_GKP_2018	pCi/g
1810627-25	Gamma_GKP_2018	pCi/g
1810627-26	Gamma_GKP_2018	pCi/g
1810627-27	Gamma_GKP_2018	pCi/g
1810627-28	Gamma_GKP_2018	pCi/g
1810627-29	Gamma_GKP_2018	pCi/g

Cnt 11/26

ALS -- Fort Collins

Radiochemistry Instrument Worksheet

Prep Batch: GS181103-2

Prep Procedure: GAMMASCAN

Analytical QASS / NCR? Y / N NA

Prep Num	Lab ID / Collection Date	QC Type	Init Alq	Fin Alq	Units / Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-21 10/26/18 09:20	SMP	233.5	233.5	g 17	pCi/g	30	5	11/27/18	120	8	12/5/18				Recount to hit MDC of 0.2
1	1810627-22 10/26/18 09:20	SMP	209.6	209.6	g 17	pCi/g		7		120	10	12/6/18				
1	1810627-23 10/26/18 11:00	SMP	169.1	169.1	g 17	pCi/g		8		1000	7	12/5/18				
1	1810627-24 10/26/18 14:45	SMP	134.7	134.7	g 17	pCi/g		9		1000	8					
1	1810627-25 10/26/18 15:30	SMP	121	121	g 17	pCi/g		10			109					
1	1810627-26 10/26/18 16:35	SMP	155.6	155.6	g 17	pCi/g		1			3	12/6/18				
1	1810627-27 10/29/18 10:10	SMP	235.5	235.5	g 17	pCi/g		3		2120	2	12/5/18				
1	1810627-28 10/29/18 11:35	SMP	172.2	172.2	g 17	pCi/g		5		1000	4	12/6/18				
1	1810627-29 10/29/18 12:45	SMP	149	149	g 17	pCi/g		7			5					
1	1810627-29 10/29/18 12:45	DUP	161	161	g 17	pCi/g		8			7					
1	GS181103-2 11/03/18 11:09	MB	215	215	g 17	pCi/g		9			89					
1	GS181103-2 11/03/18 11:09	LCS	215	215	g 17	pCi/g		10								

12/3

Natural UB

Ra226.UB

Cs-137(0.5)

Ra226(1)

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022		1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022	NA	420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

Sample Barcodes

1810627-21
GS181103-2PS1

1810627-22
GS181103-2PS2

1810627-23
GS181103-2PS3

1810627-24
GS181103-2PS4

1810627-25
GS181103-2PS5

1810627-26
GS181103-2PS6

1810627-27
GS181103-2PS7

1810627-28
GS181103-2PS8

1810627-29
GS181103-2PS9

1810627-29DUP
GS181103-2PS10

GS181103-2MB
GS181103-2PS12

GS181103-2LCS
GS181103-2PS13

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Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-2

Prep Procedure: Ra_226/228

Analytical QASS / NCR? Y / N NA

Prep Num	Lab ID Collection Date	QC Type	Init Alq	Fin Alq	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date	Notes
1	1810627-21 10/26/18 09:20	SMP	233.5	233.5	g 26	pCi/g	See Gamma Scan									
1	1810627-22 10/26/18 09:20	SMP	209.6	209.6	g 26	pCi/g										
1	1810627-23 10/26/18 11:00	SMP	169.1	169.1	g 26	pCi/g										
1	1810627-24 10/26/18 14:45	SMP	134.7	134.7	g 26	pCi/g										
1	1810627-25 10/26/18 15:30	SMP	121	121	g 26	pCi/g										
1	1810627-26 10/26/18 16:35	SMP	155.6	155.6	g 26	pCi/g										
1	1810627-27 10/29/18 10:10	SMP	235.5	235.5	g 26	pCi/g										
1	1810627-28 10/29/18 11:35	SMP	172.2	172.2	g 26	pCi/g										
1	1810627-29 10/29/18 12:45	SMP	149	149	g 26	pCi/g										
1	1810627-29 10/29/18 12:45	DUP	161	161	g 26	pCi/g										
1	GS181103-2A 11/03/18 11:09	LCS	215	215	g 26	pCi/g	30	1	11/27/18							
1	GS181103-2 11/03/18 11:09	MB	215	215	g 26	pCi/g	See Gamma Scan									

SG 12/12

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

Sample Barcodes

1810627-21
GS181103-2PS1

1810627-22
GS181103-2PS2

1810627-23
GS181103-2PS3

1810627-24
GS181103-2PS4

1810627-25
GS181103-2PS5

1810627-26
GS181103-2PS6

1810627-27
GS181103-2PS7

1810627-28
GS181103-2PS8

1810627-29
GS181103-2PS9

1810627-29DUP
GS181103-2PS10

GS181103-2ALCS
GS181103-2PS11

GS181103-2MB
GS181103-2PS12

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Reporting Units

LabID:	TstGrpName:	RptUnits:
1810627-21	GAMMA_Ra226	pCi/g
1810627-21	GAMMA_NP	pCi/g
1810627-22	GAMMA_NP	pCi/g
1810627-22	GAMMA_Ra226	pCi/g
1810627-23	GAMMA_NP	pCi/g
1810627-23	GAMMA_Ra226	pCi/g
1810627-24	GAMMA_Ra226	pCi/g
1810627-24	GAMMA_NP	pCi/g
1810627-25	GAMMA_Ra226	pCi/g
1810627-25	GAMMA_NP	pCi/g
1810627-26	GAMMA_NP	pCi/g
1810627-26	GAMMA_Ra226	pCi/g
1810627-27	GAMMA_NP	pCi/g
1810627-27	GAMMA_Ra226	pCi/g
1810627-28	GAMMA_NP	pCi/g
1810627-28	GAMMA_Ra226	pCi/g
1810627-29	GAMMA_Ra226	pCi/g
1810627-29	GAMMA_NP	pCi/g

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-2

Prep Procedure: GAMMASCAN

Reviewed By: smg SO **Review Date:** 12/4/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** NA **Re-Prep?** Y / (N) **Batch** NA **Prep QASS / NCR?** Y / (N) NA

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy SO for mrl
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 12:04:00 PM
Oven Out Date: 11/5/2018 4:15:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-21	SMP	NA	233.5	233.5	Dry Weight	17	27.5	261		
2	1	1810627-22	SMP		209.6	209.6	Dry Weight	17	27.5	237.1		
3	1	1810627-23	SMP		169.1	169.1	Dry Weight	17	27.6	196.7		
4	1	1810627-24	SMP		134.7	134.7	Dry Weight	17	27.4	162.1		
5	1	1810627-25	SMP		121	121	Dry Weight	17	27.3	148.3		
6	1	1810627-26	SMP		155.6	155.6	Dry Weight	17	27.5	183.1		
7	1	1810627-27	SMP		235.5	235.5	Dry Weight	17	27.3	262.8		
8	1	1810627-28	SMP		172.2	172.2	Dry Weight	17	27.5	199.7		
9	1	1810627-29	SMP		149	149	Dry Weight	17	27.2	176.2		
10	1	1810627-29	DUP		161	161	Dry Weight	17	27.5	188.5		
11	1	GS181103-2	MB		215	215	Dry Weight	17				
12	1	GS181103-2	LCS		215	215	Dry Weight	17			S1	

SO 12/4/18

SO 12/4

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A

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Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-2

Prep Procedure: GAMMASCAN

Reviewed By: mrl Mrl **Review Date:** 11/6/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy Mrl
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 12:04:00 PM
Oven Out Date: 11/5/2018 4:15:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-21	SMP	NA	233.5	233.5	Dry Weight	17	27.5	261		
2	1	1810627-22	SMP		209.6	209.6	Dry Weight	17	27.5	237.1	11/6/2018 Mrl	
3	1	1810627-23	SMP		169.1	169.1	Dry Weight	17	27.6	196.7		11/6/2018 Mrl
4	1	1810627-24	SMP		134.7	134.7	Dry Weight	17	27.4	162.1		
5	1	1810627-25	SMP		121	121	Dry Weight	17	27.3	148.3		
6	1	1810627-26	SMP		155.6	155.6	Dry Weight	17	27.5	183.1		
7	1	1810627-27	SMP		235.5	235.5	Dry Weight	17	27.3	262.8		
8	1	1810627-28	SMP		172.2	172.2	Dry Weight	17	27.5	199.7		
9	1	1810627-29	SMP		149	149	Dry Weight	17	27.2	176.2		
10	1	1810627-29	DUP		161	161	Dry Weight	17	27.5	188.5		
11	1	GS181103-2	MB		215	215	Dry Weight	17				
12	1	GS181103-2	LCS		215	215	Dry Weight	17			S1	

11/6/2018 Mrl

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	NA	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

323 of 614

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GS181103-2

Prep Procedure: Ra_226/228

Reviewed By: mrl MRL **Review Date:** 11/6/2018

Non-Routine Pre-Treatment? Y / (N) **Batch:** N/A **Re-Prep?** Y / (N) **Batch:** N/A **Prep QASS / NCR?** Y / (N) N/A

Prep SOP: PAI 739 **Rev:** 12
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Mitchell R. LeRoy MRL
Prep Date: 11/3/2018
Prep Dept: GM

Balance: 46
Balance: N/A

OvenNum: 19
Oven In Date: 11/3/2018 12:04:00 PM
Oven Out Date: 11/5/2018 4:15:00 PM

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes
1	1	1810627-21	SMP	N/A	233.5	233.5	Dry Weight	26	27.5	261		
2	1	1810627-22	SMP		209.6	209.6	Dry Weight	26	27.5	237.1	11/6/2018 MRL	
3	1	1810627-23	SMP		169.1	169.1	Dry Weight	26	27.6	196.7		11/6/2018 MRL
4	1	1810627-24	SMP		134.7	134.7	Dry Weight	26	27.4	162.1		
5	1	1810627-25	SMP		121	121	Dry Weight	26	27.3	148.3		
6	1	1810627-26	SMP		155.6	155.6	Dry Weight	26	27.5	183.1		
7	1	1810627-27	SMP		235.5	235.5	Dry Weight	26	27.3	262.8		
8	1	1810627-28	SMP		172.2	172.2	Dry Weight	26	27.5	199.7		
9	1	1810627-29	SMP		149	149	Dry Weight	26	27.2	176.2		
10	1	1810627-29	DUP		161	161	Dry Weight	26	27.5	188.5		
11	1	GS181103-2A	LCS		215	215	Dry Weight	26			S2	
12	1	GS181103-2	MB		215	215	Dry Weight	26				

11/6/2018 MRL 11/6/2018 MRL

Comments

Spiked By: N/A **Date:** N/A

Witnessed By: N/A **Date:** N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	1022	N/A	1,041.413	DPM/g	11/03/18	215	g	N/A
S1	Co-60	1022		420.158	DPM/g	11/03/18	215	g	N/A
S1	Cs-137	1022		395.440	DPM/g	11/03/18	215	g	N/A
S2	RA-226	144		1,039.475	DPM/g	11/03/18	215	g	N/A

Sample Condition Form (Solid)

Analyst: EST

Analysis Date: 11/3/18 | Method: Prep

Sample Condition (Visual Appearance of Analysis Aliquot at Time of Prep)

Work Order	Sample ID	Dry/Wet/ Moist	Texture	Remarks
1810627	21	Dry	Soil	None
	22			
	23			
	24			
	25			
	26			
	27			
	28			
	29			

11/2/18 EST

Section 8

STANDARDS TRACEABILITY DOCUMENTS

RSO # 1022 Received 2/26/2015

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352 8677
Fax 404·352·2837
www.ezag.com

CERTIFICATE OF CALIBRATION

Standard Reference Source

99580

Sand in Metal Can

Customer: ALS Laboratory Group
P.O. No.: FC000629, Item 2 Product Code: 8401-EG-SAN
Reference Date: 01-Jan-2015 12:00 PM EST **Grams of Master Source:** 0.01 1839

This standard radionuclide source was prepared using aliquots measured gravimetrically from master radionuclide solutions. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using a germanium gamma spectrometer system. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Nuclide	Gamma-Ray Energy (keV)	Half-Life, Days	Master Source* γps/gram	This Source γps	Uncertainty* , % Type u_A	u_B	U	Calibration Method*
Am-241	59.5	1.580E+05	———	1.348E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	1.628E+05	1.927E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	8.868E+04	1.050E+03	0.4	1.7	3.5	HPGe
Ce-139	165.9	1.376E+02	1.246E+05	1.476E+03	0.4	1.7	3.5	HPGe
Hg-203	279.2	4.659E+01	2.673E+05	3.164E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	1.756E+05	2.079E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.113E+05	1.318E+03	0.7	1.9	4.0	HPGe
Y-88	898.0	1.066E+02	4.123E+05	4.882E+03	0.7	1.7	3.7	HPGe
Co-60	1173.2	1.925E+03	2.106E+05	2.493E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	1.925E+03	2.109E+05	2.496E+03	0.7	1.8	3.9	HPGe
Y-88	1836.1	1.066E+02	4.365E+05	5.168E+03	0.7	1.7	3.7	HPGe

* Master Source refers to Analytics' 8-isotope mixture which is calibrated quarterly.

Calibration Methods: 4π LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)

Standard Re-Verified 02/26/2018.
New Exp. Date
⇒ 02/26/2019
JP 3/4/18

Comments:
~ 120 mL / 215.0 g of customer supplied sand.

This standard will expire one year after the reference date.

Source Prepared by: R. Ormsby, Radiochemist

QC Approved: J. S. Lahr, Spectroscopist Date: 20FEB15

Section 9

ADDITIONAL SUPPORTING DOCUMENTATION

Gamma Spectroscopy

Initial Calibration Standards Traceability

181403D01.SPC Analyzed by

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******************************************************************************
 SEEKER       G A M M A   A N A L Y S I S   R E S U L T S   PS Version 1.8.4

                  ALS Laboratory Group - Fort Collins
                              GammaScan
******************************************************************************
```

Geo 1 / Water

Sample ID: 082118-1 FWHM Cal (1089)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	08/21/2018 07:55:12
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	5.57E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	2700 Sec
Sample Size	1.00E+000 L	Real Time	2780 Sec
Collection Efficiency	1.0000	Spc. File	.181403D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.94 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 08/21/2018

FWHM(keV) = 0.67 + 0.010*En + 7.32E-04*En^2 + 0.00E+00*En^3 08/21/2017

Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.47	122.60	12074	308	178	6356	0.77	a
2	72.97	149.53	148	168	136	4590	0.42	a
3	87.95	179.45	53795	523	198	7926	0.83	a
4	122.07	247.56	33630	420	168	5661	0.89	a
5	136.52	276.40	4216	226	152	4688	0.83	a
6	165.84	334.94	28749	394	166	5061	0.93	a
7	255.16	513.23	832	184	143	3795	0.91	a
8	279.22	561.26	4747 Δ	212	133	3264	1.01	a
9	310.89	624.49	106	93	75	1370	0.53	a
10	391.76	785.92	18174	309	124	2632	1.15	a
11	511.34	1024.62	528	218	176	3960	2.48	a Wide Pk
12	661.76	1324.89	30300	374	113	2230	1.42	a
13	682.82	1366.94	99	156	127	2519	1.83	a NET< CL
14	712.32	1425.83	61	125	102	1823	1.50	a NET< CL
15	730.01	1461.14	54	71	57	802	0.73	a NET< CL
16	813.91	1628.63	243	119	94	1736	1.41	a
17	898.18	1796.85	19502	308	107	2104	1.64	a
18	952.77	1905.83	75	107	87	1656	1.07	a NET< CL
19	1173.38	2346.22	31544	366	72	1011	1.88	a HiResid
20	1325.23	2649.35	353	88	65	672	2.60	a HiResid
21	1332.57	2663.99	28633	344	52	504	1.98	b HiResid

Δ less Than 10,000 counts achieved due to greater Than 5 1/2 lives elapsed. [illegible]

181403D01.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	1836.03	3669.01	11469	217	27	123	2.43	a HiResid

181403D01.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 082118-1 FWHM Cal (1089)

Stds. Match Tolerance: 2.00 keV

Detector Number: 01 Calibration Date. . . 08/21/2018 07:55:12

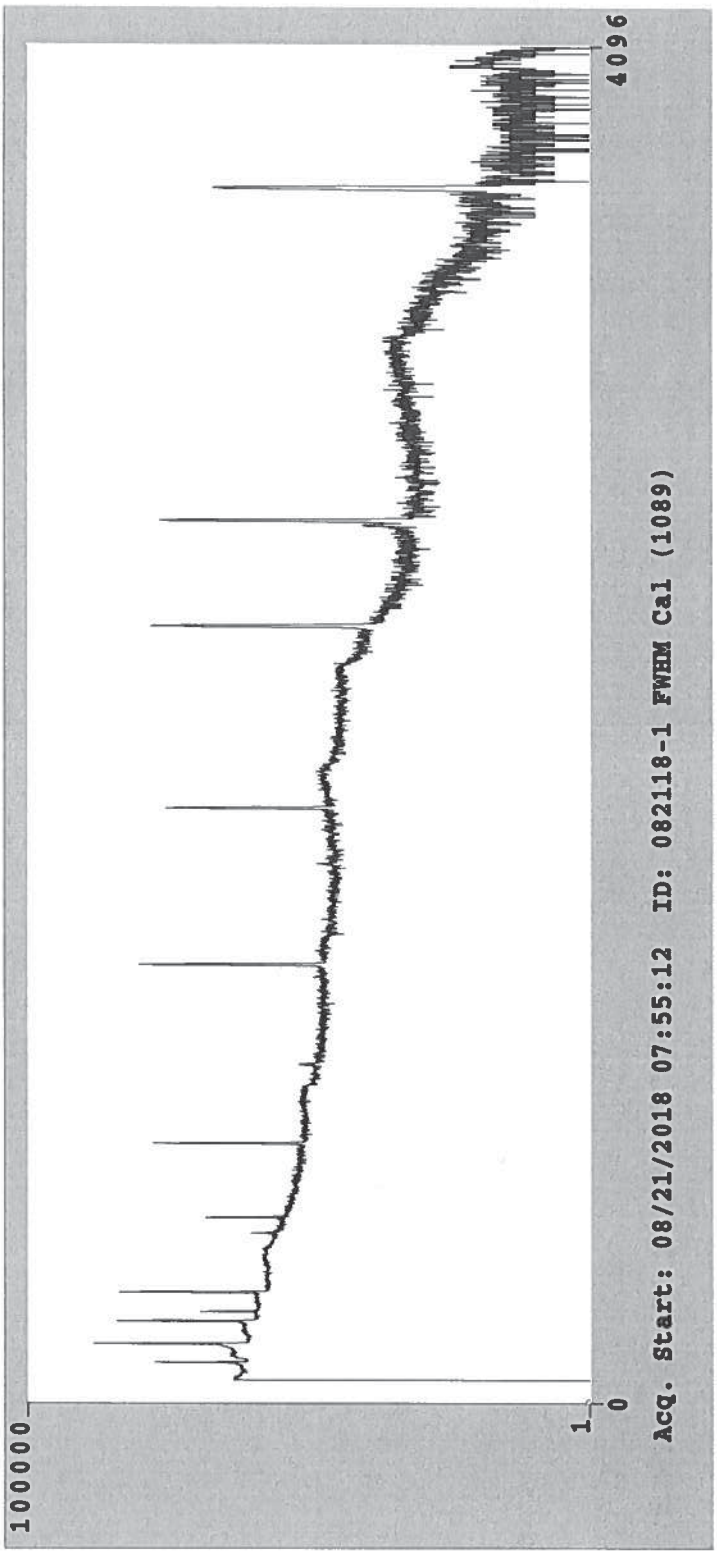
FWHM(keV) = 0.66 + 0.012*En + 6.94e-04*En^2 + 0.00e+00*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.773	1.81	0.787	-0.27	0.785
2	88.04	0.834	-0.96	0.826	-0.51	0.822
3	122.06	0.888	-2.15	0.869	-0.70	0.863
4	165.85	0.934	-1.45	0.921	-0.85	0.913
5	279.00	1.012	3.03	1.043	-1.03	1.033
6	391.68	1.147	0.84	1.157	-1.05	1.145
7	661.64	1.420	-0.50	1.413	-0.92	1.400
8	898.02	1.639	-0.83	1.626	-0.72	1.614
9	1173.21	1.883	-0.92	1.866	-0.49	1.857
10	1332.48	1.979	1.18	2.002	-0.36	1.995
11	1836.01	2.426	-0.06	2.425	0.01	2.425

Calibration Results Saved.

OK JP 8/21/18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0
4096
Acq. Start: 08/21/2018 07:55:12 ID: 082118-1 FWHM Cal (1089)

RSO
#1089
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108578
Source Description: 1.0 Liter Solid in 138G GA-MA Beaker
Product Code: 8401-EG-SD
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Density of solid matrix: 1.17 g/cm³ ± 3 %.

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.689E+03	1.324E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.193E+04	1.921E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.179E+03	1.009E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.774E+03	1.419E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.823E+03	3.118E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.035E+03	1.972E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.488E+03	1.266E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.089E+03	4.768E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.048E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.329E+03	2.326E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.329E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108578

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____

Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18

J. Lakr, Spectroscopist

181215D02.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 1 / Water

Sample ID: 073118-2 FWHM Cal (1089)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 07/31/2018 12:28:40
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 5.07E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 4500 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 4773 Sec
Collection Efficiency 1.0000	Spc. File 181215D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.34 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 07/31/2018
FWHM(keV) = 1.11 + -0.039*En + 2.65E-03*En^2 +-2.25E-05*En^3 07/31/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.49	121.43	10375	400	283	14828	1.05	a	
2	87.98	178.30	77963	699	346	20431	1.07	a	
3	122.08	246.37	58685	611	306	15994	1.09	a	
4	136.50	275.15	7656	354	253	11865	0.98	a	
5	165.86	333.76	56833	584	277	13112	1.15	a	
6	255.23	512.15	1812	296	233	9274	1.20	a	
7	279.22	560.05	13058	373	242	9276	1.31	a	
8	391.78	784.72	42044	472	193	6871	1.38	a	
9	510.34	1021.38	524	261	211	6938	1.77	a	
10	511.97	1024.63	457	224	181	5677	1.42	b	
11	661.79	1323.70	64182	555	187	5715	1.63	a	
12	814.08	1627.69	599	189	150	4182	1.71	a	
13	898.23	1795.66	47361	483	172	5228	1.87	a	
14	1173.45	2345.04	69733	550	127	2876	2.13	a	HiResid
15	1325.38	2648.31	1344	204	157	2797	4.36	a	HiResid Wide Pk
16	1332.66	2662.84	63913	518	92	1450	2.29	b	HiResid
17	1836.18	3667.92	29479	349	53	424	2.78	a	HiResid

181215D02.SPC Analyzed by

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

Sample ID: 073118-2 FWHM Cal (1089)
Stds. Match Tolerance: 2.00 keV

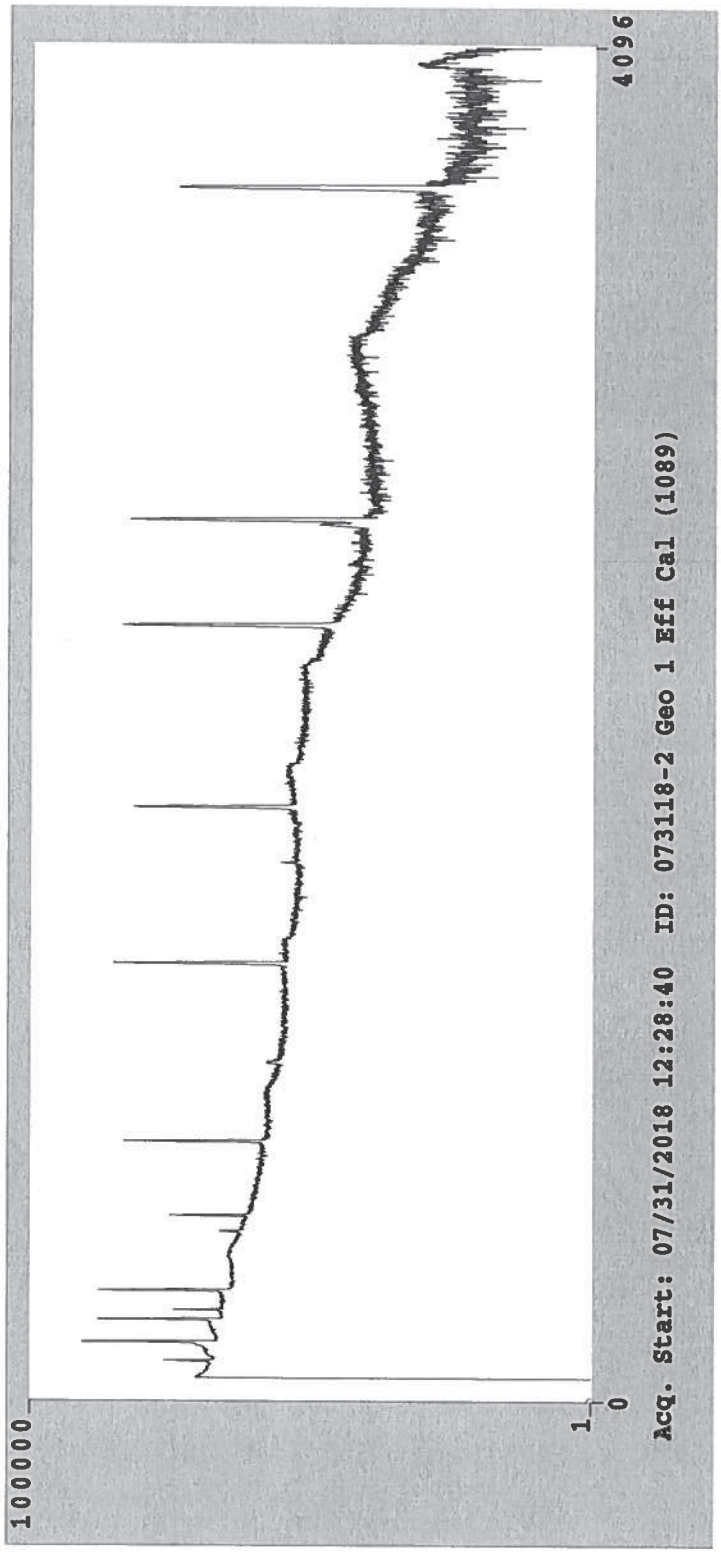
Detector Number: 02 Calibration Date. . . 07/31/2018 12:28:40

FWHM(keV) = 0.97 + 0.002*En + 9.30e-04*En^2 + 0.00e+00*En^3
(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	1.049	-0.32	1.045	-8.73	0.962
2	88.04	1.073	0.22	1.076	-11.59	0.964
3	122.06	1.093	1.60	1.111	-13.64	0.977
4	165.85	1.150	0.45	1.155	-15.02	1.004
5	279.00	1.307	-2.98	1.269	-15.49	1.099
6	391.68	1.380	-0.01	1.380	-14.30	1.208
7	661.64	1.629	0.89	1.644	-10.79	1.484
8	898.02	1.873	0.01	1.873	-8.71	1.723
9	1173.21	2.135	0.16	2.138	-7.59	1.987
10	1332.48	2.287	0.19	2.291	-7.47	2.132
11	1836.01	2.779	-0.23	2.773	-8.98	2.544

Calibration Results Saved.

OK JP 8/1/18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181215D02.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 073118-2 FWHM Cal (1089)
Stds. Match Tolerance: 2.00 keV

Detector Number: 02 Calibration Date. . . 07/31/2018 12:28:40

FWHM(keV) = 0.97 + 0.002*En + 9.30e-04*En^2 + 0.00e+00*En^3
(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	1.049	-0.32	1.045	-8.73	0.962
2	88.04	1.073	0.22	1.076	-11.59	0.964
3	122.06	1.093	1.60	1.111	-13.64	0.977
4	165.85	1.150	0.45	1.155	-15.02	1.004
5	279.00	1.307	-2.98	1.269	-15.49	1.099
6	391.68	1.380	-0.01	1.380	-14.30	1.208
7	661.64	1.629	0.89	1.644	-10.79	1.484
8	898.02	1.873	0.01	1.873	-8.71	1.723
9	1173.21	2.135	0.16	2.138	-7.59	1.987
10	1332.48	2.287	0.19	2.291	-7.47	2.132
11	1836.01	2.779	-0.23	2.773	-8.98	2.544

RSO
#1089
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108578
Source Description: 1.0 Liter Solid in 138G GA-MA Beaker
Product Code: 8401-EG-SD
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Density of solid matrix: 1.17 g/cm³ ± 3 %.

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s⁻¹	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.689E+03	1.324E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.193E+04	1.921E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.179E+03	1.009E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.774E+03	1.419E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.823E+03	3.118E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.035E+03	1.972E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.488E+03	1.266E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.089E+03	4.768E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.048E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.329E+03	2.326E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.329E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 108578

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____

Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18

J. Lakr, Spectroscopist

182393D03.SPC Analyzed by JP

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 1 / Water

Sample ID: 110118-3 FWHM Cal (1089)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	11/01/2018 11:05:02
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	7.30E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	4500 Sec
Sample Size	1.00E+000 L	Real Time	4611 Sec
Collection Efficiency	1.0000	Spc. File	.182393D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.58 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/01/2018
FWHM(keV) = 0.63 + 0.021*En + 8.26E-04*En^2 + 0.00E+00*En^3 11/03/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.47	121.83	25909	456	265	13017	0.96	a HiResid
2	87.95	178.65	92624	701	286	15079	1.00	a HiResid
3	122.06	246.73	50754	532	232	9958	1.02	a HiResid
4	136.51	275.56	6616	329	235	9400	1.09	a
5	165.85	334.12	36347	467	222	8377	1.15	a HiResid
6	255.29	512.60	762	205	162	5564	0.94	a
7	279.27	560.46	Δ 2870	233	170	5707	1.19	a
8	391.79	785.00	21187	359	173	5229	1.48	a HiResid
9	511.39	1023.68	547	233	188	5682	2.07	a
10	661.84	1323.91	53445	500	156	4278	1.83	a HiResid
11	813.82	1627.21	461	199	160	4352	2.21	a
12	821.25	1642.03	215	143	115	2798	1.41	b
13	898.29	1795.76	21239	352	163	4713	2.08	a HiResid
14	1113.76	2225.77	157	183	149	3795	2.23	a
15	1173.60	2345.18	52478	500	164	4402	2.45	a HiResid
16	1275.06	2547.64	74	65	52	563	1.46	a
17	1332.83	2662.95	47307	465	135	2887	2.65	a HiResid
18	1836.38	3667.82	12201	230	53	385	3.23	a HiResid

Δ less Than 10,000 counts achieved due to greate Than 5 1/2-lives elapsed.
JP 11/2/18

182393D03.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 110118-3 FWHM Cal (1089)

Stds. Match Tolerance: 2.00 keV

Detector Number: 03 Calibration Date. . . 11/01/2018 11:05:02

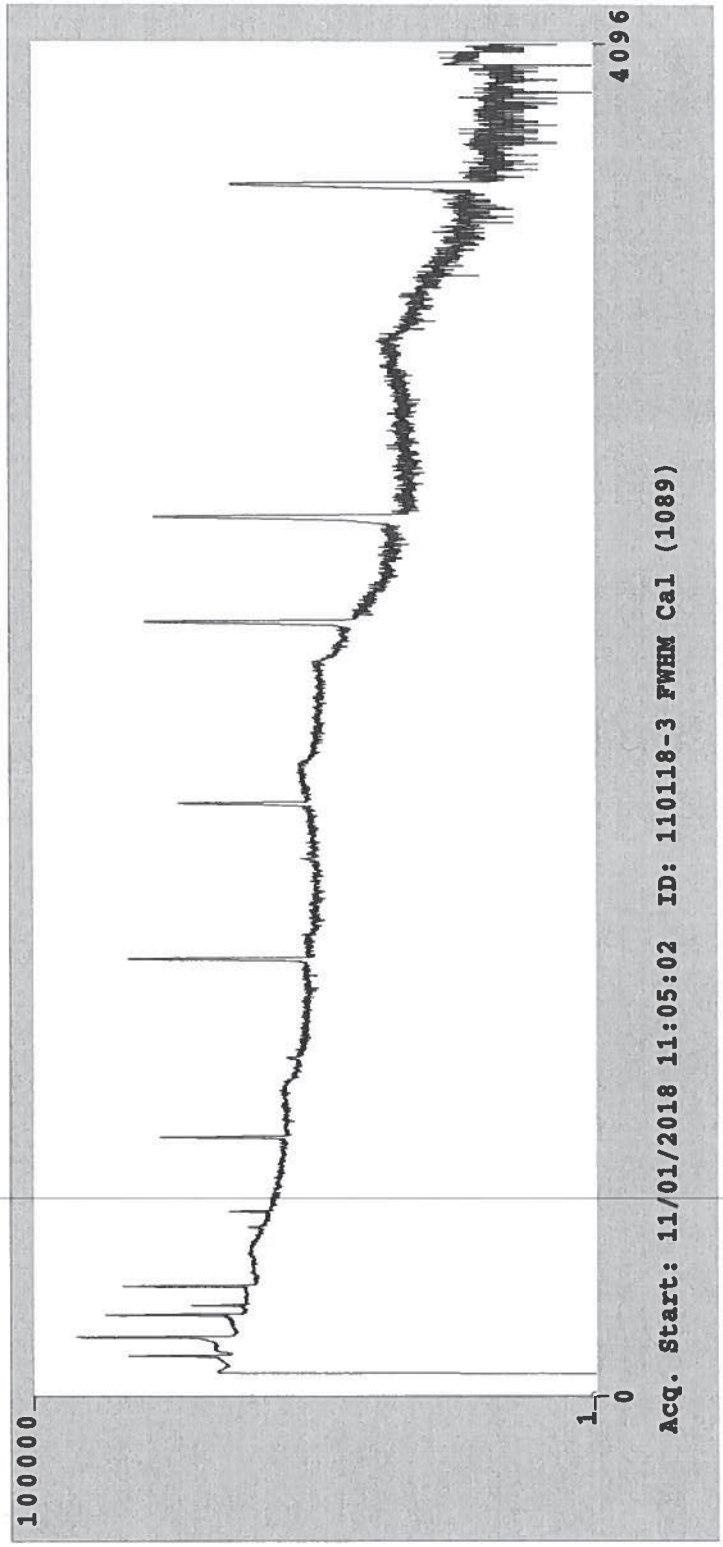
FWHM(keV) = 0.79 + 0.012*En + 1.05e-03*En^2 + 0.00e+00*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.965	-2.28	0.943	-11.82	0.844
2	88.04	0.999	-0.50	0.994	-10.11	0.903
3	122.06	1.023	2.58	1.050	-8.71	0.966
4	165.85	1.151	-2.92	1.118	-7.47	1.041
5	279.00	1.195	6.93	1.284	-5.69	1.215
6	391.68	1.476	-2.49	1.440	-4.88	1.373
7	661.64	1.831	-1.93	1.796	-4.37	1.721
8	898.02	2.076	1.00	2.097	-4.52	2.006
9	1173.21	2.445	-0.29	2.438	-4.93	2.324
10	1332.48	2.645	-0.45	2.633	-5.22	2.503
11	1836.01	3.228	0.36	3.240	-6.15	3.052

Calibration Results Saved.

On JP 11/2/18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Acq. Start: 11/01/2018 11:05:02 ID: 110118-3 FWHM Cal (1089)

181960D04.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo.9 / CHARC. FLTR

Sample ID: 092518-4 FWHM Cal (1097)

Sampling Start: 07/01/2018 10:00:00	Counting Start: 09/25/2018 09:26:02
Sampling Stop: 07/01/2018 10:00:00	Decay Time. . . . . 2.06E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 1.00E+000 SAMPLE	Real Time . . . . . 1858 Sec
Collection Efficiency 1.0000	Spc. File 181960D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.55 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/25/2018
FWHM(keV) = 0.89 + 0.004*En + 1.15E-03*En^2 + 0.00E+00*En^3 01/10/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.50	121.89	32638	472	250	11522	0.98 a	HiResid
2	67.32	137.50	1758	676	551	29305	2.73 a	Wide Pk
3	70.75	144.35	2840	374	295	13791	1.39 b	
4	72.87	148.58	3783	346	266	12067	1.07 c	
5	82.46	167.73	2181	432	347	17832	1.42 a	HiResid Wide Pk
6	85.66	174.11	6703	765	615	33497	3.09 b	HiResid
7	87.99	178.76	131692	791	258	11336	1.07 c	HiResid
8	122.09	246.85	80264	632	231	9079	1.14 a	HiResid
9	136.52	275.64	9909	330	217	8023	1.15 a	
10	165.86	334.23	85874	638	207	7303	1.20 a	HiResid
11	255.12	512.43	2472	231	172	5456	1.27 a	
12	279.19	560.49	53325	503	164	4988	1.33 a	HiResid
13	310.27	622.52	199	146	118	2917	1.03 a	
14	391.73	785.16	51982	495	159	4421	1.48 a	HiResid
15	427.09	855.75	84	119	97	2129	0.86 a	NET< CL
16	509.82	1020.92	343	172	139	3545	1.71 a	
17	511.77	1024.82	586	224	180	4963	2.22 b	
18	661.71	1324.17	33284	416	164	4716	1.81 a	HiResid
19	693.04	1386.71	148	155	126	3258	1.30 a	
20	813.86	1627.91	928	180	139	3301	2.23 a	

181960D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	898.12	1796.14	47812	473	149	3916	2.05	a HiResid
22	1173.31	2345.54	30466	375	113	2188	2.22	a HiResid
23	1332.53	2663.41	26998	361	122	2449	2.49	a HiResid
24	1835.93	3668.43	24376	335	99	1442	2.97	a HiResid

181960D04.SPC Analyzed by

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

Sample ID: 092518-4 FWHM Cal (1097)
Stds. Match Tolerance: 2.00 keV

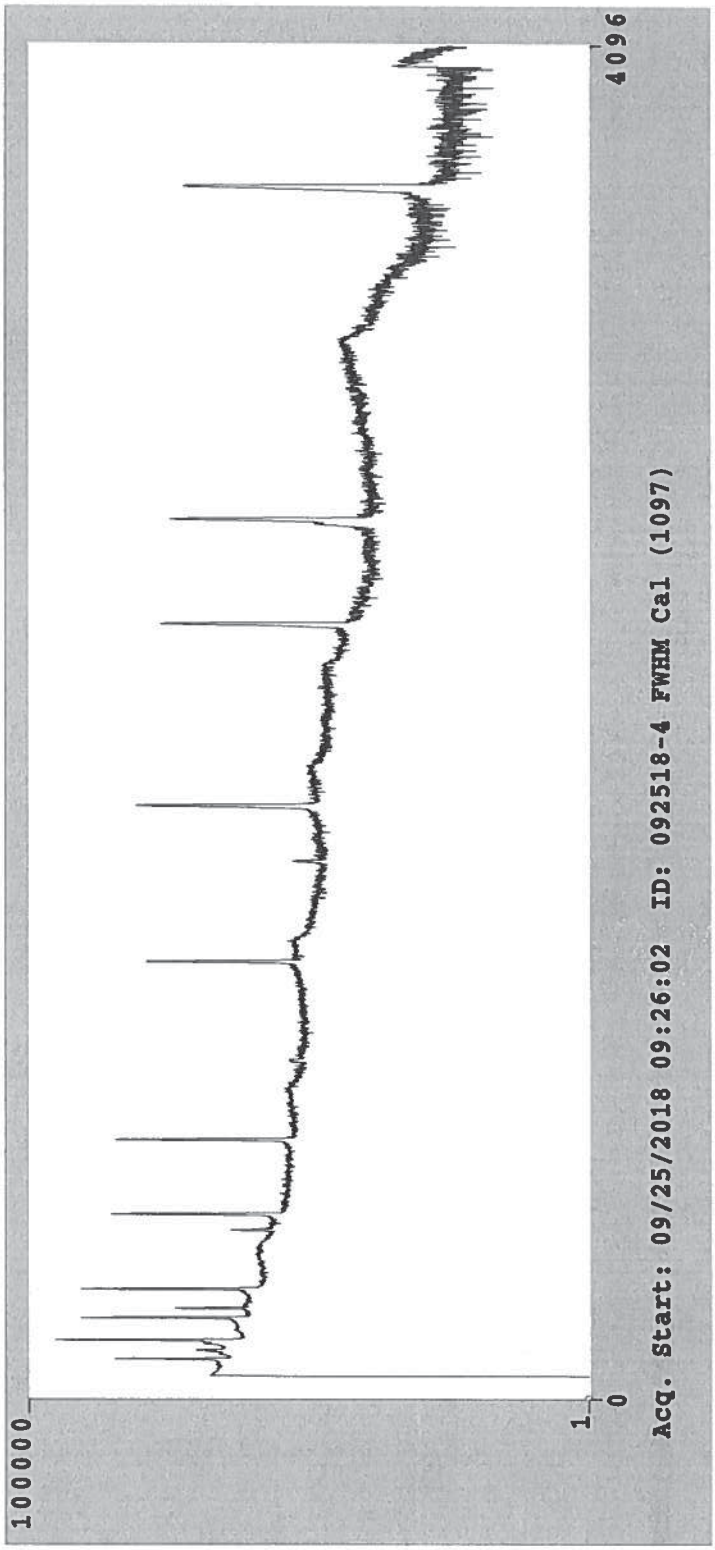
Detector Number: 04 Calibration Date. . . 09/25/2018 09:26:02

FWHM(keV) = 0.82 + 0.019*En + 7.17e-04*En^2 + 0.00e+00*En^3
(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.983	2.78	1.011	-1.82	0.993
2	88.04	1.072	-0.86	1.063	-2.92	1.033
3	122.06	1.136	-1.49	1.119	-3.69	1.079
4	165.85	1.196	-0.95	1.185	-4.18	1.137
5	279.00	1.327	0.88	1.338	-4.24	1.284
6	391.68	1.475	0.17	1.478	-3.55	1.427
7	661.64	1.814	-1.73	1.783	-1.14	1.763
8	898.02	2.055	-1.06	2.033	1.01	2.054
9	1173.21	2.221	3.91	2.312	3.25	2.389
10	1332.48	2.492	-0.97	2.468	4.42	2.582
11	1836.01	2.969	-0.66	2.949	7.54	3.190

Calibration Results Saved.

OK JP 9/25/18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Acq. Start: 09/25/2018 09:26:02 ID: 092518-4 FWHM Cal (1097)

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.ezag.com

RSO
1097

Received 8/20/18

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 110300
Source Description: Face Loaded Yellow Plastic Hi-Q Charcoal Cartridge
Product Code: 8401-EG-CH
Customer: ALS Laboratory Group
P.O. Number: FC001958, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-July-2018 12:00 PM EST

MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	1.868E+03	6.706E+02	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	2.625E+04	9.713E+02	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	5.936E+02	5.081E+02	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	8.908E+02	7.126E+02	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	1.896E+03	1.547E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	1.546E+03	1.005E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	7.596E+02	6.464E+02	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	2.541E+03	2.381E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	2.521E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	1.186E+03	1.184E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	1.185E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 110300

Comments:
Active material deposited on first 5 mm

Expiration Date: 17-August-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: Anthony J. Chirillo
A. Chirillo, Radiochemist

QC Approved by:
J. Lahr, Spectroscopist

Date: 16-AUG-18

180435D05.SPC Analyzed by JP

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo.9 / CHARC. FLTR

Sample ID: 041718-5 FWHM (1075)

Sampling Start: 07/01/2017 10:00:00	Counting Start: 04/17/2018 12:33:46
Sampling Stop: 07/01/2017 10:00:00	Decay Time. . . . . 6.96E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 1.00E+000 SAMPLE	Real Time . . . . . 3776 Sec
Collection Efficiency 1.0000	Spc. File 180435D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.75 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 04/17/2018
FWHM(keV) = 0.48 + 0.023*En + 6.98E-04*En^2 + 0.00E+00*En^3 04/18/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.52	120.43	28929	439	229	10558	0.75 a	
2	88.01	177.37	152624	837	248	12353	0.79 a	Wide Pk
3	89.48	180.31	3381	413	326	15733	1.50 b	
4	121.99	245.27	93248	656	196	7746	0.88 a	HiResid
5	136.40	274.07	12372	322	191	6765	0.94 a	
6	165.78	332.78	67247	567	188	6541	0.96 a	HiResid
7	167.69	336.59	503	233	188	6541	0.94 b	HiResid
8	255.00	511.06	1884	247	190	6187	1.14 a	
9	279.09	559.20	6094	272	183	5697	1.10 a	
10	310.35	621.66	207	143	115	2927	0.65 a	
11	391.59	784.01	39691	449	171	5393	1.29 a	HiResid
12	511.19	1022.99	519	225	181	5383	1.70 a	
13	568.27	1137.05	136	173	141	3664	1.29 a	NET< CL
14	661.58	1323.52	88659	628	165	5004	1.62 a	HiResid
15	813.75	1627.59	286	184	148	4071	1.57 a	
16	898.00	1795.94	35417	432	174	5326	1.88 a	HiResid
17	1173.17	2345.80	83992	603	137	3338	2.20 a	HiResid
18	1332.47	2664.11	73418	575	158	4239	2.30 a	HiResid
19	1510.35	3019.57	92	86	69	909	1.72 a	
20	1836.03	3670.36	19139	296	87	1194	2.65 a	HiResid

180435D05.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 041718-5 FWHM (1075)
Stds. Match Tolerance: 2.00 keV

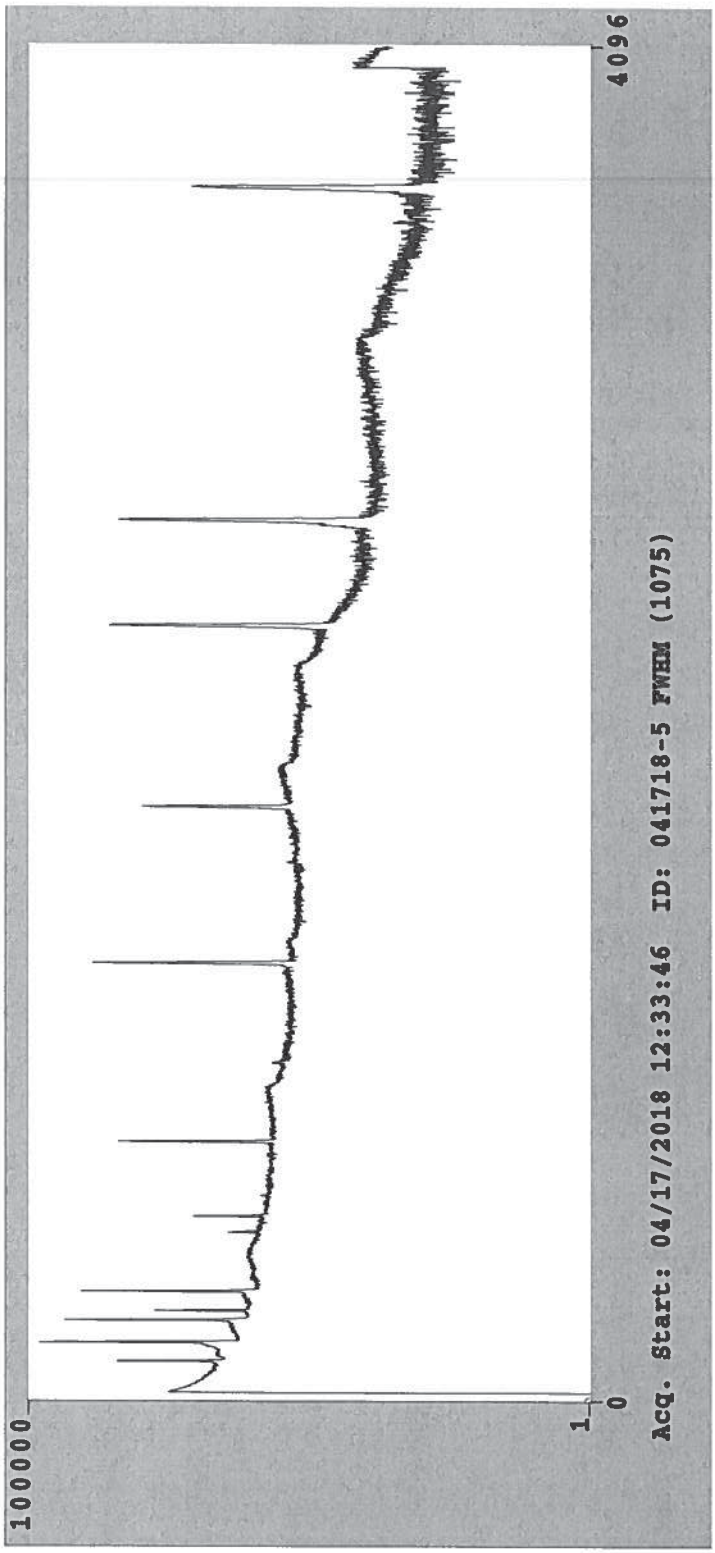
Detector Number: 05 Calibration Date. . . 04/17/2018 12:33:46

FWHM(keV) = 0.65 + -0.002*En + 2.17e-03*En^2 +-2.42e-05*En^3
(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.753	0.36	0.756	-8.01	0.700
2	88.04	0.785	2.58	0.806	-6.29	0.758
3	122.06	0.884	-2.23	0.865	-5.33	0.821
4	165.85	0.956	-2.03	0.937	-4.88	0.894
5	279.00	1.102	1.15	1.115	-5.07	1.061
6	391.68	1.286	-0.52	1.279	-5.61	1.211
7	661.64	1.616	0.88	1.630	-6.06	1.537
8	898.02	1.880	0.83	1.896	-5.31	1.800
9	1173.21	2.196	-1.47	2.164	-3.46	2.092
10	1332.48	2.295	0.22	2.301	-2.03	2.255
11	1836.01	2.649	0.19	2.654	3.59	2.753

Calibration Results Saved.

OK JP 4/18/18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Acq. Start: 04/17/2018 12:33:46 ID: 041718-5 FWHM (1075)

180435D05.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 041718-5 FWHM (1075)

Stds. Match Tolerance: 2.00 keV

Detector Number: 05 Calibration Date. . . 04/17/2018 12:33:46

FWHM(keV) = 0.65 + -0.002*En + 2.17e-03*En^2 +-2.42e-05*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.753	0.36	0.756	-8.01	0.700
2	88.04	0.785	2.58	0.806	-6.29	0.758
3	122.06	0.884	-2.23	0.865	-5.33	0.821
4	165.85	0.956	-2.03	0.937	-4.88	0.894
5	279.00	1.102	1.15	1.115	-5.07	1.061
6	391.68	1.286	-0.52	1.279	-5.61	1.211
7	661.64	1.616	0.88	1.630	-6.06	1.537
8	898.02	1.880	0.83	1.896	-5.31	1.800
9	1173.21	2.196	-1.47	2.164	-3.46	2.092
10	1332.48	2.295	0.22	2.301	-2.03	2.255
11	1836.01	2.649	0.19	2.654	3.59	2.753

RSO # 1075 Reid 8/31/17

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 106879
Source Description: Face Loaded Yellow Plastic Hi-Q Charcoal Cartridge
Product Code: 8401-EG-CH
Customer: ALS Laboratory Group
P.O. Number: FC001498, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-July-2017 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	1.868E+03	6.707E+02	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	2.600E+04	9.618E+02	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	5.993E+02	5.130E+02	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	8.934E+02	7.147E+02	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	1.890E+03	1.541E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	1.547E+03	1.005E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	7.420E+02	6.315E+02	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	2.574E+03	2.412E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	2.554E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	1.224E+03	1.222E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	1.224E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 106879

Comments:
Active material deposited on first 5 mm.

Expiration Date: 29-August-2018

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 25-AUG-17
J. Lahr, Spectroscopist

181498D07.SPC Analyzed by

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

****

Geo 1 / Water

Sample ID: 092418-7 FWHM Cal (1089)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 09/24/2018 09:33:26
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 6.38E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 3725 Sec
Collection Efficiency 1.0000	Spc. File 181498D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.37 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/24/2018
FWHM(keV) = 0.78 + -0.005*En + 1.72E-03*En^2 + 0.00E+00*En^3 11/08/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.39	123.15	13576	340	204	8378	0.88	a	HiResid
2	87.95	180.10	70856	603	232	10882	0.88	a	HiResid
3	121.95	247.89	46497	512	226	9459	0.93	a	
4	136.38	276.65	5992	293	205	7733	0.93	a	
5	165.80	335.32	37079	454	197	7183	0.97	a	HiResid
6	255.27	513.70	1102	240	190	6141	1.16	a	
7	279.26	561.54	4394	240	165	5338	1.09	a	
8	391.82	785.97	23831	353	141	3945	1.19	a	
9	511.18	1023.96	712	239	191	5631	2.25	a	
10	621.06	1243.05	97	104	84	1729	0.89	a	
11	661.97	1324.63	48724	470	132	3393	1.41	a	HiResid
12	814.36	1628.46	345	140	111	2606	1.53	a	
13	898.32	1795.88	25651	358	131	3461	1.66	a	HiResid
14	1173.51	2344.58	52185	473	101	1877	1.94	a	HiResid
15	1328.79	2654.20	1662	223	171	2398	6.87	a	HiResid Wide Pk
16	1332.68	2661.94	48140	446	65	742	2.05	b	HiResid
17	1835.72	3664.96	15544	253	34	188	2.46	a	HiResid

181496D07.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: daily check
Stds. Match Tolerance: 2.00 keV

Detector Number: 07 Calibration Date. . . 09/24/2018 09:09:32

Energy(keV) = -2.37 + 0.502*Ch + 0.00e+00*Ch^2 + 0.00e+00*Ch^3

Pk. #	Measured Centroid	Calculated Energy	Energy (keV)	% Difference
1	123.14	59.39	59.50	-0.19
2	1324.39	661.85	661.64	0.03
3	2661.35	1332.38	1332.48	-0.01

Calibration Results Saved.

181498D07.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 092418-7 FWHM Cal (1089)
Stds. Match Tolerance: 2.00 keV

Detector Number: 07 Calibration Date. . . 09/24/2018 09:33:26

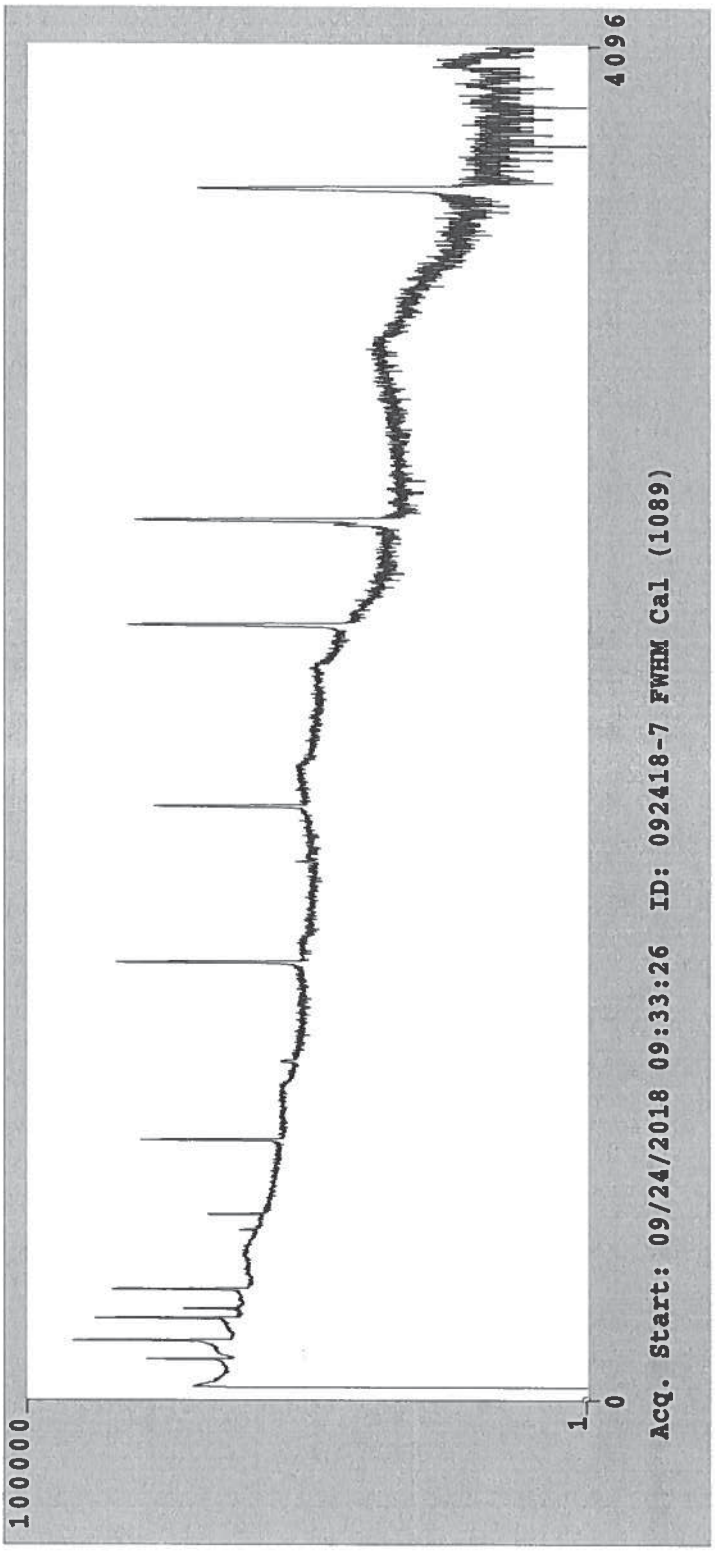
FWHM(keV) = 0.77 + 0.005*En + 8.11e-04*En^2 + 0.00e+00*En^3
(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.		Prev.Calc. FWHM(kev)
1	59.50	0.880	-2.06	0.862	-2.20	Δ	0.843
2	88.04	0.878	1.72	0.894	-1.08		0.884
3	122.06	0.932	-0.28	0.930	0.48		0.934
4	165.85	0.969	0.55	0.974	2.58		1.000
5	279.00	1.092	-0.59	1.086	7.66		1.176
6	391.68	1.193	-0.05	1.193	11.92		1.354
7	661.64	1.405	2.53	1.442	19.42		1.789
8	898.02	1.657	-0.12	1.655	23.90		2.175
9	1173.21	1.935	-1.83	1.900	27.68		2.628
10	1332.48	2.055	-0.67	2.041	29.40		2.891
11	1836.01	2.461	0.83	2.482	33.40		3.726

Calibration Results Saved.

Ok
JP 9/25/18

Δ → Different Detector than previous FWHM Calibration → Detector will be re-calibrated for all geometries.
JP 9/25/18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4096
Acq. Start: 09/24/2018 09:33:26 ID: 092418-7 FWHM Cal (1089)

RSO
#1089
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108578
Source Description: 1.0 Liter Solid in 138G GA-MA Beaker
Product Code: 8401-EG-SD
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Density of solid matrix: 1.17 g/cm³ ± 3 %.

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.689E+03	1.324E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.193E+04	1.921E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.179E+03	1.009E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.774E+03	1.419E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.823E+03	3.118E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.035E+03	1.972E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.488E+03	1.266E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.089E+03	4.768E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.048E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.329E+03	2.326E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.329E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 108578

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____

Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18

J. Lakr, Spectroscopist

180490D08.SPC Analyzed by JM

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo.9 / CHARC. FLTR

Sample ID: 041718-8 FWHM (1075)

Sampling Start: 07/01/2017 10:00:00	Counting Start: 04/17/2018 08:49:57
Sampling Stop: 07/01/2017 10:00:00	Decay Time. . . . . 6.96E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 1.00E+000 SAMPLE	Real Time . . . . . 4213 Sec
Collection Efficiency 1.0000	Spc. File 180490D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.42 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 04/17/2018
FWHM(keV) = 0.66 + 0.008*En + 7.24E-04*En^2 + 0.00E+00*En^3 04/18/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	43.54	91.69	12062	645	499	50111	0.79 a	HiResid
2	46.82	98.23	0	376	310	23604	0.49 b	Wide Pk NET< CL
3	49.57	103.73	3066	435	346	26563	0.60 c	HiResid HiResid
4	51.10	106.77	-0	668	549	47809	1.30 d	NET< CL
5	51.22	107.02	0	463	381	29254	0.77 e	HiResid NET< CL
6	52.02	108.61	0	899	739	67293	2.04 f	HiResid NET< CL
7	59.47	123.49	353464	1253	325	21326	0.77 a	HiResid Wide Pk
8	60.40	125.33	1458	525	427	28902	1.34 b	
9	66.42	137.35	6826	652	519	33202	1.89 a	Wide Pk
10	68.21	140.91	6000	693	555	35969	2.09 b	
11	70.49	145.46	6181	736	591	38736	2.21 c	
12	73.03	150.53	4494	731	591	38736	2.36 d	
13	77.09	158.64	2852	727	591	38736	2.36 e	
14	78.38	161.20	272	274	223	11067	0.60 f	
15	81.14	166.72	1177	326	262	13834	0.89 g	
16	88.02	180.44	333358	1196	257	13278	0.82 a	HiResid

180490D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
17	102.82	209.98	260	250	204	8373	0.85	a
18	109.60	223.50	1613	280	221	8992	0.97	a HiResid
19	112.52	229.33	142	166	135	4496	0.42	b HiResid
20	122.03	248.30	115772	713	175	6171	0.86	a HiResid
21	136.45	277.07	14823	310	158	5053	0.87	a
22	143.26	290.66	546	353	288	10830	1.82	a Wide Pk
23	165.88	335.79	59590	530	169	5305	0.91	a
24	199.20	402.27	4787	248	169	5295	0.96	a
25	203.92	411.69	1089	216	169	5295	1.02	b
26	255.29	514.19	1251	176	133	3550	0.81	a
27	279.31	562.11	5657	230	143	3758	1.05	a
28	310.64	624.61	216	127	101	2273	0.66	a
29	391.92	786.78	32637	409	157	4208	1.14	a
30	511.15	1024.68	775	291	235	6810	2.65	a Wide Pk
31	512.59	1027.56	67	102	83	1703	0.64	b NET< CL
32	572.54	1147.15	104	154	126	2913	1.24	a NET< CL
33	662.12	1325.89	71102	566	156	4250	1.40	a
34	683.61	1368.76	399	179	144	3815	1.31	a
35	814.56	1630.04	423	153	121	2705	1.30	a
36	877.88	1756.38	139	179	146	3924	1.61	a NET< CL
37	898.49	1797.50	28096	387	158	4638	1.61	a
38	912.70	1825.86	1399	264	208	6657	2.22	a
39	1173.71	2346.63	70003	552	129	2917	1.82	a HiResid
40	1194.64	2388.38	686	229	184	4022	3.38	a Wide Pk
41	1198.57	2396.23	52	142	117	2092	2.31	b NET< CL
42	1325.19	2648.87	429	116	89	1246	2.61	a HiResid
43	1332.88	2664.21	62360	513	97	1752	1.97	b HiResid
44	1353.30	2704.95	731	181	142	2412	4.07	a Wide Pk
45	1835.99	3668.01	15578	260	61	611	2.40	a
46	1850.37	3696.70	682	100	71	761	2.85	a

180490D08.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 041718-8 FWHM (1075)

Stds. Match Tolerance: 2.00 keV

Detector Number: 08 Calibration Date. . . 04/17/2018 08:49:57

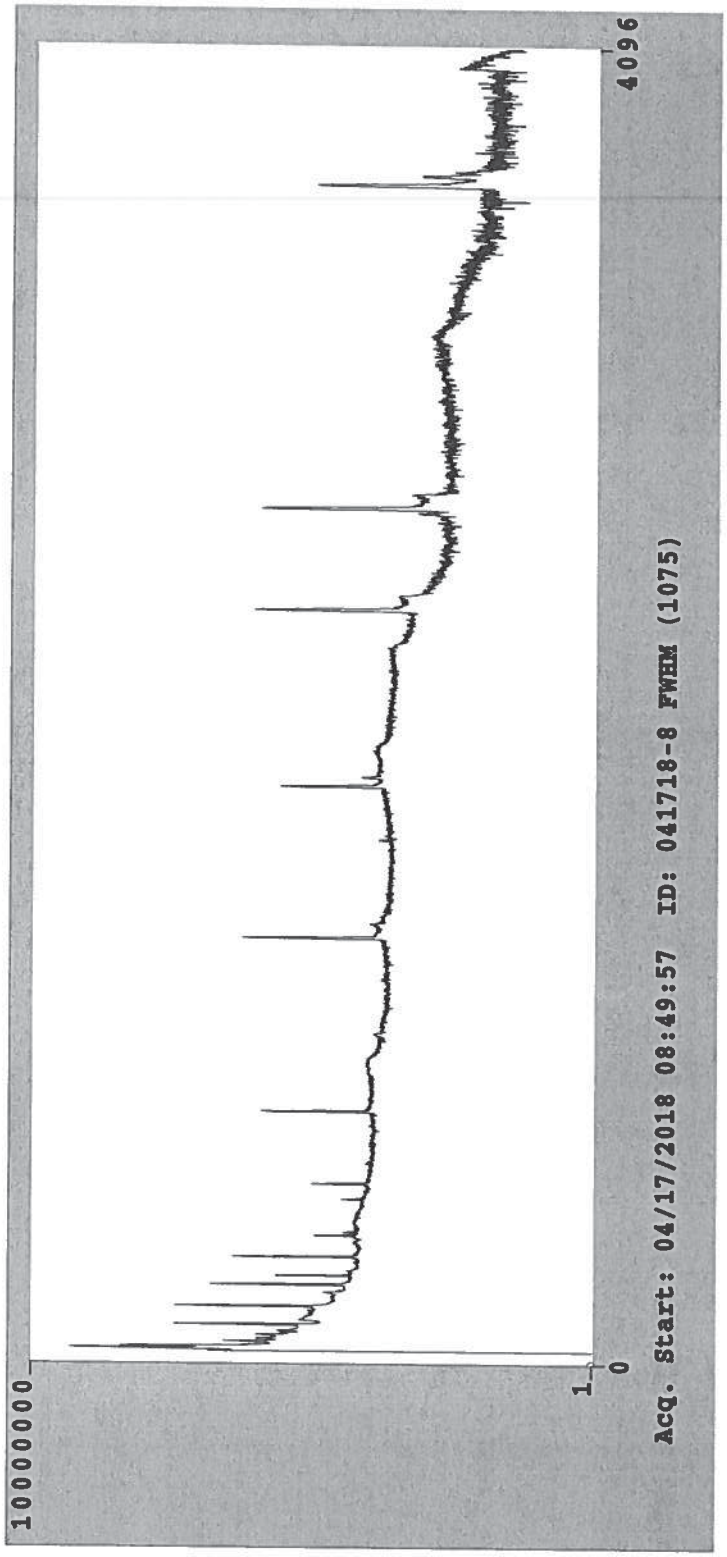
FWHM(keV) = 0.65 + 0.012*En + 6.79e-04*En^2 + 0.00e+00*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.772	0.98	0.780	-1.18	0.771
2	88.04	0.821	-0.35	0.818	-1.63	0.805
3	122.06	0.861	-0.09	0.861	-1.99	0.844
4	165.85	0.907	0.47	0.911	-2.32	0.891
5	279.00	1.048	-1.48	1.032	-2.75	1.005
6	391.68	1.141	0.31	1.144	-2.91	1.112
7	661.64	1.400	-0.32	1.396	-2.88	1.357
8	898.02	1.611	-0.34	1.605	-2.68	1.564
9	1173.21	1.824	0.98	1.842	-2.40	1.799
10	1332.48	1.970	0.28	1.976	-2.23	1.933
11	1836.01	2.401	-0.43	2.391	-1.73	2.350

Calibration Results Saved.

Ok JP 4/18/18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Acq. Start: 04/17/2018 08:49:57 ID: 041718-8 FWHM (1075)

RSO # 1075 Rec'd 8/31/17

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 106879
Source Description: Face Loaded Yellow Plastic Hi-Q Charcoal Cartridge
Product Code: 8401-EG-CH
Customer: ALS Laboratory Group
P.O. Number: FC001498, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-July-2017 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	1.868E+03	6.707E+02	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	2.600E+04	9.618E+02	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	5.993E+02	5.130E+02	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	8.934E+02	7.147E+02	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	1.890E+03	1.541E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	1.547E+03	1.005E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	7.420E+02	6.315E+02	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	2.574E+03	2.412E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	2.554E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	1.224E+03	1.222E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	1.224E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 106879

Comments:
Active material deposited on first 5 mm.

Expiration Date: 29-August-2018

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 25-AUG-17
J. Lahr, Spectroscopist

181558D09.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 1 / Water

Sample ID: 110118-9 FWHM CAL (1089)

Sampling Start:	01/08/2018 10:00:00	Counting Start:	11/01/2018 09:55:22
Sampling Stop:	01/08/2018 10:00:00	Decay Time.	7.13E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	1.00E+000 L	Real Time	3797 Sec
Collection Efficiency	1.0000	Spc. File	.181558D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.31 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/01/2018
FWHM(keV) = 0.65 + 0.015*En + 5.05E-04*En^2 + 0.00E+00*En^3 11/03/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.24	102.79	6820	645	513	41641	1.34 a	Wide Pk
2	50.61	105.53	1176	331	267	17527	0.41 b	
3	59.37	123.01	157566	882	315	20033	0.86 a	HiResid
4	65.09	134.40	475	292	237	12493	0.70 a	Wide Pk
5	66.84	137.89	6292	734	590	40603	2.10 b	
6	69.72	143.64	4855	822	666	46850	2.42 c	
7	87.93	179.95	157993	866	282	16013	0.88 a	
8	102.53	209.06	296	242	197	7838	0.74 a	
9	105.74	215.46	196	310	254	10973	1.13 b	NET< CL
10	121.92	247.73	59031	548	208	7981	0.92 a	
11	136.33	276.46	6968	259	162	5320	0.89 a	
12	165.77	335.16	33980	425	173	5552	0.97 a	
13	198.97	401.36	540	209	167	5179	1.05 a	
14	255.01	513.11	899	255	204	6132	1.40 a	
15	279.16	561.28 Δ	2622	198	140	3610	0.96 a	
16	282.61	568.15	83	192	157	4212	1.10 b	NET< CL
17	310.58	623.93	142	140	114	2610	0.84 a	
18	391.74	785.77	17373	310	134	3084	1.16 a	
19	510.99	1023.56	395	228	185	4578	2.25 a	Wide Pk
20	534.60	1070.66	103	113	91	1760	1.06 a	
21	661.84	1324.37	43138	438	115	2437	1.39 a	

Δ less Than 10,000 count achieved due to greater Than 5 1/2-lives elapsed JP 11/27/18

181558D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	814.21	1628.21	347	151	121	2386	1.61	a	
23	821.86	1643.48	139	160	131	2651	1.77	a	
24	898.12	1795.54	17035	297	117	2671	1.50	a	
25	1048.79	2095.98	98	103	83	1499	1.15	a	
26	1173.24	2344.14	43641	431	86	1311	1.78	a	HiResid
27	1324.80	2646.38	401	93	69	752	2.64	a	HiResid
28	1332.33	2661.40	39460	402	52	517	1.88	b	HiResid
29	1835.17	3664.10	10026	203	29	150	2.20	a	

181558D09.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

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Sample ID: 110118-9 FWHM CAL (1089)

Stds. Match Tolerance: 2.00 keV

Detector Number: 09 Calibration Date. . . 11/01/2018 09:55:22

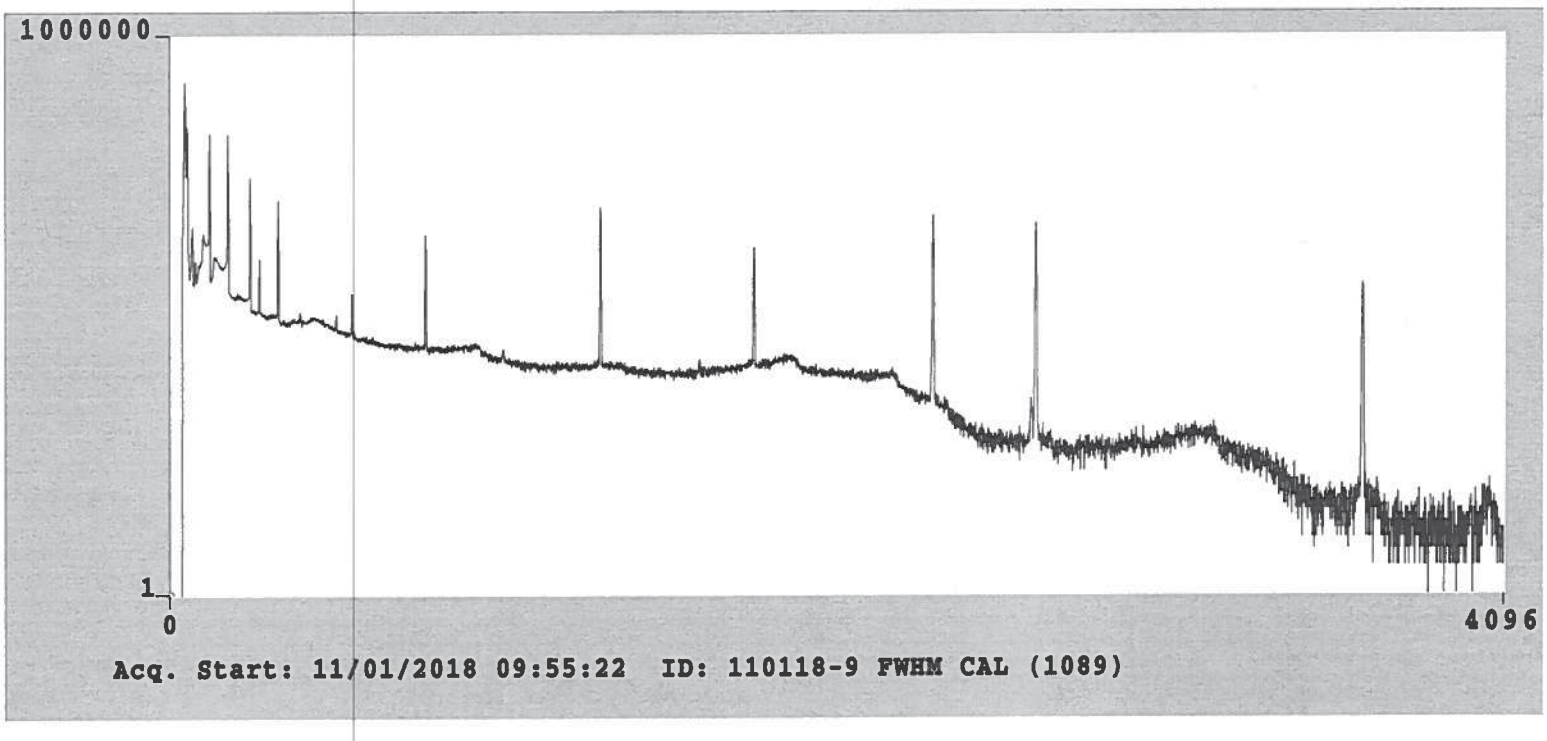
FWHM(keV) = 0.76 + 0.007*En + 6.45e-04*En^2 + 0.00e+00*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	0.864	-1.69	0.850	-7.27	0.792
2	88.04	0.877	0.30	0.879	-5.67	0.832
3	122.06	0.925	-1.37	0.912	-4.30	0.874
4	165.85	0.974	-2.29	0.952	-3.02	0.924
5	279.00	0.958	8.79	1.050	-1.04	1.039
6	391.68	1.159	-1.43	1.143	0.01	1.143
7	661.64	1.389	-2.50	1.355	0.99	1.369
8	898.02	1.497	2.52	1.535	1.10	1.552
9	1173.21	1.783	-2.45	1.741	0.88	1.756
10	1332.48	1.877	-1.04	1.858	0.67	1.871
11	1836.01	2.197	1.22	2.224	-0.14	2.221

Calibration Results Saved.

On JB 11/2/18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Acq. Start: 11/01/2018 09:55:22 ID: 110118-9 FWHM CAL (1089)

181841D10.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 1 / Water

Sample ID: 111518-10 FWHM Cal (1089)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	11/15/2018 08:17:10
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	7.63E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	2700 Sec
Sample Size	1.00E+000 L	Real Time	2936 Sec
Collection Efficiency	1.0000	Spc. File	.181841D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.05 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/15/2018
FWHM(keV) = 0.99 + 0.002*En + 8.54E-04*En^2 + 0.00E+00*En^3 11/15/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	49.57	103.01	294	304	248	12408	0.84	a	
2	59.33	122.50	53011	618	339	19546	1.11	a	HiResid
3	67.18	138.16	1594	670	547	34922	2.13	a	Wide Pk
4	87.87	179.46	147950	893	374	23797	1.09	a	Wide Pk
5	89.40	182.51	6071	646	516	32751	2.01	b	
6	121.86	247.30	74112	646	286	13967	1.10	a	Wide Pk
7	122.36	248.30	6151	702	563	31925	2.70	b	
8	136.29	276.09	10319	372	257	11230	1.19	a	
9	165.72	334.83	54890	558	250	10640	1.21	a	
10	167.59	338.57	1280	344	277	12160	1.32	b	
11	254.99	513.00	1505	270	213	8949	1.17	a	
12	279.16	561.23 Δ	4191	278	202	8040	1.15	a	
13	280.08	563.07	251	323	264	11486	1.72	b	NET< CL
14	373.23	748.97	150	172	140	4467	0.85	a	
15	391.72	785.87	39366	472	211	7731	1.42	a	Wide Pk
16	392.96	788.35	2849	522	421	18039	3.45	b	
17	511.28	1024.50	1074	325	262	9235	2.21	a	
18	609.45	1220.42	170	180	146	4390	1.31	a	
19	661.85	1325.01	129261	756	191	6405	1.74	a	HiResid Wide Pk
20	663.35	1327.99	7497	440	333	12811	3.66	b	HiResid

Δ less than 10,000 counts achieved due to greater than 5 1/2-lives elapsed. JP 11/20/18

181841D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	775.23	1551.29	60	118	96	2287	0.86	a	NET< CL
22	814.08	1628.83	88	123	100	2470	0.88	a	NET< CL
23	898.22	1796.75	48828	506	202	6880	2.04	a	HiResid
24	901.20	1802.70	910	284	228	8026	2.36	b	HiResid
25	1173.38	2345.92	141972	787	186	5660	2.41	a	HiResid
26	1332.54	2663.57	130670	752	170	4766	2.52	a	HiResid
27	1336.18	2670.85	1322	144	102	2024	1.83	b	HiResid
28	1835.54	3667.47	33217	382	94	1262	3.11	a	HiResid

181841D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET101114.BKG (111418-10 LONG BKG CAL)

Bkg.File Detector #: 10

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	67.18	1594	670	547	1551	670	547	
4	87.87	147950	893	374	147936	893	374	
5	89.40	6071	646	516	6064	646	516	
17	511.28	1074	325	262	863	326	264	
18	609.45	170	180	146	57	180	148	NET<CL
23	898.22	48828	506	202	48823	506	203	

181841D10.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

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Sample ID: 111518-10 FWHM Cal (1089)

Stds. Match Tolerance: 2.00 keV

Detector Number: 10 Calibration Date. . . 11/15/2018 08:17:10

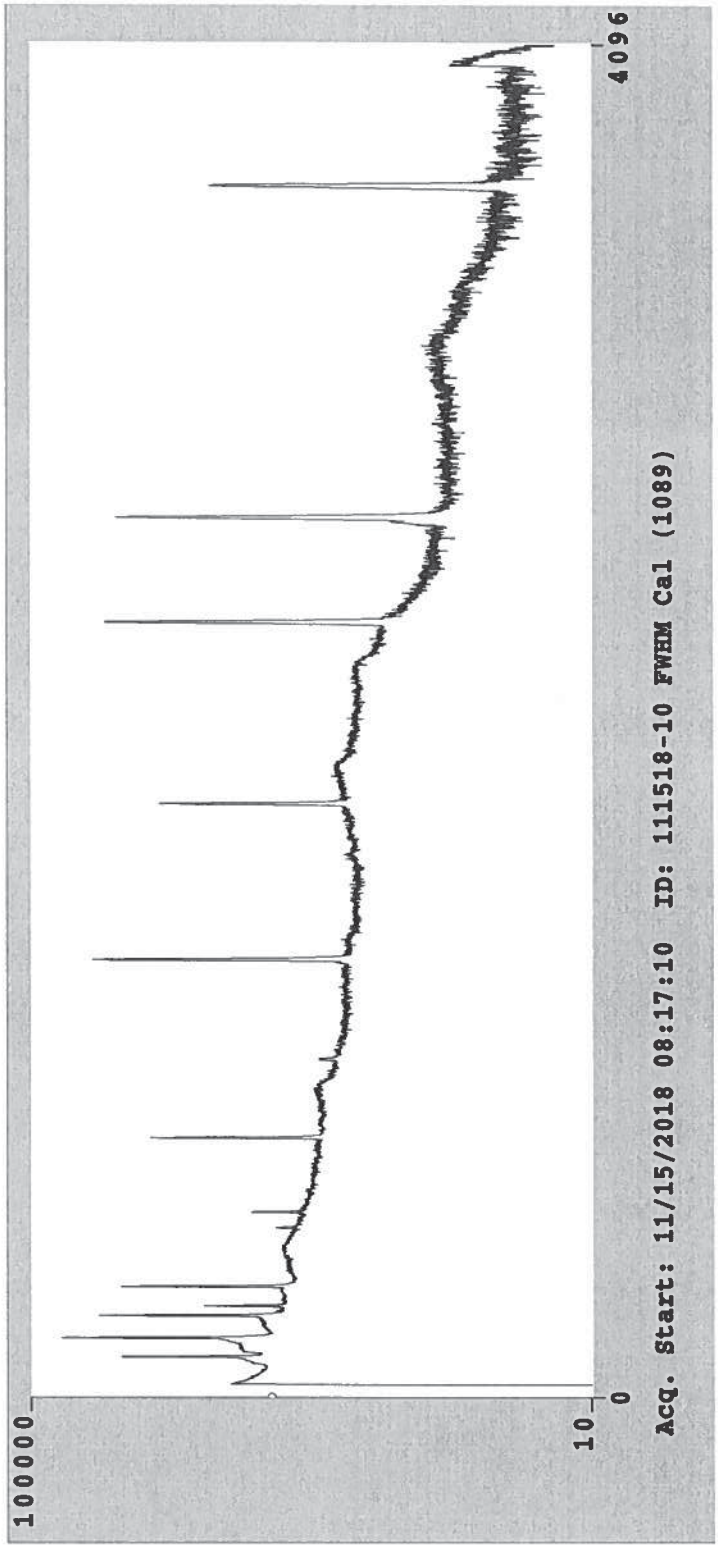
FWHM(keV) = 1.03 + -0.007*En + 1.30e-03*En^2 + 0.00e+00*En^3

(Where En = SQR(Energy in keV))

Pk. #	Energy (kev)	Measured FWHM(keV)	% Diff.	Calculated FWHM(keV)	% Diff.	Prev.Calc. FWHM(kev)
1	59.50	1.110	-4.76	1.060	0.41	1.064
2	88.04	1.087	-0.10	1.086	0.59	1.093
3	122.06	1.098	1.93	1.120	0.54	1.126
4	165.85	1.206	-3.54	1.165	0.23	1.168
5	279.00	1.148	10.82 Δ	1.288	-1.09	1.274
6	391.68	1.419	-0.30	1.415	-2.68	1.378
7	661.64	1.743	-0.87	1.728	-6.49	1.623
8	898.02	2.039	-1.52	2.009	-9.47	1.835
9	1173.21	2.414	-3.17	2.340	-12.46	2.080
10	1332.48	2.517	0.63	2.533	-13.99	2.222
11	1836.01	3.108	1.27	3.148	-18.02	2.668

Calibration Results Saved.

Δ on < 10,000 counts achieved due to greater than 5 ½-lives elapsed.
JP 11/20/18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Acq. Start: 11/15/2018 08:17:10 ID: 111518-10 FWHM Cal (1089)

RSO
#1089
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108578
Source Description: 1.0 Liter Solid in 138G GA-MA Beaker
Product Code: 8401-EG-SD
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Density of solid matrix: 1.17 g/cm³ ± 3 %.

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.689E+03	1.324E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.193E+04	1.921E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.179E+03	1.009E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.774E+03	1.419E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.823E+03	3.118E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.035E+03	1.972E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.488E+03	1.266E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.089E+03	4.768E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.048E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.329E+03	2.326E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.329E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____

Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18

J. Lakr, Spectroscopist

181516D01.SPC Analyzed by JW

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 091218-1 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 09/12/2018 08:15:00
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 6.09E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 3600 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 3723 Sec
Collection Efficiency 1.0000	Spc. File 181516D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.94 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/12/2018
FWHM(keV) = 0.66 + 0.012*En + 6.94E-04*En^2 + 0.00E+00*En^3 08/21/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.43	122.54	11366	332	209	8078	0.96	a	
2	87.93	179.45	67923	607	255	12056	1.02	a	
3	122.03	247.55	44114	492	211	8218	1.05	a	
4	136.45	276.34	5336	277	193	6916	0.92	a	HiResid
5	165.81	334.96	34996	449	204	7114	1.10	a	
6	255.17	513.40	834	176	136	3751	0.90	a	
7	279.14	561.29 Δ	4549	244	167	4780	1.19	a	
8	352.26	707.28	102	103	83	1686	0.56	a	
9	391.69	786.02	21905	355	162	4143	1.32	a	
10	510.14	1022.55	384	193	155	3964	1.65	a	
11	511.71	1025.69	367	178	143	3567	1.51	b	
12	661.65	1325.11	42159	448	147	3528	1.56	a	
13	800.86	1603.10	86	136	111	2398	1.48	a	NET< CL
14	813.86	1629.05	343	152	122	2735	1.67	a	
15	898.05	1797.17	23918	352	138	3365	1.78	a	
16	1173.22	2346.66	44534	437	92	1566	2.01	a	HiResid
17	1325.28	2650.31	594	136	104	1336	3.98	a	HiResid Wide Pk
18	1332.40	2664.53	40845	412	64	724	2.15	b	HiResid
19	1607.79	3214.45	67	72	57	666	1.69	a	
20	1835.83	3669.82	14171	241	32	169	2.51	a	HiResid

Δ less Than 10,000 counts achieved due to greater Than 5 ½-lives elapsed. JW 11/18/18

181516D01.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET010905.BKG (090518-1 LONG BKG CAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	59.43	11366	332	209	11364	332	209	
2	87.93	67923	607	255	67921	607	255	
8	352.26	102	103	83	95	103	83	
10	510.14	384	193	155	309	193	156	

181516D01.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

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Sample ID: 091218-1 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 01 Calibration Date. . . 09/12/2018 08:15:00
Geometry File (D01)(Sh17).EFF ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

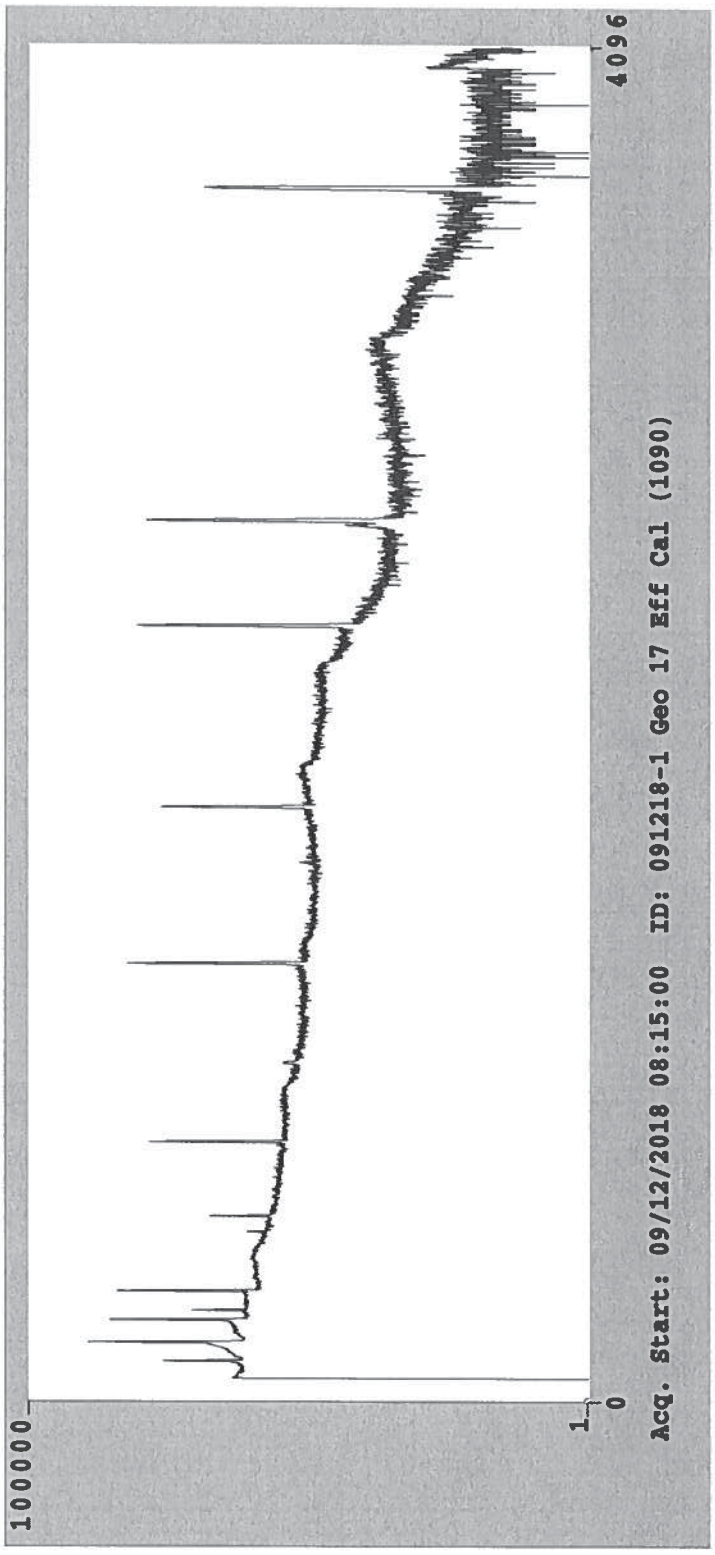
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-1.00e+02 + 1.28e+02*En +-5.55e+01*En^2 + 7.96e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-9.85e-01 + 4.24e-01*En +-4.07e-01*En^2 + 4.46e-02*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	2.38e-03	0.41	2.39e-03	3.55	2.48e-03
2	88.04	1.43e-02	-1.96	1.40e-02	1.21	1.42e-02
3	122.06	2.31e-02	3.01	2.38e-02	0.14	2.39e-02
4	165.85	2.45e-02	-1.77	2.41e-02	1.19	2.44e-02
5	279.00	1.76e-02	0.24	1.77e-02	10.22	1.97e-02
6	391.68	1.42e-02	0.06	1.42e-02	0.17	1.42e-02
7	661.64	9.36e-03	-0.42	9.32e-03	-0.69	9.26e-03
8	898.02	7.24e-03	0.50	7.27e-03	-1.95	7.13e-03
9	1173.21	5.81e-03	0.64	5.84e-03	-2.49	5.70e-03
10	1332.48	5.32e-03	-0.99	5.27e-03	-2.34	5.15e-03
11	1836.01	4.05e-03	0.20	4.06e-03	-0.24	4.05e-03

Calibration Results Saved.

OK JP 9/13/18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4096
Acq. Start: 09/12/2018 08:15:00 ID: 091218-1 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 9/12/2018
Detector 1
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.017335	-4.57%	OK
UPPER EFFICIENCY CURVE	0.018165	4.79%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.000655E+02		
B	1.283687E+02		
C	-5.552281E+01	Calculated efficiency	0.017335
D	7.961529E+00		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-9.853056E-01		
B	4.240614E-01		
C	-4.072964E-01	Calculated efficiency	0.018165
D	4.561320E-02		

En is energy in keV
Crossover energy 300

Ok JP 9/13/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 — 352-8677
Fax 404 — 352-2837
www.ez g.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_d, %	u_g, %	U, %*	Calibration Method**
Am-241	59.8	1.580E+06	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1			5.066E+03	0.7	1.7	3.7	
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.8			2.337E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 108679

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978: 1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ **Date:** 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 1

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 9/12/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	469	100%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6460	101%	Pass	2.13
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	148	94%	Pass	3.62
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	200	88%	Pass	7.16
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	21.14
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	8.56
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	191	100%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.24
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	302	99%	Pass	0.51
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	300	98%	Pass	0.51
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.24

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OK JP 9/13/18

181517D01.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 091218-1 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/12/2018 09:25:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.36E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1832 Sec
Collection Efficiency 1.0000	Spc. File 181517D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.94 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/12/2018
FWHM(keV) = 0.66 + 0.012*En + 6.94E-04*En^2 + 0.00E+00*En^3 08/21/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.46	122.61	5753	203	110	2253	0.94	a	
2	87.91	179.42	11084	250	111	2295	1.01	a	
3	122.02	247.52	3474	167	97	1732	1.00	a	
4	136.48	276.39	447	120	92	1565	0.94	a	
5	165.69	334.73	390	116	90	1497	0.94	a	
6	279.39	561.78	67	101	82	1240	1.05	a	NET< CL
7	365.17	733.07	61	80	64	835	0.90	a	NET< CL
8	391.69	786.03	88	82	66	870	0.89	a	
9	470.99	944.38	92	98	79	1224	1.08	a	
10	546.71	1095.58	152	134	108	1511	2.44	a	Wide Pk
11	566.40	1134.91	146	135	109	1470	2.58	a	Wide Pk
12	661.64	1325.09	20407	298	69	825	1.53	a	
13	712.13	1425.92	33	66	54	567	1.11	a	NET< CL
14	821.35	1644.00	55	55	44	469	0.85	a	
15	898.18	1797.44	58	74	59	764	1.15	a	NET< CL
16	1173.21	2346.64	17740	273	51	478	1.99	a	HiResid
17	1332.39	2664.49	15859	254	26	124	2.10	a	HiResid
18	1836.13	3670.41	52	19	10	22	1.37	a	

181517D01.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

****

Background File:. . . . . DET010905.BKG (090518-1 LONG BKG CAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	59.46	5753	203	110	5752	203	110	
2	87.91	11084	250	111	11083	250	111	

181517D01.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 091218-1 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/12/2018 09:25:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.36e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1832 Sec
Collection Efficiency 1.0000	Spectrum File 181517D01.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 1 (Detector 1)

Efficiency File: (D01)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.00E+02 +1.28E+02*L +-5.55E+01*L^2 +7.96E+00*L^3] 09/12/2018
Eff.=10^[-9.85E-01 +4.24E-01*L +-4.07E-01*L^2 +4.46E-02*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.69E+02 +- 1.65E+01	1.82E+01	9.00E+00	3.79E+06
Cd-109	88.02		6.46E+03 +- 1.46E+02	1.31E+02	6.50E+01	1.11E+04
Co-57	122.07		1.48E+02 +- 7.09E+00	8.36E+00	4.12E+00	6.50E+03
Ce-139	165.85		2.00E+02 +- 5.97E+01	9.38E+01	4.62E+01	3.30E+03
Cs-137	661.62		1.91E+02 +- 2.78E+00	1.31E+00	6.44E-01	2.64E+05
Co-60	Average:x		3.01E+02 +- 3.34E+00	. . . .	. . . .	4.62E+04
	1173.21		3.02E+02 +- 4.66E+00	1.78E+00	8.67E-01	4.62E+04
	1332.48		3.00E+02 +- 4.80E+00	1.05E+00	4.99E-01	4.62E+04
Hg-203	279.18		MDA	1.98E+06	9.72E+05	1.12E+03
Sn-113	391.68		MDA	3.30E+02r	1.61E+02	2.76E+03
Y-88	898.02		MDA	9.56E+02	4.69E+02	2.56E+03

MEASURED TOTAL: 7.77E+03 +- 2.35E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

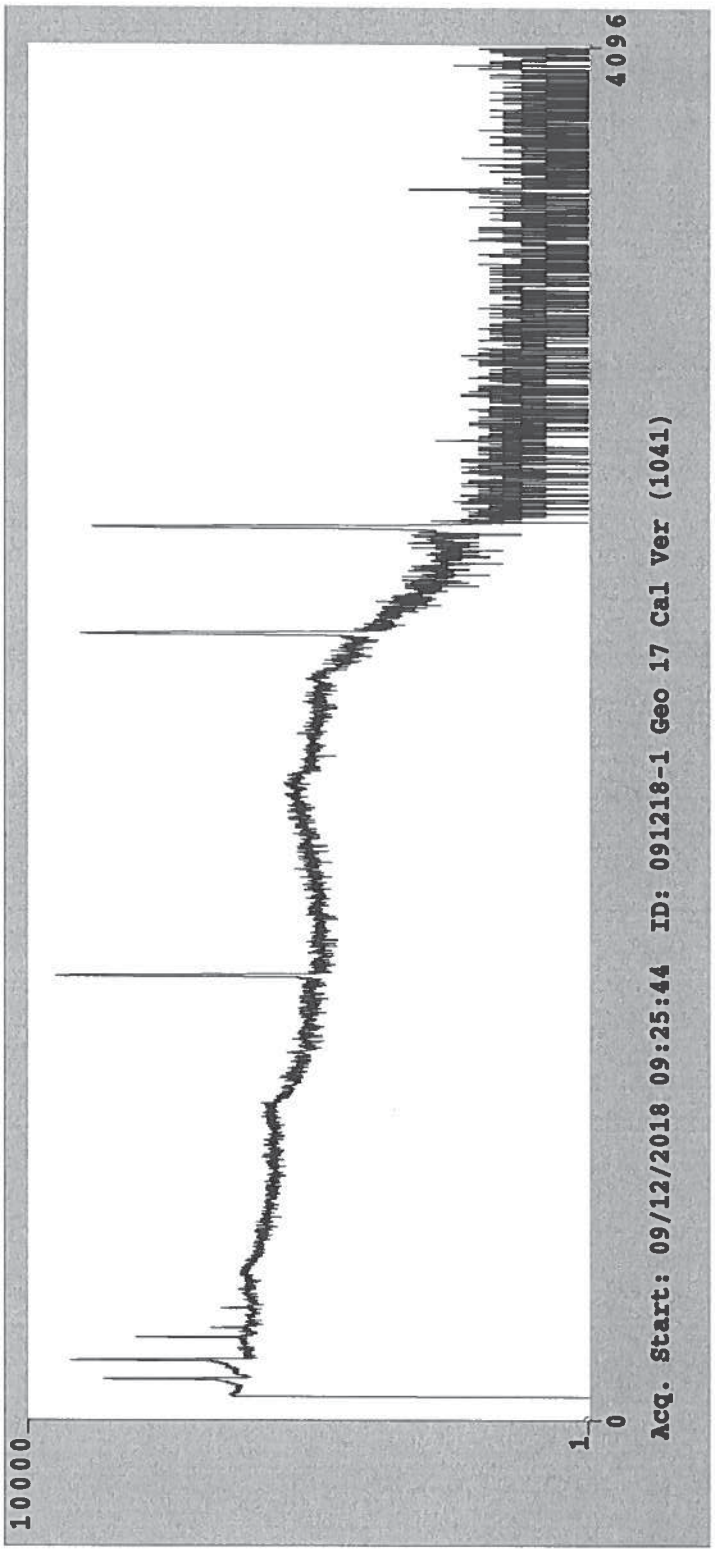
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
4	136.48	276.39	447	120	92	1565	0.94	Unknown

181517D01.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
6	279.39	561.78	67	101	82	1240	1.05	Deleted
7	365.17	733.07	61	80	64	835	0.90	Deleted
8	391.69	786.03	88	82	66	870	0.89	Unknown
9	470.99	944.38	92	98	79	1224	1.08	Unknown
10	546.71	1095.58	152	134	108	1511	2.44	Unknown
11	566.40	1134.91	146	135	109	1470	2.58	Unknown
13	712.13	1425.92	33	66	54	567	1.11	Deleted
14	821.35	1644.00	55	55	44	469	0.85	1332SEsc
15	898.18	1797.44	58	74	59	764	1.15	Deleted
18	1836.13	3670.41	52	19	10	22	1.37	Unknown

c:\SEEKER\BIN\181517d01.res Analysis Results Saved.


10000
1
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4096
Acq. Start: 09/12/2018 09:25:44 ID: 091218-1 Geo 17 Cal Ver (1041)

#1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.6	1.580E+06	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	6.114E+04	1.692E+03	0.8	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.265E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.669E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1			5.269E+03	0.7	1.7	3.7	
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5			2.433E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. *Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." **Calibration Methods: 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

F-CR-32, Rev 0, 01 Nov 14

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

181481D02.SPC Analyzed by JP

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 090618-2 Geo 17 Eff Cal (1090)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	09/06/2018 07:46:57
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	5.95E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	4500 Sec
Sample Size	2.15E+002 g	Real Time	4675 Sec
Collection Efficiency	1.0000	Spc. File	.181481D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.36 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/06/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.46	121.40	10970	348	229	10533	0.89 a	HiResid
2	86.31	174.99	3339	643	520	35329	1.86 a	Wide Pk
3	87.98	178.32	93652	732	330	18547	1.09 b	
4	122.08	246.38	66075	630	300	15332	1.11 a	HiResid
5	136.50	275.17	8794	380	272	12635	1.11 a	
6	165.86	333.76	54805	567	263	11814	1.15 a	
7	255.13	511.96	1734	340	271	12078	1.57 a	
8	279.22	560.05 Δ	8110	321	218	8819	1.30 a	
9	391.77	784.70	37039	462	211	7724	1.43 a	
10	511.32	1023.33	1080	322	259	9011	2.36 a	
11	661.77	1323.63	70977	575	178	5846	1.71 a	
12	814.21	1627.92	423	150	119	3065	1.11 a	
13	822.15	1643.77	204	161	131	3503	1.33 b	
14	898.19	1795.54	40856	459	179	5951	1.98 a	
15	955.33	1909.59	13	168	138	4240	1.33 a	NET< CL
16	1173.41	2344.90	75280	574	138	3231	2.30 a	HiResid
17	1324.32	2646.12	120	108	87	1583	1.47 a	
18	1332.64	2662.72	68264	541	116	2198	2.42 a	HiResid
19	1836.11	3667.67	25370	327	60	508	3.05 a	

Δ less Thm 10,000 Counts achieved due to greate Than 5 1/2-lives elapsed. JP 9/7/18

181481D02.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET020815.BKG (081518-2 LONG BKG CAL)

Bkg.File Detector #: 2

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
10	511.32	1080	322	259	960	322	260	
14	898.19	40856	459	179	40851	459	180	

181481D02.SPC Analyzed by

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

Sample ID: 090618-2 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 02 Calibration Date. . . 09/06/2018 07:46:57
Geometry File (D02)(Sh17).EFF ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

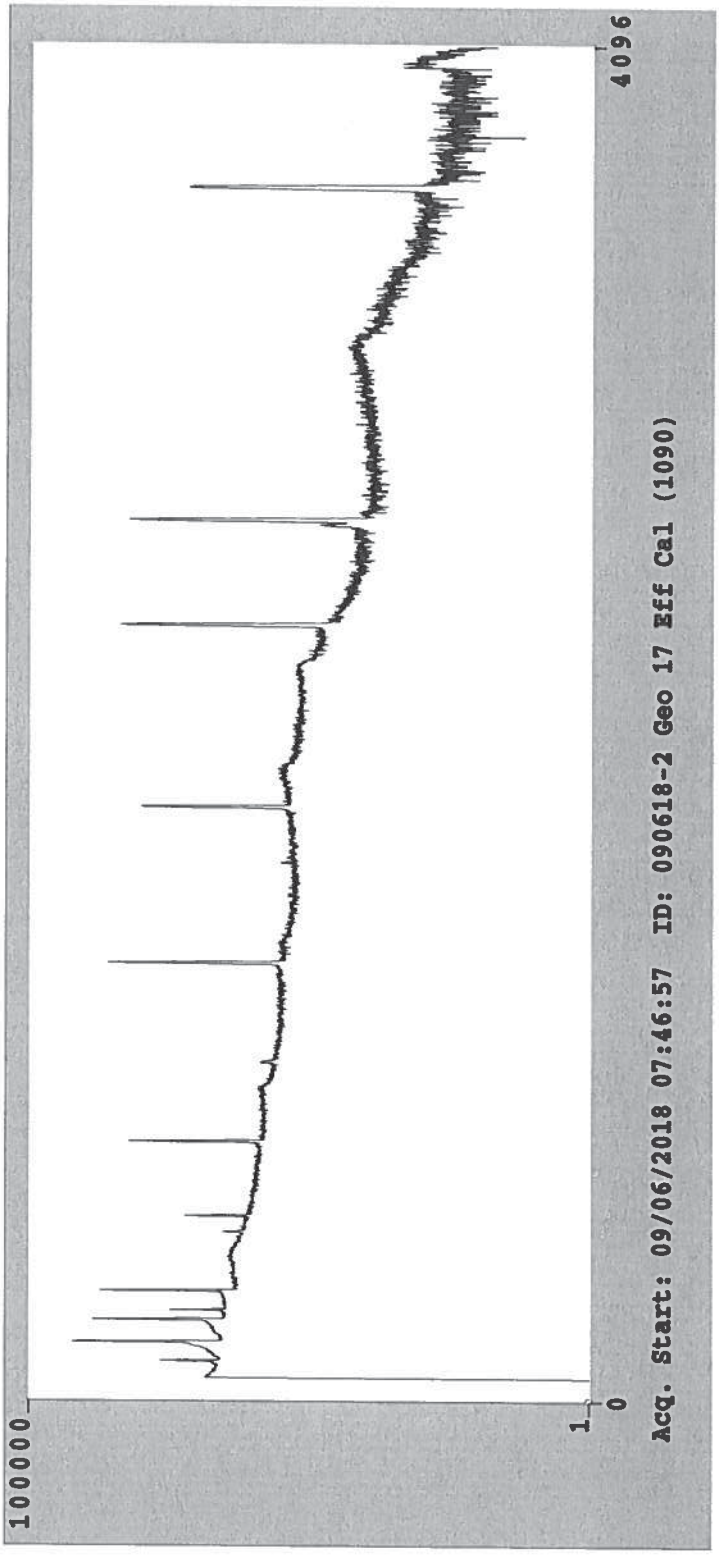
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-1.25e+02 + 1.62e+02*En +-7.06e+01*En^2 + 1.02e+01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-1.14e+01 + 1.13e+01*En +-4.16e+00*En^2 + 4.74e-01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	1.84e-03	0.54	1.85e-03	0.00	1.85e-03
2	88.04	1.56e-02	-2.60	1.53e-02	0.00	1.53e-02
3	122.06	2.73e-02	3.95	2.84e-02	0.00	2.84e-02
4	165.85	2.98e-02	-2.34	2.91e-02	0.00	2.91e-02
5	279.00	2.30e-02	0.32	2.30e-02	-0.00	2.30e-02
6	391.68	1.85e-02	0.15	1.85e-02	-0.00	1.85e-02
7	661.64	1.26e-02	-1.11	1.25e-02	-0.00	1.25e-02
8	898.02	9.51e-03	1.90	9.69e-03	-0.00	9.69e-03
9	1173.21	7.84e-03	-0.58	7.79e-03	-0.00	7.79e-03
10	1332.48	7.10e-03	-0.67	7.05e-03	-0.00	7.05e-03
11	1836.01	5.58e-03	0.29	5.59e-03	-0.00	5.59e-03

Calibration Results Saved.

OK JP 9/7/18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4096
Acq. Start: 09/06/2018 07:46:57 ID: 090618-2 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 9/6/2018
Detector 2
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.022325	2.33%	OK
UPPER EFFICIENCY CURVE	0.021817	-2.27%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.246279E+02		
B	1.617768E+02		
C	-7.063768E+01	Calculated efficiency	0.022325
D	1.024201E+01		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.141093E+01		
B	1.132590E+01		
C	-4.157520E+00	Calculated efficiency	0.021817
D	4.740273E-01		

En is energy in keV
Crossover energy 300

9/7/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSW
1090
Rec'd 3-5-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 — 352-8677
Fax 404 — 352-7837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1			5.066E+03	0.7	1.7	3.7	
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5			2.337E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978: 1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ **Date:** 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 2

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 9/6/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	497	106%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6520	102%	Pass	2.12
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	151	96%	Pass	3.60
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	230	101%	Pass	7.11
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	21.01
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	323	>5 h-lives	>5 h-lives	8.51
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	192	101%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.18
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	305	100%	Pass	0.51
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	310	101%	Pass	0.51
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.18

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OL JP 9/7/18

181482D02.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 090618-2 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/06/2018 09:28:46
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.35E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1831 Sec
Collection Efficiency 1.0000	Spc. File 181482D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.36 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/06/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.47	121.41	4723	198	117	2522	1.01	a	HiResid
2	65.84	134.14	80	150	122	2559	1.07	a	NET< CL
3	87.98	178.33	12266	275	135	3091	1.10	a	
4	122.07	246.37	4291	195	119	2423	1.14	a	
5	136.54	275.26	448	132	103	1971	0.91	a	
6	165.75	333.56	558	131	100	1862	1.00	a	
7	188.96	379.89	92	107	86	1689	0.87	a	
8	218.03	437.92	111	108	87	1728	0.83	a	
9	391.64	784.44	130	110	89	1557	1.10	a	
10	413.68	828.44	41	73	59	872	0.70	a	NET< CL
11	661.77	1323.64	27398	345	80	1179	1.69	a	
12	898.56	1796.28	138	101	80	1305	1.64	a	
13	1173.42	2344.92	23948	320	68	792	2.26	a	
14	1332.64	2662.72	21998	300	37	229	2.47	a	
15	1836.31	3668.08	73	28	18	51	2.72	a	

181482D02.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET020905.BKG (090518-2 LONG BKG CAL)

Bkg.File Detector #: 2

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	65.84	80	150	122	76	150	123	NET<CL
12	898.56	138	101	80	137	101	81	

181482D02.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 090618-2 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/06/2018 09:28:46
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.35e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1831 Sec
Collection Efficiency 1.0000	Spectrum File 181482D02.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-1.25E+02 +1.62E+02*L +-7.06E+01*L^2 +1.02E+01*L^3] 09/06/2018
Eff.=10^[-1.14E+01 +1.13E+01*L +-4.16E+00*L^2 +4.74E-01*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.97E+02 +- 2.08E+01	2.49E+01	1.23E+01	3.79E+06
Cd-109	88.02		6.52E+03 +- 1.46E+02	1.45E+02	7.16E+01	1.11E+04
Co-57	122.07		1.51E+02 +- 6.87E+00	8.48E+00	4.19E+00	6.50E+03
Ce-139	165.85		2.30E+02 +- 5.39E+01	8.39E+01	4.14E+01	3.30E+03
Cs-137	661.62		1.92E+02 +- 2.41E+00	1.14E+00	5.58E-01	2.64E+05
Co-60	Average:x		3.08E+02 +- 2.94E+00	. . . .	. . . .	4.62E+04
	1173.21		3.05E+02 +- 4.09E+00	1.77E+00	8.69E-01	4.62E+04
	1332.48		3.10E+02 +- 4.23E+00	1.09E+00	5.26E-01	4.62E+04
Hg-203	279.18		MDA	1.82E+06	8.97E+05	1.12E+03
Sn-113	391.68		MDA	2.65E+02r	1.30E+02	2.76E+03
Y-88	898.02		MDA	5.19E+02r	2.54E+02	2.56E+03

MEASURED TOTAL: 7.90E+03 +- 2.33E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

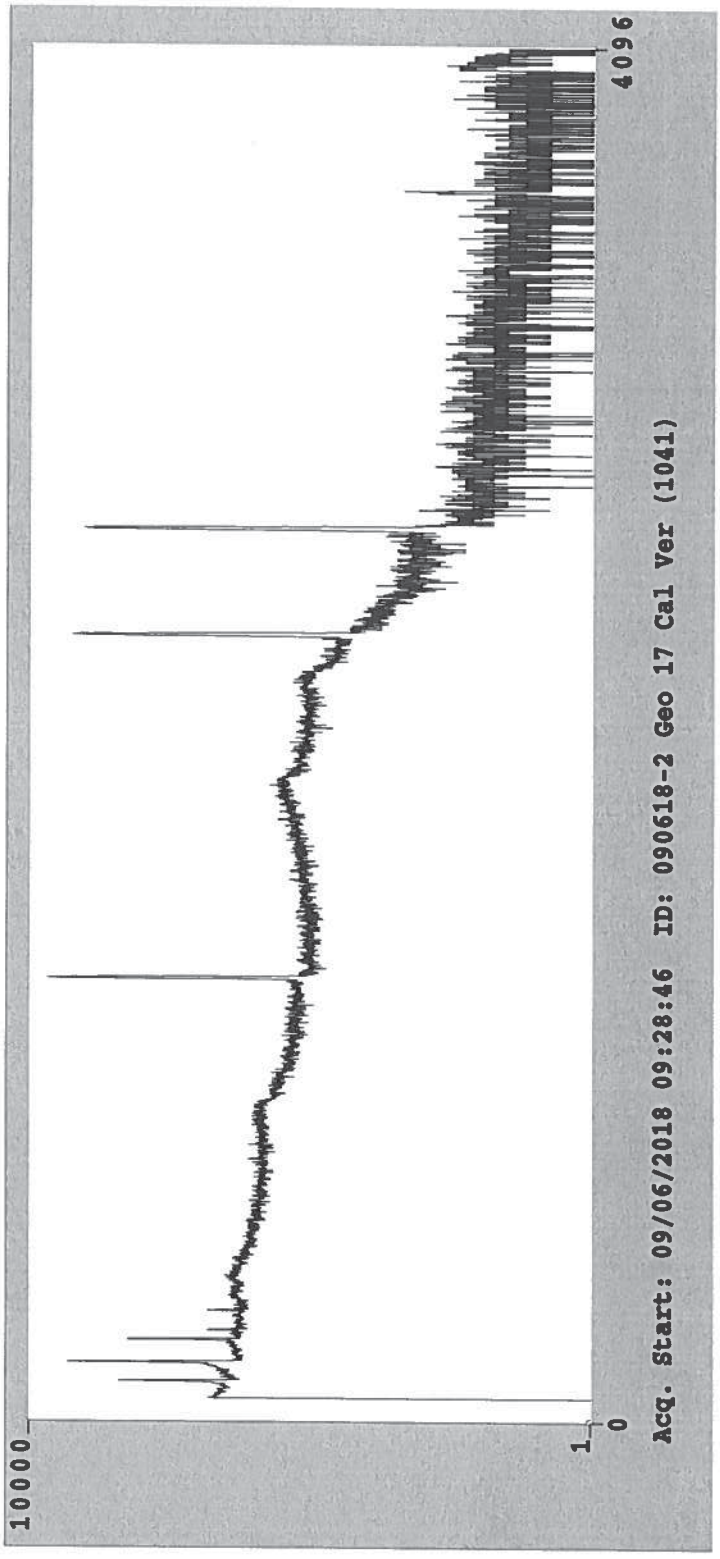
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	65.84	134.14	76	150	123	2559	1.07	Deleted

181482D02.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
5	136.54	275.26	448	133	103	1971	0.91	Unknown
7	188.96	379.89	92	107	86	1689	0.87	Unknown
8	218.03	437.92	111	108	87	1728	0.83	Unknown
9	391.64	784.44	130	110	89	1557	1.10	Unknown
10	413.68	828.44	41	73	59	872	0.70	Deleted
12	898.56	1796.28	137	101	81	1305	1.64	Unknown
15	1836.31	3668.08	73	28	18	51	2.72	Unknown

c:\SEEKER\BIN\181482d02.res Analysis Results Saved.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4096
Acq. Start: 09/06/2018 09:28:46 ID: 090618-2 Geo 17 Cal Ver (1041)

#1041
Rec'd 2-27-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	6.114E+04	1.892E+03	0.8	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1			5.269E+03	0.7	1.7	3.7	
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5			2.433E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. *Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." **Calibration Methods: 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

F-CR-32, Rev 0, 01 Nov 14

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity por ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

182390D03.SPC Analyzed by JP

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

****

Geo 17/26

Sample ID: 110118-3 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 11/01/2018 07:53:30
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 7.29E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 4200 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 4334 Sec
Collection Efficiency 1.0000	Spc. File 182390D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.58 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/01/2018
FWHM(keV) = 0.63 + 0.021*En + 8.26E-04*En^2 + 0.00E+00*En^3 11/03/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.46	121.80	23635	438	256	12149	0.97	a	HiResid
2	87.92	178.61	94415	707	287	15235	1.01	a	
3	122.03	246.66	51650	535	232	9979	1.04	a	HiResid
4	136.45	275.44	6647	322	228	8874	1.10	a	
5	165.80	334.03	35586	461	217	8068	1.20	a	
6	255.27	512.57	806	241	193	6876	1.28	a	
7	279.15	560.23 Δ	2785	244	181	6060	1.32	a	
8	391.70	784.83	20255	370	194	6194	1.60	a	HiResid
9	463.97	929.05	144	142	115	2996	0.88	a	
10	511.13	1023.16	497	253	205	6482	2.24	a	
11	661.70	1323.64	50545	489	159	4435	1.79	a	HiResid
12	814.05	1627.66	243	148	119	2982	1.49	a	
13	898.16	1795.52	20312	358	178	5403	2.26	a	HiResid
14	1173.45	2344.88	50854	494	166	4390	2.66	a	HiResid
15	1332.69	2662.66	44843	464	155	3682	2.77	a	HiResid
16	1836.17	3667.40	11195	224	60	503	3.33	a	HiResid

Δ less than 10,000 counts achieved due to greater than 5 Half-lives elapsed.
JP 11/2/18

182390D03.SPC Analyzed by

****

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins
GammaScan

****

Background File:. . . . . DET031031.BKG (103118-3 LONG BKG CAL)

Bkg.File Detector #: 3

==========

BACKGROUND SUBTRACT RESULTS

==========

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
10	511.13	497	253	205	407	254	206	
13	898.16	20312	358	178	20310	358	178	

182390D03.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 110118-3 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 03 Calibration Date. . . 11/01/2018 07:53:30
Geometry File (D03)(Sh17).EFF ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

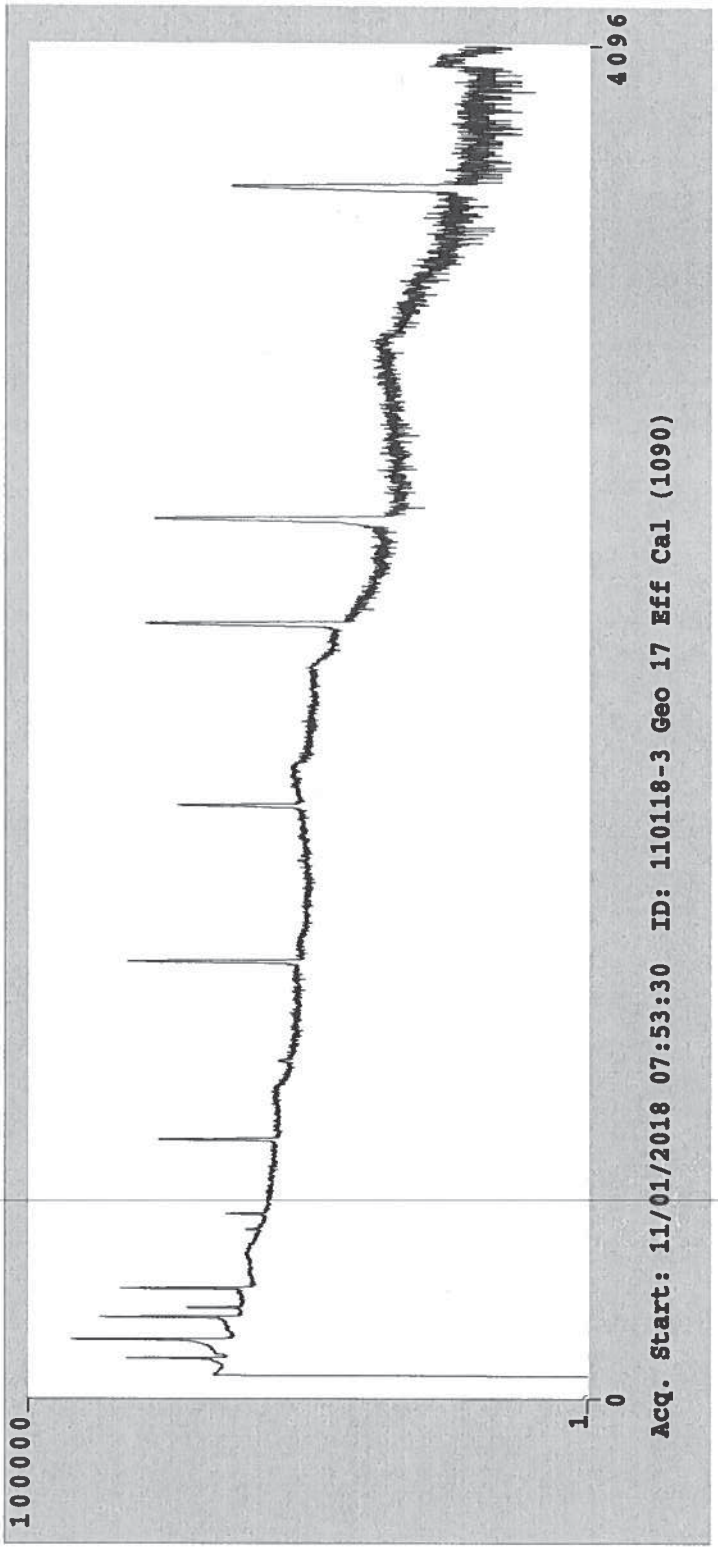
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-8.15e+01 + 1.04e+02*En +-4.49e+01*En^2 + 6.40e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-2.02e-01 +-3.44e-01*En +-1.27e-01*En^2 + 7.29e-03*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	4.24e-03	0.48	4.26e-03	0.00	4.26e-03
2	88.04	1.84e-02	-2.29	1.80e-02	0.00	1.80e-02
3	122.06	2.63e-02	3.51	2.73e-02	0.00	2.73e-02
4	165.85	2.75e-02	-2.07	2.69e-02	0.01	2.69e-02
5	279.00	1.94e-02	0.28	1.95e-02	0.01	1.95e-02
6	391.68	1.52e-02	0.03	1.52e-02	-0.00	1.52e-02
7	661.64	9.65e-03	-0.24	9.63e-03	-0.00	9.63e-03
8	898.02	7.29e-03	0.56	7.33e-03	-0.00	7.33e-03
9	1173.21	5.79e-03	-0.68	5.75e-03	-0.00	5.75e-03
10	1332.48	5.10e-03	0.33	5.11e-03	-0.00	5.11e-03
11	1836.01	3.79e-03	0.00	3.79e-03	-0.00	3.79e-03

Calibration Results Saved.

Oh JP 11/2/18


100000
1
0
4096
Acq. Start: 11/01/2018 07:53:30 ID: 110118-3 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 11/1/2018
Detector 3
Geometry 1
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.018947	-0.47%	OK
UPPER EFFICIENCY CURVE	0.019037	0.48%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-8.147170E+01		
B	1.040020E+02		
C	-4.485402E+01	Calculated efficiency	0.018947
D	6.404879E+00		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-2.016041E-01		
B	-3.438270E-01		
C	-1.267765E-01	Calculated efficiency	0.019037
D	7.291130E-03		

En is energy in keV
Crossover energy 300

On JT 11/2/18

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 3

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 11/1/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	474	101%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6690	105%	Pass	2.24
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	151	96%	Pass	3.81
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	300	>5 h-lives	>5 h-lives	7.52
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	22.21
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	8.99
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	192	101%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.71
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	305	100%	Pass	0.54
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	308	101%	Pass	0.54
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.71

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

JP 11/2/18

182391D03.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 110118-3 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/01/2018 09:56:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.48E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1860 Sec
Collection Efficiency 1.0000	Spc. File 182391D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.58 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/01/2018
FWHM(keV) = 0.63 + 0.021*En + 8.26E-04*En^2 + 0.00E+00*En^3 11/03/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.48	121.84	10382	258	130	3099	0.97	a	
2	87.92	178.60	13650	275	119	2620	1.02	a	
3	122.06	246.72	3586	170	99	1814	1.06	a	
4	136.46	275.48	458	163	130	2489	1.42	a	
5	165.59	333.61	508	193	154	2940	2.00	a	Wide Pk
6	208.60	419.44	51	73	59	853	0.56	a	NET< CL
7	212.38	426.98	33	117	96	1706	1.04	b	NET< CL
8	391.24	783.91	80	151	123	2252	2.03	a	NET< CL
9	500.82	1002.57	77	98	79	1211	1.54	a	NET< CL
10	661.70	1323.64	21090	308	84	1234	1.85	a	HiResid
11	1173.40	2344.78	17297	285	90	1271	2.59	a	HiResid
12	1332.60	2662.49	15547	256	47	343	2.82	a	HiResid
13	1836.83	3668.71	38	23	16	43	2.56	a	

182391D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET031031.BKG (103118-3 LONG BKG CAL)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG

182391D03.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 110118-3 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/01/2018 09:56:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.48e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1860 Sec
Collection Efficiency 1.0000	Spectrum File 182391D03.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-8.15E+01 +1.04E+02*L +-4.49E+01*L^2 +6.40E+00*L^3] 11/01/2018

Eff.=10^[-2.02E-01 +-3.44E-01*L +-1.27E-01*L^2 +7.29E-03*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.74E+02 +- 1.18E+01	1.20E+01	5.92E+00	3.79E+06
Cd-109	88.02		6.69E+03 +- 1.35E+02	1.18E+02	5.84E+01	1.11E+04
Co-57	122.07		1.51E+02 +- 7.17E+00	8.48E+00	4.18E+00	6.50E+03
Ce-139	165.85		3.00E+02 +- 1.14E+02	1.84E+02	9.13E+01	3.30E+03
Cs-137	661.62		1.92E+02 +- 2.80E+00	1.55E+00	7.61E-01	2.64E+05
Co-60	Average:x		3.07E+02 +- 3.57E+00	. . . .	. . . .	4.62E+04
	1173.21		3.05E+02 +- 5.02E+00	3.21E+00	1.58E+00	4.62E+04
	1332.48		3.08E+02 +- 5.07E+00	1.93E+00	9.39E-01	4.62E+04
Hg-203	279.18		MDA	4.01E+06	1.97E+06	1.12E+03
Sn-113	391.68		MDA	6.51E+02	3.20E+02	2.76E+03
Y-88	898.02		MDA	1.50E+03	7.40E+02	2.56E+03

MEASURED TOTAL: 8.12E+03 +- 2.74E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

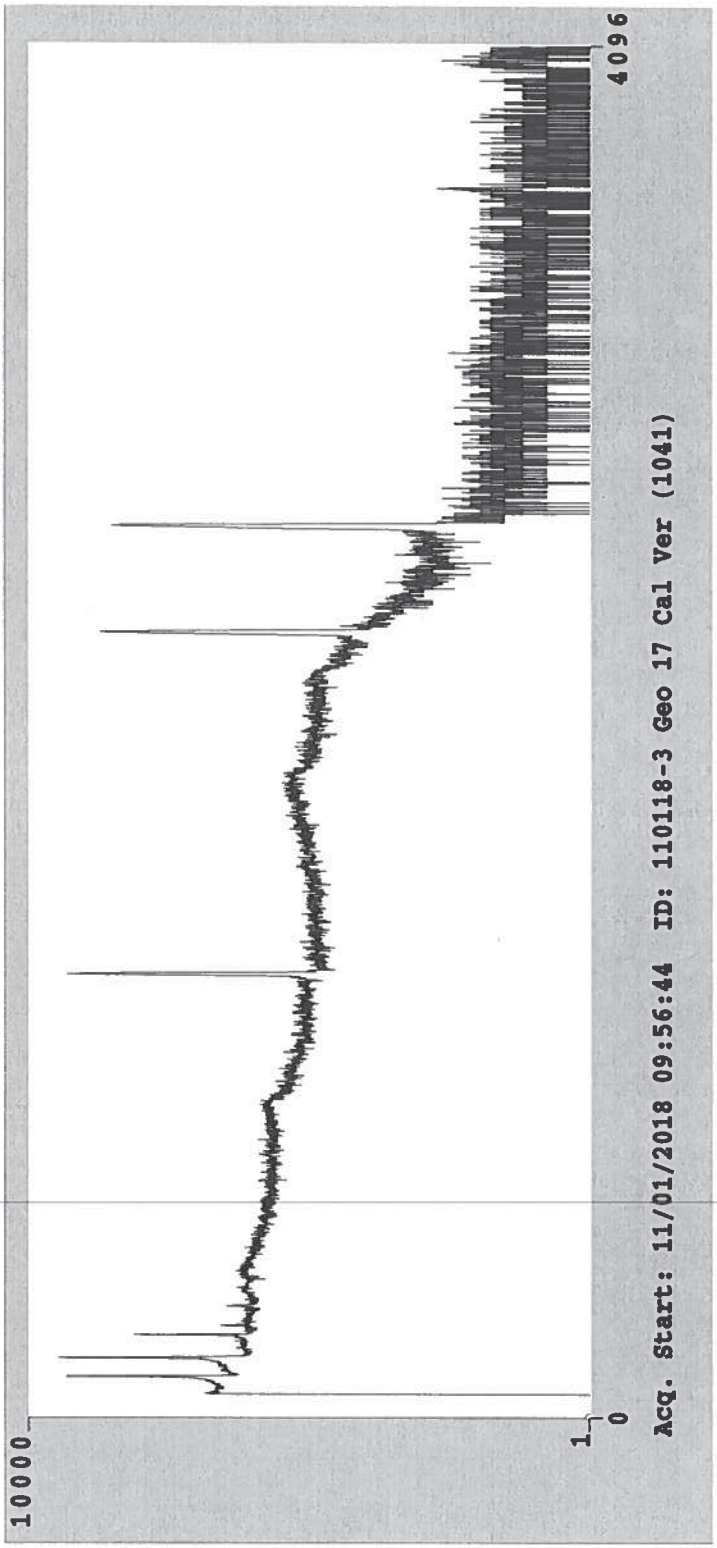
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
4	136.46	275.48	458	163	130	2489	1.42	Unknown

182391D03.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
6	208.60	419.44	51	73	59	853	0.56	Deleted
7	212.38	426.98	33	117	96	1706	1.04	Deleted
8	391.24	783.91	80	151	123	2252	2.03	Deleted
9	500.82	1002.57	77	98	79	1211	1.54	Deleted
13	1836.83	3668.71	38	23	16	43	2.56	Unknown

c:\SEEKER\BIN\182391d03.res Analysis Results Saved.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4096
Acq. Start: 11/01/2018 09:56:44 ID: 110118-3 Geo 17 Cal Ver (1041)

181964D04.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

****

Geo 17/26

Sample ID: 092518-4 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 09/25/2018 10:39:45
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 6.41E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 4200 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 4297 Sec
Collection Efficiency 1.0000	Spc. File 181964D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.55 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/25/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.40	121.70	30338	483	275	13960	0.96 a	HiResid
2	66.49	135.84	411	369	301	15479	1.21 a	
3	87.89	178.56	111793	762	300	16608	1.02 a	
4	121.98	246.62	61283	574	240	10613	1.05 a	HiResid
5	136.40	275.41	7807	342	241	9921	1.10 a	
6	165.74	333.98	44788	495	211	8789	1.15 a	HiResid
7	254.96	512.10	1184	273	217	8222	1.40 a	
8	279.06	560.23 Δ	4864	268	189	6570	1.26 a	
9	310.23	622.46	130	135	109	2943	0.69 a	
10	371.28	744.33	129	129	104	2671	0.73 a	
11	391.53	784.76	24663	374	168	5185	1.39 a	HiResid
12	423.96	849.51	55	136	111	3059	0.76 a	NET< CL
13	510.46	1022.21	565	247	199	6369	2.14 a	
14	661.44	1323.63	49912	486	157	4534	1.72 a	HiResid
15	813.63	1627.46	347	162	130	3399	1.60 a	
16	897.77	1795.45	24739	369	159	4689	2.02 a	HiResid
17	1172.89	2344.72	48666	476	147	3703	2.26 a	HiResid
18	1332.02	2662.40	43934	446	126	2588	2.50 a	HiResid
19	1835.26	3667.10	13601	244	59	540	2.81 a	HiResid

Δ less Than 10,000 counts achieved due to greater Than 5 ½-lives elapsed.
JP 9/26/18

181964D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET040924.BKG (092418-4 LONG BKG CAL)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	66.49	411	369	301	408	369	301	
13	510.46	565	247	199	479	247	200	

181964D04.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 092518-4 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 04 Calibration Date. . . 09/25/2018 10:39:45
Geometry File (D04)(Sh17).EFF ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

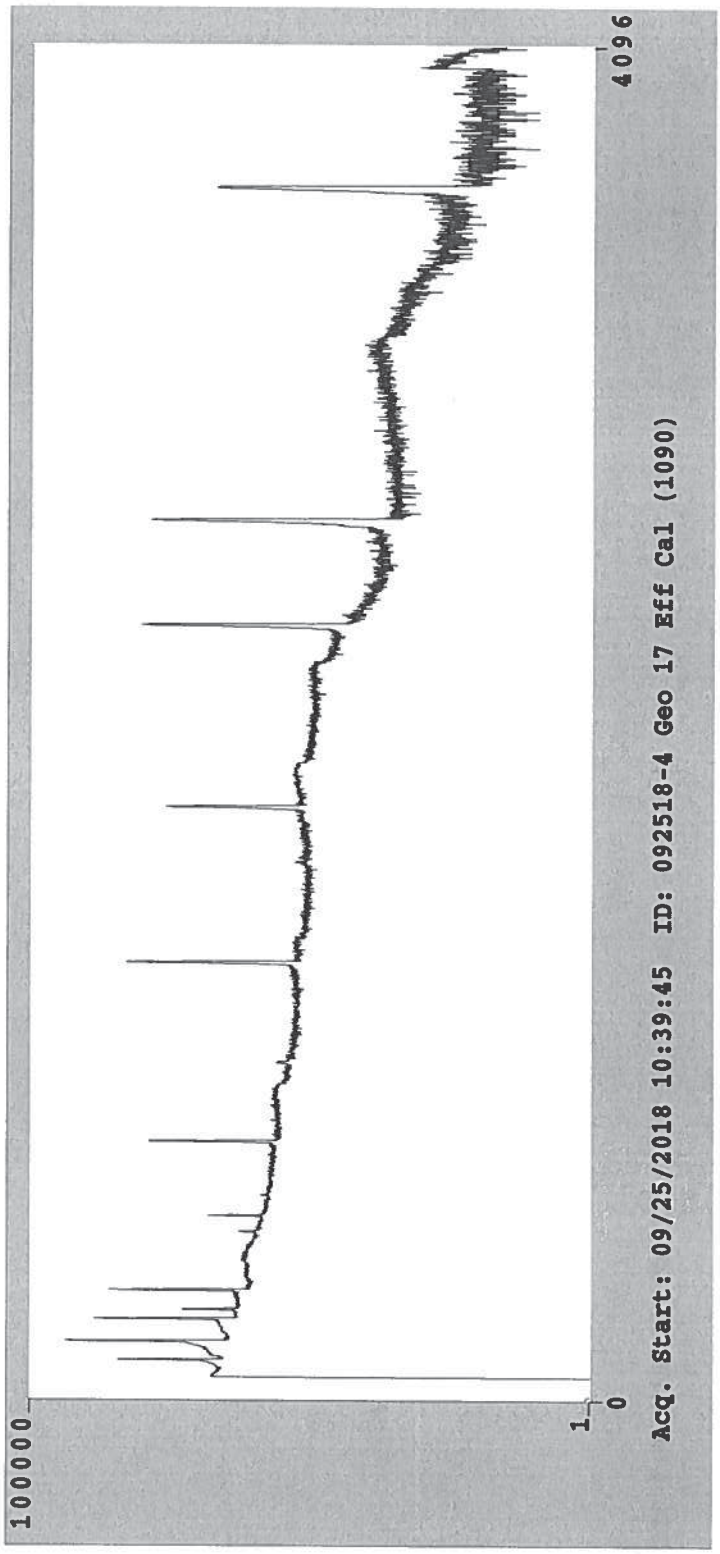
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-7.41e+01 + 9.43e+01*En +-4.05e+01*En^2 + 5.76e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-8.67e+00 + 8.41e+00*En +-3.13e+00*En^2 + 3.49e-01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	5.44e-03	0.37	5.46e-03	7.01	5.87e-03
2	88.04	2.06e-02	-1.81	2.02e-02	3.22	2.09e-02
3	122.06	2.85e-02	2.78	2.93e-02	0.32	2.94e-02
4	165.85	2.87e-02	-1.63	2.83e-02	-1.58	2.78e-02
5	279.00	1.96e-02	0.22	1.97e-02	-1.39	1.94e-02
6	391.68	1.48e-02	0.12	1.48e-02	-0.19	1.48e-02
7	661.64	9.51e-03	-0.87	9.43e-03	-6.02	8.89e-03
8	898.02	6.98e-03	1.27	7.07e-03	-8.42	6.52e-03
9	1173.21	5.47e-03	0.38	5.49e-03	-9.90	4.99e-03
10	1332.48	4.93e-03	-1.24	4.87e-03	-10.40	4.41e-03
11	1836.01	3.63e-03	0.31	3.64e-03	-11.08	3.28e-03

Calibration Results Saved.

OK JP 9/26/18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1
0
4096
Acq. Start: 09/25/2018 10:39:45 ID: 092518-4 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 9/25/2018
Detector 4
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.0189	4.78%	OK
UPPER EFFICIENCY CURVE	0.018037	-4.57%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-7.413745E+01
B	9.430037E+01
C	-4.054200E+01
D	5.762618E+00

Calculated efficiency 0.018900

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-8.668339E+00
B	8.408918E+00
C	-3.130553E+00
D	3.489539E-01

Calculated efficiency 0.018037

En is energy in keV
Crossover energy 300

Ok JP 9/26/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 - 352-8677
Fax 404 - 352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity por ISO 9978: 1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 4

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 9/25/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	478	102%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6500	102%	Pass	2.16
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	151	96%	Pass	3.67
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	211	93%	Pass	7.25
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	21.42
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	8.67
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	191	100%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.36
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	301	99%	Pass	0.52
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	305	100%	Pass	0.52
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.36

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OK JM 9/26/18

181965D04.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 092518-4A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/25/2018 12:19:43
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.40E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1827 Sec
Collection Efficiency 1.0000	Spc. File 181965D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.55 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/25/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	48.96	100.83	47	96	78	1513	0.50	a	NET< CL
2	59.44	121.77	13397	282	133	3245	0.99	a	
3	87.90	178.59	15757	290	119	2612	1.04	a	
4	122.00	246.67	4218	179	101	1895	1.06	a	
5	136.45	275.52	493	124	96	1690	0.92	a	
6	165.62	333.75	452	113	86	1556	1.01	a	
7	391.53	784.77	84	112	91	1515	1.31	a	NET< CL
8	661.49	1323.73	20598	301	76	1058	1.72	a	HiResid
9	1172.98	2344.88	16508	276	83	1171	2.23	a	HiResid
10	1272.40	2543.37	27	30	23	110	1.71	a	
11	1332.11	2662.59	14826	249	43	300	2.41	a	HiResid
12	1835.57	3667.71	48	28	20	56	3.41	a	

181965D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET040924.BKG (092418-4 LONG BKG CAL)

Bkg.File Detector #: 4

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG

181965D04.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 092518-4A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/25/2018 12:19:43
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.40e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1827 Sec
Collection Efficiency 1.0000	Spectrum File 181965D04.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh17).EFF (Geo 17 Eff Cal)
Eff=10^[-7.41E+01 +9.43E+01*L +-4.05E+01*L^2 +5.76E+00*L^3] 09/25/2018
Eff.=10^[-8.67E+00 +8.41E+00*L +-3.13E+00*L^2 +3.49E-01*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.78E+02 +- 1.01E+01	9.55E+00	4.73E+00	3.79E+06
Cd-109	88.02		6.50E+03 +- 1.19E+02	9.92E+01	4.90E+01	1.11E+04
Co-57	122.07		1.51E+02 +- 6.42E+00	7.36E+00	3.63E+00	6.50E+03
Ce-139	165.85		2.11E+02 +- 5.27E+01	8.15E+01	4.01E+01	3.30E+03
Cs-137	661.62		1.91E+02 +- 2.79E+00	1.43E+00	7.00E-01	2.64E+05
Co-60	Average:x		3.03E+02 +- 3.59E+00	. . . .	. . . .	4.62E+04
	1173.21		3.01E+02 +- 5.03E+00	3.07E+00	1.51E+00	4.62E+04
	1332.48		3.05E+02 +- 5.12E+00	1.81E+00	8.79E-01	4.62E+04
Hg-203	279.18		MDA	2.53E+06	1.25E+06	1.12E+03
Sn-113	391.68		MDA	5.92E+02	2.92E+02	2.76E+03
Y-88	898.02		MDA	1.24E+03	6.12E+02	2.56E+03

MEASURED TOTAL: 7.83E+03 +- 1.95E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	48.96	100.83	47	96	78	1513	0.50	Deleted

181965D04.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
5	136.45	275.52	493	124	96	1690	0.92	Unknown
7	391.53	784.77	84	112	91	1515	1.31	Deleted
10	1272.40	2543.37	27	30	23	110	1.71	Unknown
12	1835.57	3667.71	48	28	20	56	3.41	Unknown

c:\SEEKER\BIN\181965d04.res Analysis Results Saved.

181959D04.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: DAILY CHECK

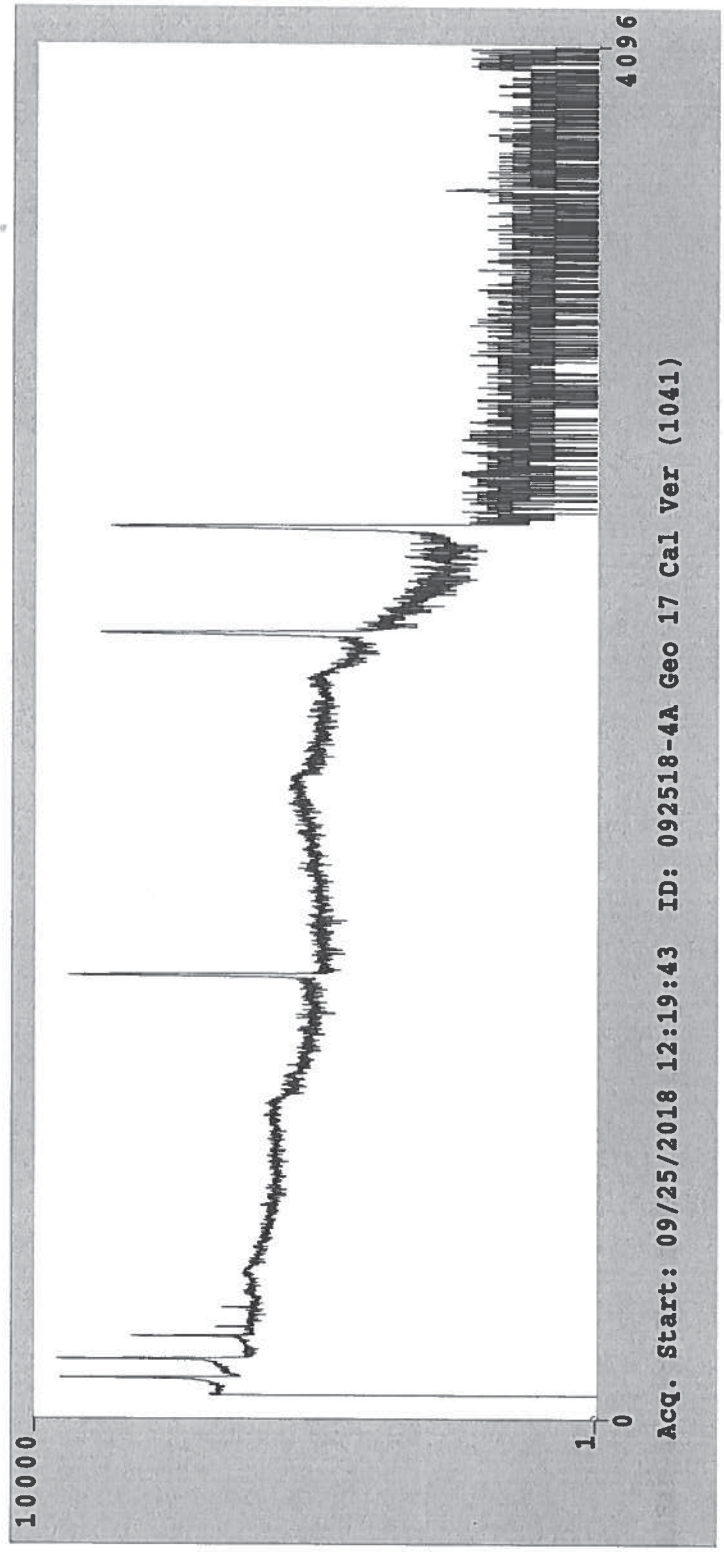
Stds. Match Tolerance: 2.00 keV

Detector Number: 04 Calibration Date. . . 09/25/2018 08:23:59

Energy(keV) = -1.55 + 0.501*Ch + 0.00e+00*Ch^2 + 0.00e+00*Ch^3

Pk. #	Measured Centroid	Calculated Energy	Energy (keV)	% Difference
1	121.85	59.48	59.50	-0.03
2	1324.08	661.67	661.64	0.00
3	2663.29	1332.47	1332.48	-0.00

Calibration Results Saved.


10000
1
0
4096
Acq. Start: 09/25/2018 12:19:43 ID: 092518-4A Geo 17 Cal Ver (1041)

1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity por ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

180545D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 051718-5 Geo 17 Eff Cal (1090)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	05/17/2018 11:06:33
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	3.27E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	2.15E+002 g	Real Time	3821 Sec
Collection Efficiency	1.0000	Spc. File	.180545D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.69 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/17/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	58.42	118.14	1666	675	551	35488	2.10 a	Wide Pk
2	59.50	120.32	12065	385	260	13649	0.76 b	
3	72.81	146.92	753	291	235	12282	0.71 a	
4	87.97	177.22	94809	722	310	19429	0.80 a	
5	121.96	245.16	74762	662	307	17398	0.90 a	HiResid
6	136.39	273.98	9834	358	245	12094	0.90 a	
7	165.76	332.70	81956	660	270	13498	0.97 a	HiResid
8	254.99	511.03	2830	285	218	8756	1.01 a	
9	257.54	516.14	209	233	190	7297	0.74 b	
10	279.07	559.17	36389	476	234	9328	1.13 a	HiResid
11	369.39	739.70	246	228	186	6791	1.18 a	
12	391.52	783.92	10661	427	308	12716	2.33 a	Wide Pk
13	391.60	784.09	52262	507	180	6358	1.14 b	
14	402.49	805.86	143	212	173	5894	1.11 a	NET< CL
15	511.02	1022.78	1713	353	282	10211	2.48 a	Wide Pk
16	661.59	1323.72	61009	546	191	6740	1.62 a	HiResid
17	813.79	1627.93	896	235	187	5637	2.20 a	
18	851.02	1702.35	121	197	161	4980	1.87 a	NET< CL
19	898.00	1796.26	71645	577	177	5807	1.92 a	HiResid
20	1173.20	2346.30	64996	539	145	3578	2.21 a	HiResid
21	1332.49	2664.68	57963	511	140	3329	2.33 a	HiResid

180545D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	1836.08	3671.21	42648	435	112	1933	2.78	a HiResid

180545D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET050516.BKG (051618-5 WEEKLY BKG)

Bkg.File Detector #: 5

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
4	87.97	94809	722	310	94807	722	310	
15	511.02	1713	353	282	1609	353	283	
19	898.00	71645	577	177	71641	577	177	

180545D05.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 051718-5 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 05 Calibration Date. . . 05/17/2018 11:06:33
Geometry File (D05)(Sh17).eff ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

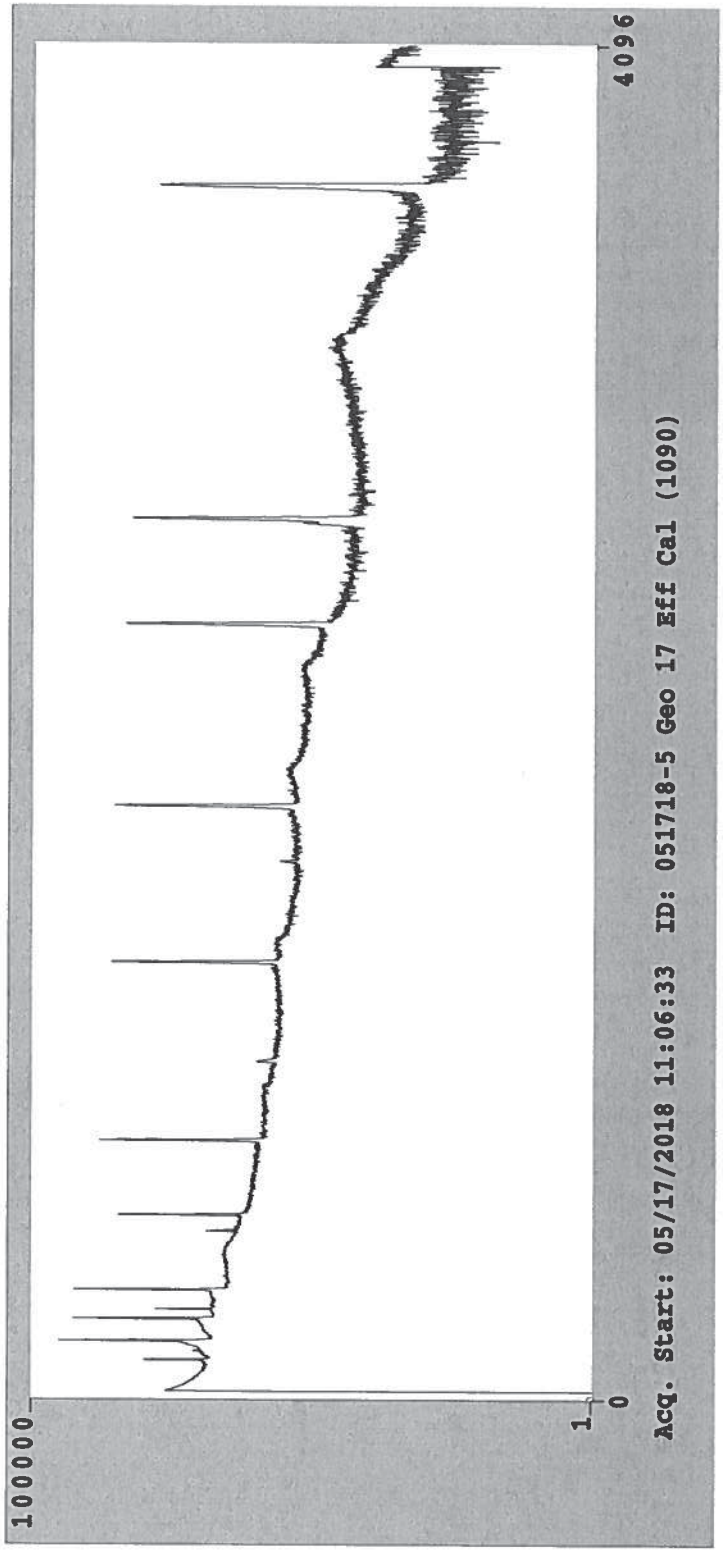
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-1.03e+02 + 1.32e+02*En +-5.73e+01*En^2 + 8.21e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-4.57e+01 + 4.54e+01*En +-1.54e+01*En^2 + 1.70e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	2.52e-03	0.31	2.53e-03	1.91	2.58e-03
2	88.04	1.67e-02	-1.50	1.65e-02	9.06	1.81e-02
3	122.06	2.90e-02	2.32	2.97e-02	6.30	3.17e-02
4	165.85	3.17e-02	-1.35	3.13e-02	2.05	3.20e-02
5	279.00	2.44e-02	0.18	2.45e-02	5.90	2.60e-02
6	391.68	1.66e-02	0.16	1.67e-02	16.90	2.01e-02
7	661.64	1.34e-02	-1.20	1.33e-02	-3.12	1.29e-02
8	898.02	1.01e-02	2.11	1.03e-02	-3.41	9.95e-03
9	1173.21	8.12e-03	-0.88	8.05e-03	-1.58	7.93e-03
10	1332.48	7.24e-03	-0.52	7.20e-03	-1.18	7.11e-03
11	1836.01	5.66e-03	0.28	5.68e-03	-4.94	5.41e-03

Calibration Results Saved.

OL JP 5/21/18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1
0
4096
Acq. Start: 05/17/2018 11:06:33 ID: 051718-5 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 5/17/2018
Detector 5
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.023107	3.99%	OK
UPPER EFFICIENCY CURVE	0.022221	-3.84%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.032613E+02		
B	1.324744E+02		
C	-5.726396E+01	Calculated efficiency	0.023107
D	8.213783E+00		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-4.568304E+01		
B	4.535038E+01		
C	-1.537548E+01	Calculated efficiency	0.022221
D	1.712991E+00		

En is energy in keV
Crossover energy 300

OK JP 5/21/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 – 352·8677
Fax 404 – 352·2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST

MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978: 1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 5

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 5/17/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	# of Half Lives Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	440	94%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6730	105%	Pass	1.87
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	157	99%	Pass	3.19
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	222	98%	Pass	6.30
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	18.61
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	362	93%	Pass	7.53
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	192	101%	Pass	0.08
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	8.13
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	297	97%	Pass	0.45
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	310	101%	Pass	0.45
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	8.13

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OKJP 5/21/18

180546D05.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 051718-5A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 05/17/2018 12:33:17
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.08E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1844 Sec
Collection Efficiency 1.0000	Spc. File 180546D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.69 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/17/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.50	120.30	5734	193	99	2171	0.72 a	Wide Pk
2	60.95	123.20	-0	299	246	7055	2.18 b	NET< CL
3	87.98	177.23	16194	290	115	2654	0.81 a	
4	89.88	181.03	138	121	98	1917	0.84 b	
5	121.96	245.16	6221	199	100	2023	0.87 a	
6	136.32	273.86	828	129	95	1832	0.82 a	
7	165.81	332.80	1018	129	92	1713	0.88 a	
8	234.93	470.94	61	131	107	2107	0.99 a	NET< CL
9	391.76	784.41	303	104	81	1370	1.01 a	
10	489.45	979.66	43	90	73	1127	0.91 a	NET< CL
11	661.56	1323.66	29503	359	85	1322	1.59 a	HiResid
12	898.12	1796.49	312	102	79	1303	1.51 a	
13	1173.17	2346.25	25023	333	86	1368	2.02 a	HiResid
14	1332.43	2664.57	23367	311	49	410	2.27 a	HiResid
15	1836.06	3671.17	172	34	18	53	2.69 a	

180546D05.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET050516.BKG (051618-5 WEEKLY BKG)

Bkg.File Detector #: 5

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	87.98	16194	290	115	16193	290	115	
12	898.12	312	102	79	311	102	79	

180546D05.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 051718-5A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 05/17/2018 12:33:17
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.08e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1844 Sec
Collection Efficiency 1.0000	Spectrum File 180546D05.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 5 (Detector 5)
Efficiency File: (D05)(Sh17).eff (Geo 17 Eff Cal)
*Eff=10^[-1.03E+02 +1.32E+02*L +-5.73E+01*L^2 +8.21E+00*L^3] 05/17/2018
Eff.=10^[-4.57E+01 +4.54E+01*L +-1.54E+01*L^2 +1.70E+00*L^3] Above 300.00 keV
Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.40E+02 +- 1.49E+01	1.54E+01	7.60E+00	3.79E+06
Cd-109	88.02		6.73E+03 +- 1.21E+02	9.65E+01	4.77E+01	1.11E+04
Co-57	122.07		1.57E+02 +- 5.04E+00	5.13E+00	2.53E+00	6.50E+03
Ce-139	165.85		2.22E+02 +- 2.82E+01	4.09E+01	2.01E+01	3.30E+03
Sn-113	391.68		3.62E+02 +- 1.24E+02	1.96E+02	9.63E+01	2.76E+03
Cs-137	661.62		1.92E+02 +- 2.34E+00	1.12E+00	5.51E-01	2.64E+05
Co-60	Average:x		3.03E+02 +- 2.85E+00	. . . .	. . . .	4.62E+04
	1173.21		2.97E+02 +- 3.95E+00	2.07E+00	1.02E+00	4.62E+04
	1332.48		3.10E+02 +- 4.13E+00	1.34E+00	6.50E-01	4.62E+04
Hg-203	279.18		MDA	3.25E+05	1.61E+05	1.12E+03
Y-88	898.02		MDA	2.53E+02r	1.24E+02	2.56E+03

MEASURED TOTAL: 8.41E+03 +- 2.98E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

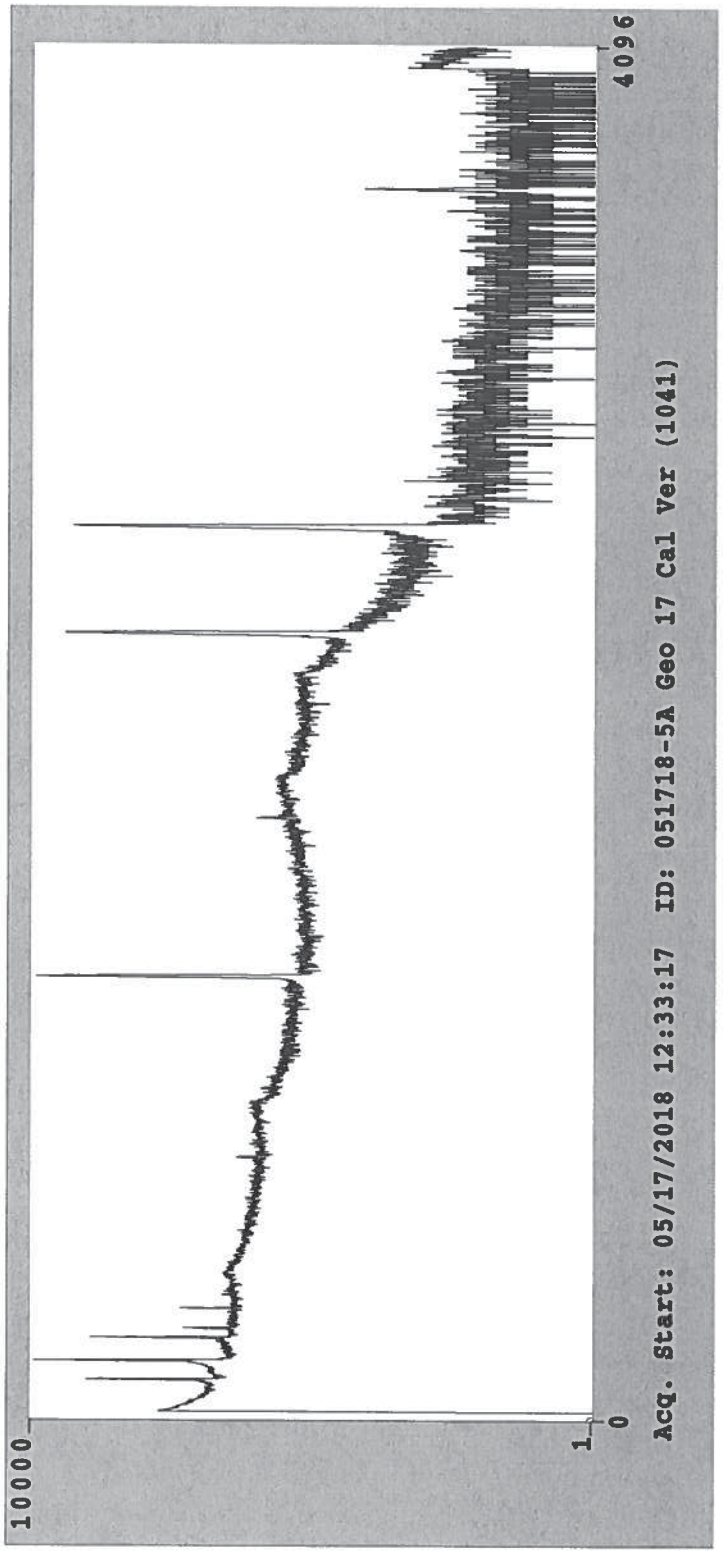
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	60.95	123.20	-0	299	246	7055	2.18	Deleted

180546D05.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
4	89.88	181.03	138	121	98	1917	0.84	Unknown
6	136.32	273.86	828	129	95	1832	0.82	Unknown
8	234.93	470.94	61	131	107	2107	0.99	Deleted
10	489.45	979.66	43	90	73	1127	0.91	Deleted
12	898.12	1796.49	311	102	79	1303	1.51	Unknown
15	1836.06	3671.17	172	34	18	53	2.69	Unknown

c:\SEEKER\BIN\180546d05.res Analysis Results Saved.


10000
1
0
4096
Acq. Start: 05/17/2018 12:33:17 ID: 051718-5A Geo 17 Cal Ver (1041)

#1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

181504D07.SPC Analyzed by JP

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 092518-7 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 09/25/2018 07:55:25
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 6.41E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 5400 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 5549 Sec
Collection Efficiency 1.0000	Spc. File 181504D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.39 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/25/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.40	123.22	12031	342	216	9418	0.89 a	HiResid
2	87.95	180.15	87491	669	257	13351	0.87 a	HiResid
3	121.95	247.94	60159	585	262	12714	0.93 a	HiResid
4	136.35	276.66	7903	335	234	10107	1.00 a	
5	165.77	335.34	46189	510	226	9444	0.97 a	HiResid
6	228.71	460.84	204	295	242	9968	1.23 a	NET< CL
7	255.07	513.41	1391	271	215	7848	1.15 a	
8	279.21	561.54 Δ	5769	289	202	6993	1.21 a	
9	391.76	785.98	30298	416	187	6474	1.25 a	HiResid
10	511.40	1024.57	988	276	221	7242	1.99 a	
11	661.86	1324.61	62457	541	170	5007	1.42 a	HiResid
12	813.64	1627.28	483	227	183	5382	2.15 a	
13	898.20	1795.91	32697	413	163	4929	1.69 a	HiResid
14	1173.36	2344.62	67638	549	144	3854	1.98 a	HiResid
15	1324.24	2645.50	382	123	96	1640	2.13 a	
16	1332.50	2661.98	61771	513	105	1959	2.18 a	HiResid
17	1835.51	3665.06	20439	292	50	396	2.55 a	HiResid

Δ less than 10,000 counts achieved due to greater than 5 1/2-lives elapsed.
JP 9/25/18

181504D07.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET070919.BKG (091918-7 LONG BKG CAL)

Bkg.File Detector #: 7

==========

BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	87.95	87491	669	257	87485	669	258	
10	511.40	988	276	221	833	277	223	

181504D07.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 092518-7 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 07 Calibration Date. . . 09/25/2018 07:55:25
Geometry File (D07)(Sh17).EFF ID. DET 7 GEO 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

Crossover: 300.00 keV

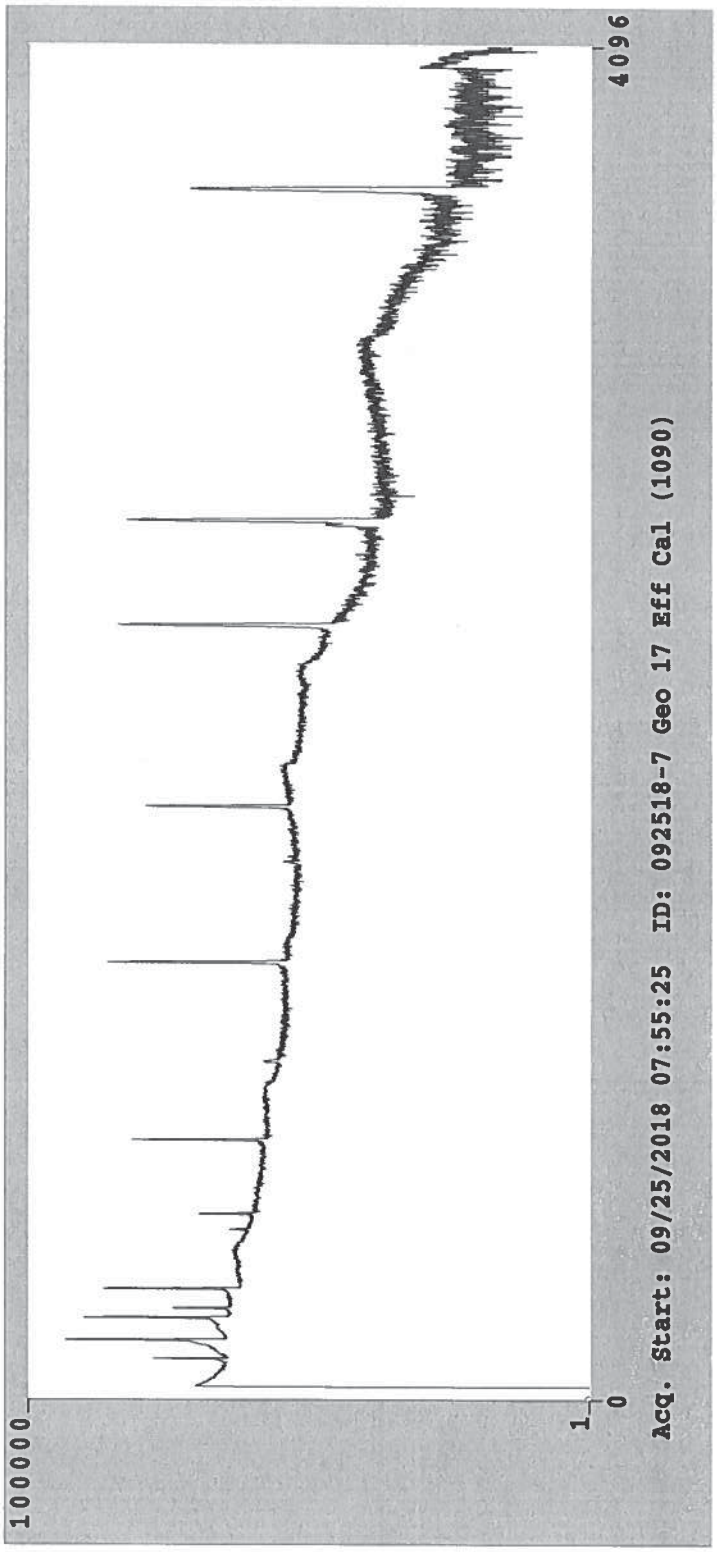
Below Crossover Efficiency Fit:
Eff = 10 ^ [-1.18e+02 + 1.52e+02*En +-6.65e+01*En^2 + 9.63e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [9.78e-01 +-1.35e+00*En + 1.03e-01*En^2 +-1.37e-03*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference		Prev.Calc. Efficiency
1	59.50	1.68e-03	0.30	1.68e-03	69.20	Δ	5.47e-03
2	88.04	1.25e-02	-1.45	1.24e-02	39.92		2.06e-02
3	122.06	2.17e-02	2.25	2.22e-02	29.45		3.15e-02
4	165.85	2.30e-02	-1.31	2.27e-02	24.20		3.00e-02
5	279.00	1.81e-02	0.18	1.81e-02	14.38		2.11e-02
6	391.68	1.41e-02	0.07	1.42e-02	13.37		1.63e-02
7	661.64	9.25e-03	-0.53	9.21e-03	15.76		1.09e-02
8	898.02	7.17e-03	0.88	7.24e-03	16.25		8.64e-03
9	1173.21	5.91e-03	-0.12	5.90e-03	16.18		7.04e-03
10	1332.48	5.39e-03	-0.46	5.36e-03	15.97		6.38e-03
11	1836.01	4.24e-03	0.15	4.24e-03	14.98		4.99e-03

Calibration Results Saved.

OK JP 9/26/18

Δ % Difference > 10% due to being a different Detector JP 9/26/18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4096
Acq. Start: 09/25/2018 07:55:25 ID: 092518-7 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 9/25/2018
Detector 7
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.018304	3.40%	OK
UPPER EFFICIENCY CURVE	0.017702	-3.29%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.175258E+02		
B	1.522638E+02		
C	-6.645202E+01	Calculated efficiency	0.018304
D	9.629689E+00		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	9.761600E-01		
B	-1.348446E+00		
C	1.031581E-01	Calculated efficiency	0.017702
D	-1.373180E-03		

En is energy in keV
Crossover energy 300

OK JN 9/26/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 - 352-8677
Fax 404 - 352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 7

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 9/25/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	460	98%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6460	101%	Pass	2.16
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	154	98%	Pass	3.67
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	204	90%	Pass	7.25
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	21.42
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	8.67
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	197	103%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.36
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	303	99%	Pass	0.52
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	307	100%	Pass	0.52
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.36

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

Ok JP 9/26/18

181505D07.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 092518-7A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/25/2018 10:18:31
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.40E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1856 Sec
Collection Efficiency 1.0000	Spc. File 181505D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.39 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 09/25/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	47.98	100.43	61	94	76	1293	0.67	a	NET< CL
2	51.49	107.44	24	77	63	970	0.48	b	NET< CL
3	59.35	123.11	3986	167	90	1628	0.89	a	
4	87.89	180.03	9566	228	96	1853	0.89	a	
5	121.88	247.80	3255	163	95	1680	0.93	a	
6	136.27	276.49	339	106	82	1352	0.82	a	
7	165.74	335.28	351	103	79	1258	0.89	a	
8	215.75	434.99	121	129	105	1878	1.15	a	
9	419.24	840.79	60	68	54	728	0.71	a	
10	570.19	1141.82	62	91	74	946	1.48	a	NET< CL
11	619.85	1240.84	57	51	40	389	0.74	a	
12	648.45	1297.86	65	88	71	876	1.48	a	NET< CL
13	661.81	1324.52	20788	301	70	845	1.54	a	HiResid
14	815.39	1630.78	33	55	44	474	0.79	a	NET< CL
15	820.35	1640.67	44	88	72	948	1.56	b	NET< CL
16	898.49	1796.50	73	75	60	793	1.12	a	
17	1173.28	2344.47	17875	281	71	936	1.91	a	HiResid
18	1332.39	2661.76	16478	259	30	159	2.13	a	HiResid
19	1835.85	3665.74	45	19	11	23	1.68	a	

181505D07.SPC Analyzed by

****

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

****

Background File:. . . . . DET070919.BKG (091918-7 LONG BKG CAL)

Bkg.File Detector #: 7

==========

BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	51.49	24	77	63	23	77	63	NET<CL
4	87.89	9566	228	96	9564	228	96	
10	570.19	62	91	74	58	91	74	NET<CL

181505D07.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 092518-7A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 09/25/2018 10:18:31
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.40e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1856 Sec
Collection Efficiency 1.0000	Spectrum File 181505D07.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 7 (Detector 7)
Efficiency File: (D07)(Sh17).EFF (DET 7 GEO 17 Eff Cal)
Eff=10^[-1.18E+02 +1.52E+02*L +-6.65E+01*L^2 +9.63E+00*L^3] 09/25/2018
Eff.=10^[9.78E-01 +-1.35E+00*L +1.03E-01*L^2 +-1.37E-03*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)		MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.60E+02	+- 1.93E+01	2.11E+01	1.04E+01	3.79E+06
Cd-109	88.02		6.46E+03	+- 1.54E+02	1.31E+02	6.48E+01	1.11E+04
Co-57	122.07		1.54E+02	+- 7.68E+00	9.13E+00	4.50E+00	6.50E+03
Ce-139	165.85		2.04E+02	+- 5.99E+01	9.34E+01	4.59E+01	3.30E+03
Cs-137	661.62		1.97E+02	+- 2.85E+00	1.35E+00	6.61E-01	2.64E+05
Co-60	Average:x		3.05E+02	+- 3.39E+00	. . . .	. . . .	4.62E+04
	1173.21		3.03E+02	+- 4.77E+00	2.46E+00	1.21E+00	4.62E+04
	1332.48		3.07E+02	+- 4.84E+00	1.17E+00	5.59E-01	4.62E+04
Hg-203	279.18		MDA	. . . .	2.65E+06	1.31E+06	1.12E+03
Sn-113	391.68		MDA	. . . .	5.03E+02	2.47E+02	2.76E+03
Y-88	898.02		MDA	. . . .	6.76E+02r	3.29E+02	2.56E+03

MEASURED TOTAL: 7.78E+03 +- 2.47E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	47.98	100.43	61	94	76	1293	0.67	Deleted

181505D07.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	51.49	107.44	23	77	63	970	0.48	Deleted
6	136.27	276.49	339	106	82	1352	0.82	Unknown
8	215.75	434.99	121	129	105	1878	1.15	Unknown
9	419.24	840.79	60	68	54	728	0.71	Unknown
10	570.19	1141.82	58	91	74	946	1.48	Deleted
11	619.85	1240.84	57	51	40	389	0.74	Unknown
12	648.45	1297.86	65	88	71	876	1.48	Deleted
14	815.39	1630.78	33	55	44	474	0.79	Deleted
15	820.35	1640.67	44	88	72	948	1.56	Deleted
16	898.49	1796.50	73	75	60	793	1.12	Unknown
19	1835.85	3665.74	45	19	11	23	1.68	Unknown

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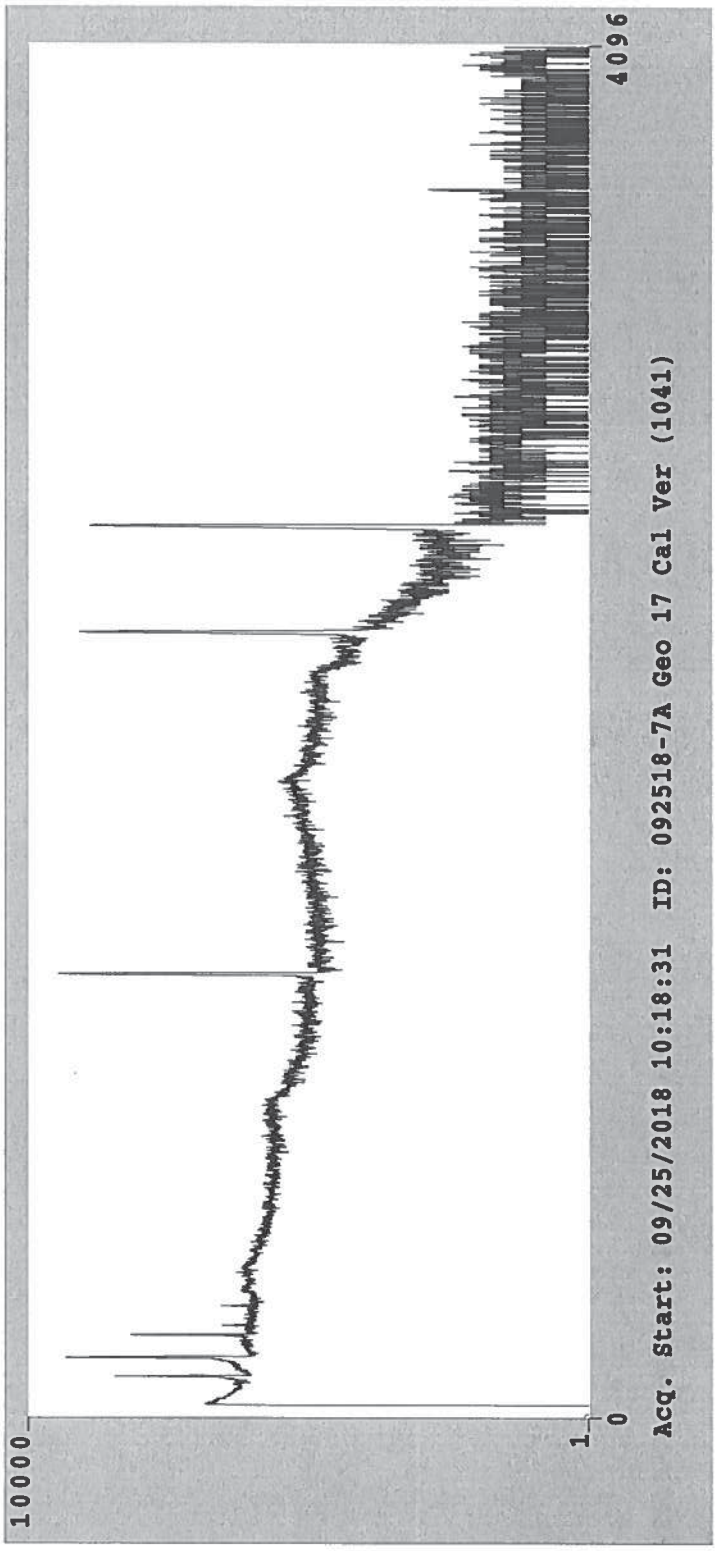
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4096
Acq. Start: 09/25/2018 10:18:31 ID: 092518-7A Geo 17 Cal Ver (1041)

1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity por ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

180601D08.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 051718-8 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 05/17/2018 09:21:56
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 3.26E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1907 Sec
Collection Efficiency 1.0000	Spc. File 180601D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.38 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/17/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	49.27	103.09	1052	326	263	11814	1.11	a	
2	58.06	120.64	2367	488	394	21474	1.65	a	Wide Pk
3	59.41	123.33	61870	547	187	7720	0.73	b	
4	66.31	137.12	2307	587	476	25158	2.34	a	Wide Pk
5	68.53	141.54	1801	446	360	17970	1.72	b	
6	70.70	145.88	1844	341	272	12579	1.17	c	
7	72.73	149.93	2406	310	242	10782	1.04	d	
8	74.86	154.17	327	222	180	7188	0.69	e	
9	82.56	169.55	1508	410	331	17335	1.32	a	HiResid Wide Pk
10	84.98	174.39	3705	659	532	29924	2.44	b	HiResid
11	87.95	180.31	97807	670	198	7869	0.77	c	HiResid
12	121.93	248.14	44145	468	170	5808	0.80	a	HiResid
13	136.35	276.93	5360	237	154	4758	0.87	a	
14	165.75	335.61	38201	427	141	4004	0.75	a	HiResid
15	198.96	401.91	265	207	168	4808	1.22	a	
16	199.92	403.82	39	112	91	2061	0.48	b	NET< CL
17	255.15	514.09	1013	154	115	2677	0.78	a	
18	272.74	549.19	52	95	77	1454	0.51	a	NET< CL
19	279.16	562.00	15787	292	123	2793	0.97	a	
20	391.72	786.71	25417	349	116	2312	1.10	a	

180601D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	511.05	1024.93	608	196	156	3422	2.11	a	Wide Pk
22	661.82	1325.90	24109	336	104	2017	1.37	a	
23	814.18	1630.04	393	100	76	1250	1.21	a	
24	898.12	1797.59	28878	362	102	1927	1.57	a	
25	1173.24	2346.81	26260	335	71	976	1.82	a	HiResid
26	1283.58	2567.08	57	65	52	523	1.76	a	
27	1324.86	2649.47	778	120	87	1017	3.46	a	HiResid Wide Pk
28	1332.36	2664.44	24216	319	56	581	1.96	b	HiResid
29	1835.28	3668.40	17530	267	31	155	2.41	a	HiResid

180601D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

****

Background File:. . . . . DET080516.BKG (051618-8 WEEKLY BKG)

Bkg.File Detector #: 8

==========

BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
4	66.31	2307	587	476	2302	587	476	
5	68.53	1801	446	360	1799	446	360	
7	72.73	2406	310	242	2400	310	242	
9	82.56	1508	410	331	1508	410	331	
10	84.98	3705	659	532	3700	659	532	
15	198.96	265	207	168	258	207	168	
21	511.05	608	196	156	558	196	156	

180601D08.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 051718-8 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

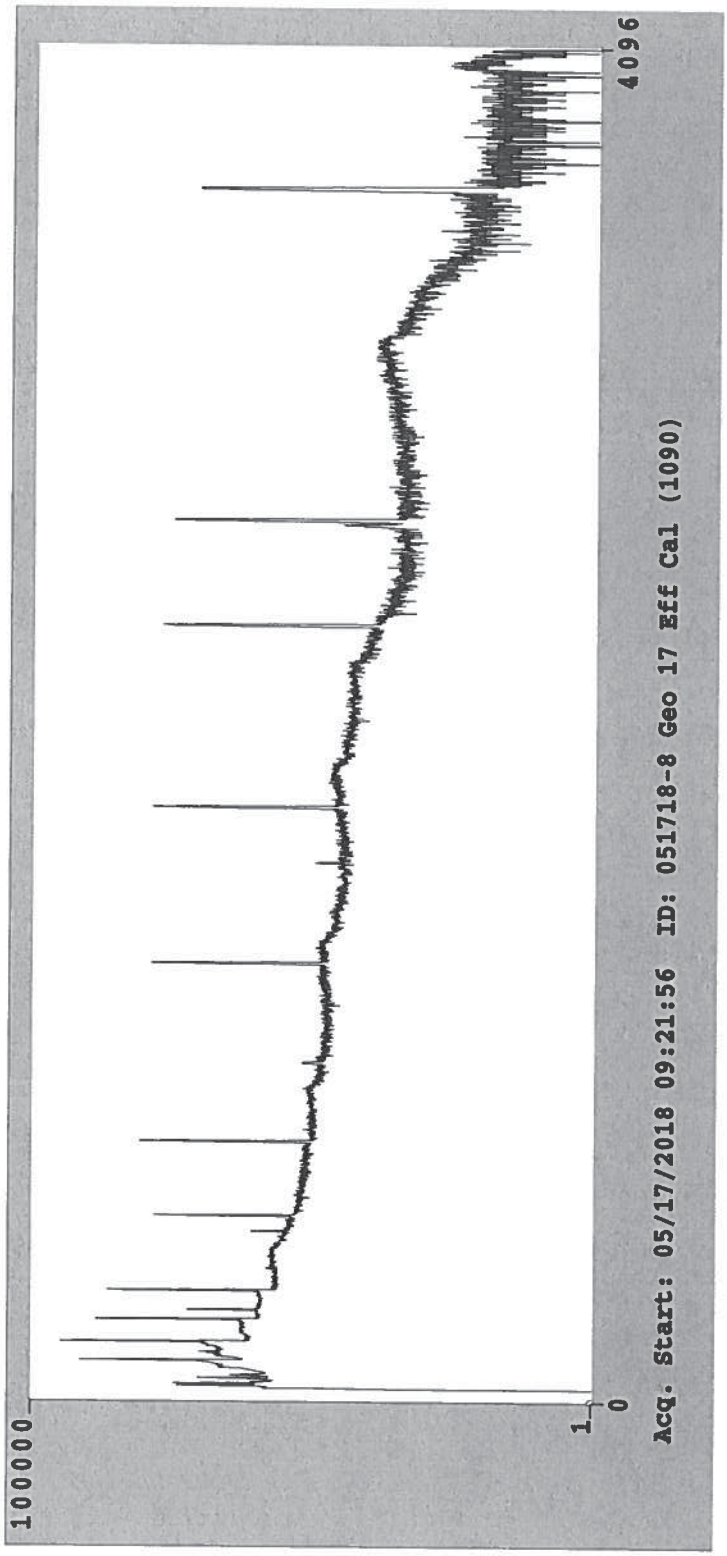
Detector Number: 08 Calibration Date. . . 05/17/2018 09:21:56
Geometry File (D08)(Sh17).eff ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

Eff = 1 / [5.03e-02*En^-2.20e+00 + 1.32e+02*En^ 8.10e-01]
(Where En = Energy in MeV)) (Exponential)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	2.59e-02	0.17	2.59e-02	4.04	2.70e-02
2	88.04	3.46e-02	-0.40	3.44e-02	-2.36	3.36e-02
3	122.06	3.42e-02	-0.01	3.42e-02	-0.99	3.39e-02
4	165.85	2.96e-02	1.14	2.99e-02	1.59	3.04e-02
5	279.00	2.12e-02	-1.17	2.09e-02	3.52	2.17e-02
6	391.68	1.62e-02	-0.65	1.61e-02	3.11	1.66e-02
7	661.64	1.06e-02	-0.60	1.06e-02	1.14	1.07e-02
8	898.02	8.12e-03	1.71	8.26e-03	-0.38	8.22e-03
9	1173.21	6.56e-03	1.30	6.65e-03	-1.82	6.53e-03
10	1332.48	6.05e-03	-0.77	6.00e-03	-2.54	5.85e-03
11	1836.01	4.65e-03	-0.54	4.63e-03	-4.39	4.43e-03

Calibration Results Saved.

OK JP 5/21/18


100000
1
0
4096
Acq. Start: 05/17/2018 09:21:56 ID: 051718-8 Geo 17 Eff Cal (1090)

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Rec'd 3-8-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 - 352-8677
Fax 404 - 352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST

MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978: 1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 8

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 5/17/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	# of Half Lives Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	469	100%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6160	96%	Pass	1.87
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	155	98%	Pass	3.19
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	253	111%	Pass	6.30
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	18.61
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	484	>5 h-lives	>5 h-lives	7.53
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	194	102%	Pass	0.08
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	8.13
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	304	100%	Pass	0.45
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	305	100%	Pass	0.45
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	8.13

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

5/21/18

180602D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 051718-8A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 05/17/2018 10:04:55
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.08E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1883 Sec
Collection Efficiency 1.0000	Spc. File 180602D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.38 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/17/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.13	102.82	1068	299	240	9122	1.30 a	Wide Pk
2	59.41	123.35	62291	536	160	5666	0.73 a	
3	65.84	136.17	200	167	135	3390	1.05 a	
4	87.96	180.33	30934	375	107	2519	0.71 a	HiResid
5	121.93	248.15	7093	199	88	1543	0.78 a	
6	128.94	262.14	135	144	117	2173	1.35 a	
7	136.34	276.91	1002	129	93	1593	0.95 a	
8	165.79	335.70	1105	114	77	1180	0.88 a	
9	283.30	570.28	86	111	90	1387	1.20 a	NET< CL
10	310.70	624.98	62	99	80	1195	1.01 a	NET< CL
11	391.85	786.96	391	131	103	1565	1.48 a	
12	577.46	1157.49	48	52	41	415	0.66 a	
13	661.83	1325.91	23696	318	64	765	1.37 a	
14	898.25	1797.87	209	80	61	817	1.22 a	
15	955.64	1912.42	-0	61	50	625	0.83 a	NET< CL
16	961.45	1924.02	163	89	70	1000	1.39 b	
17	1173.24	2346.81	21157	297	49	457	1.81 a	HiResid
18	1332.37	2664.47	19155	278	23	100	1.95 a	HiResid
19	1835.43	3668.70	161	31	14	34	2.22 a	

180602D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET080516.BKG (051618-8 WEEKLY BKG)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	65.84	200	167	135	194	167	136	
16	961.45	163	89	70	162	89	70	

180602D08.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 051718-8A Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 05/17/2018 10:04:55
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.08e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1883 Sec
Collection Efficiency 1.0000	Spectrum File 180602D08.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 8 (Detector 8)
Efficiency File: (D08)(Sh17).eff (Geo 17 Eff Cal)
*Eff.=1/[5.03E-02*En^-2.20E+00 + 1.32E+02*En^8.10E-01] 05/17/2018

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.69E+02 +- 4.03E+00	2.43E+00	1.20E+00	3.79E+06
Cd-109	88.02		6.16E+03 +- 7.47E+01	4.30E+01	2.12E+01	1.11E+04
Co-57	122.07		1.55E+02 +- 4.37E+00	3.89E+00	1.92E+00	6.50E+03
Ce-139	165.85		2.53E+02 +- 2.61E+01	3.56E+01	1.75E+01	3.30E+03
Sn-113	391.68		4.84E+02 +- 1.62E+02	2.58E+02	1.27E+02	2.76E+03
Cs-137	661.62		1.94E+02 +- 2.60E+00	1.08E+00	5.27E-01	2.64E+05
Co-60	Average:x		3.04E+02 +- 3.07E+00	. . . .	. . . .	4.62E+04
	1173.21		3.04E+02 +- 4.26E+00	1.44E+00	6.99E-01	4.62E+04
	1332.48		3.05E+02 +- 4.43E+00	7.83E-01	3.70E-01	4.62E+04
Hg-203	279.18		MDA	2.90E+05	1.43E+05	1.12E+03
Y-88	898.02		MDA	2.58E+02r	1.26E+02	2.56E+03

MEASURED TOTAL: 8.02E+03 +- 2.77E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.13	102.82	1068	299	240	9122	1.30	Unknown
3	65.84	136.17	194	167	136	3390	1.05	Unknown

180602D08.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
6	128.94	262.14	135	144	117	2173	1.35	Unknown
7	136.34	276.91	1002	129	93	1593	0.95	Unknown
9	283.30	570.28	86	111	90	1387	1.20	Deleted
10	310.70	624.98	62	99	80	1195	1.01	Deleted
12	577.46	1157.49	48	52	41	415	0.66	Unknown
14	898.25	1797.87	209	80	61	817	1.22	Unknown
15	955.64	1912.42	-0	61	50	625	0.83	Deleted
16	961.45	1924.02	162	89	70	1000	1.39	Unknown
19	1835.43	3668.70	161	31	14	34	2.22	Unknown

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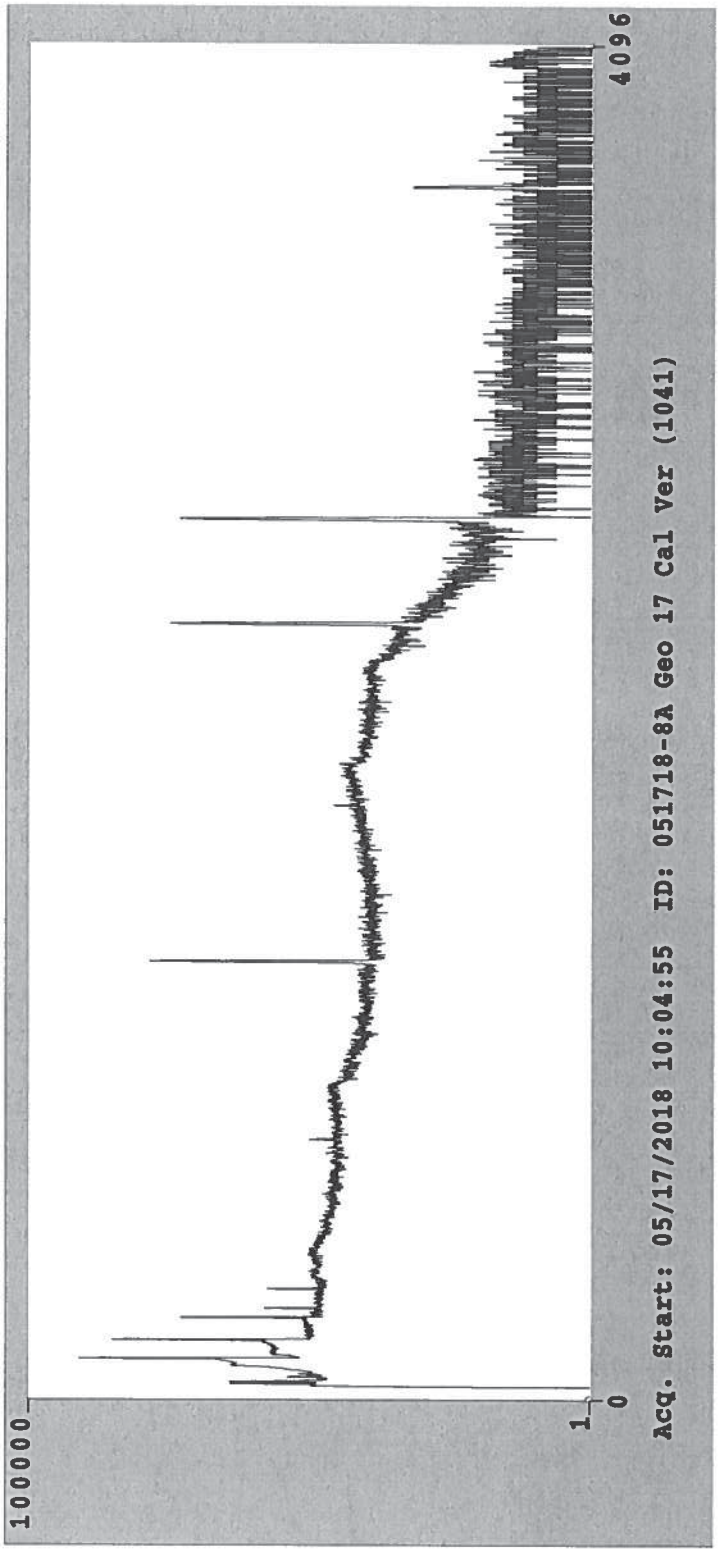
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4096
Acq. Start: 05/17/2018 10:04:55 ID: 051718-8A Geo 17 Cal Ver (1041)

#1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

181592D09.SPC Analyzed by JP

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 110618-9 Geo 17 Eff Cal (1090)

Sampling Start: 01/01/2018 10:00:00	Counting Start: 11/06/2018 08:13:44
Sampling Stop: 01/01/2018 10:00:00	Decay Time. . . . . 7.41E+003 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 4200 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 4373 Sec
Collection Efficiency 1.0000	Spc. File 181592D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.31 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/06/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	49.19	102.68	2503	483	389	23937	1.26	a	
2	59.39	123.02	135345	812	282	16063	0.86	a	
3	66.06	136.32	851	364	296	16169	1.04	a	
4	87.95	179.94	158775	864	274	15121	0.88	a	
5	121.93	247.70	61213	559	213	8387	0.91	a	HiResid
6	136.38	276.51	7106	262	165	5458	0.85	a	HiResid
7	165.77	335.09	34143	427	177	5772	0.92	a	HiResid
8	198.72	400.79	185	209	170	5350	0.94	a	
9	255.07	513.13	693	148	114	2891	0.72	a	
10	279.17	561.16 Δ	2172	200	145	3903	1.01	a	
11	391.76	785.63	17777	320	145	3605	1.15	a	
12	511.19	1023.72	559	279	226	6296	2.61	a	Wide Pk
13	661.87	1324.13	47117	462	130	2944	1.42	a	HiResid
14	709.88	1419.85	122	136	110	2244	1.39	a	
15	814.28	1627.97	487	163	129	2738	1.64	a	
16	898.18	1795.23	18013	307	123	2927	1.55	a	
17	910.16	1819.12	116	149	122	2873	1.49	a	NET< CL
18	1173.30	2343.72	47801	451	89	1406	1.82	a	HiResid
19	1324.95	2646.05	521	112	84	950	3.39	a	HiResid Wide Pk
20	1332.40	2660.91	43361	422	54	543	1.97	b	HiResid

Δ less than 10,000 counts achieved due to greater than 5 ½-lives elapsed JP 11/7/18

181592D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	1835.27	3663.44	10729	210	29	144	2.32	a HiResid

181592D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins

GammaScan

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Background File:. . . . . DET091031.BKG (103118-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	66.06	851	364	296	838	365	296	
4	87.95	158775	864	274	158770	864	274	
8	198.72	185	209	170	167	209	171	NET<CL
12	511.19	559	279	226	458	279	227	
13	661.87	47117	462	130	47114	462	130	
16	898.18	18013	307	123	18009	307	123	
17	910.16	116	149	122	112	149	122	NET<CL

181592D09.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 110618-9 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

Detector Number: 09 Calibration Date. . . 11/06/2018 08:13:44
Geometry File (D09)(Sh17).EFF ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

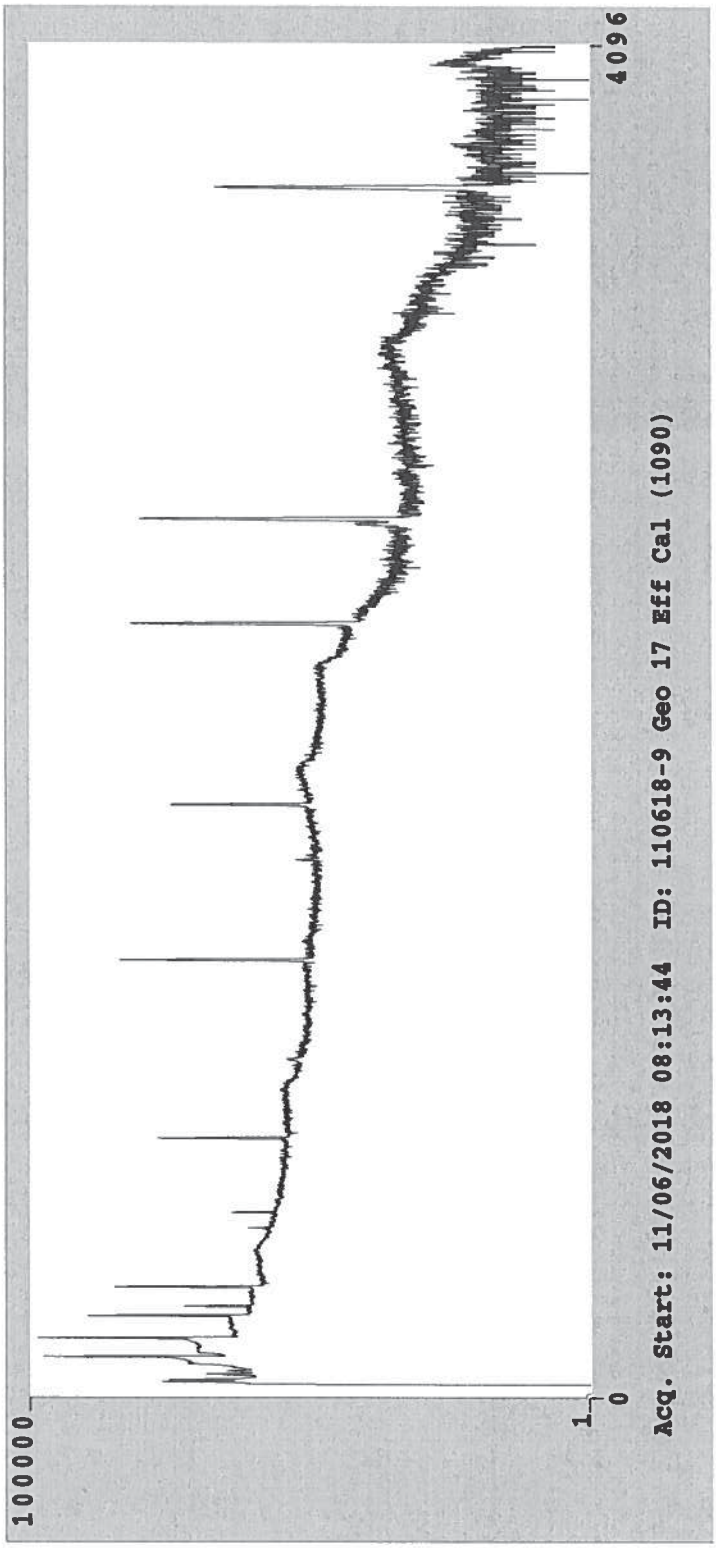
Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-1.47e+01 + 1.58e+01*En +-5.94e+00*En^2 + 6.70e-01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-4.97e+00 + 4.67e+00*En +-1.91e+00*En^2 + 2.19e-01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	2.43e-02	-0.10	2.43e-02	-0.97	2.40e-02
2	88.04	3.11e-02	0.47	3.13e-02	-1.10	3.10e-02
3	122.06	3.16e-02	-0.74	3.14e-02	0.11	3.14e-02
4	165.85	2.71e-02	0.42	2.72e-02	3.60	2.82e-02
5	279.00	1.63e-02	-0.06	1.63e-02	16.88	1.96e-02
6	391.68	1.37e-02	0.18	1.38e-02	1.22	1.39e-02
7	661.64	9.00e-03	-1.33	8.88e-03	-1.39	8.76e-03
8	898.02	6.68e-03	2.18	6.83e-03	-0.95	6.76e-03
9	1173.21	5.45e-03	-0.33	5.43e-03	-0.24	5.42e-03
10	1332.48	4.94e-03	-1.12	4.88e-03	0.02	4.88e-03
11	1836.01	3.76e-03	0.38	3.77e-03	-0.09	3.77e-03

Calibration Results Saved.

OK JP 11/7/18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4096
Acq. Start: 11/06/2018 08:13:44 ID: 110618-9 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 11/6/2018
Detector 9
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.015937	-4.61%	OK
UPPER EFFICIENCY CURVE	0.016707	4.83%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-1.466460E+01		
B	1.579560E+01		
C	-5.939207E+00	Calculated efficiency	0.015937
D	6.699466E-01		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-4.969571E+00		
B	4.672936E+00		
C	-1.909453E+00	Calculated efficiency	0.016707
D	2.193232E-01		

En is energy in keV
Crossover energy 300

On JD 11/7/18

Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Recd 3-5-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404 - 352-8677
Fax 404 - 352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 9

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 11/6/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						# of Half Lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	537	114%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6440	101%	Pass	2.25
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	157	99%	Pass	3.83
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	227	100%	Pass	7.56
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	22.32
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	9.04
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	189	99%	Pass	0.09
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.75
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	305	100%	Pass	0.54
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	305	100%	Pass	0.54
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.75

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OH JD 11/7/19

181593D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 110618-9 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/06/2018 09:47:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.50E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1889 Sec
Collection Efficiency 1.0000	Spc. File 181593D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.31 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/06/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	49.13	102.55	-39	104	86	1830	0.55	a	NET< CL HiResid Wide Pk
2	49.23	102.77	-62	104	86	1830	0.43	b	NET< CL HiResid
3	56.89	118.02	6247	330	239	6650	2.19	c	HiResid
4	59.37	122.97	66716	536	118	2570	0.96	d	HiResid
5	74.45	153.05	149	136	110	2454	0.89	a	
6	87.95	179.95	22698	328	107	2297	0.89	a	
7	102.85	209.65	73	71	57	790	0.45	a	
8	121.93	247.69	4217	163	81	1335	0.88	a	
9	136.36	276.46	575	114	85	1340	0.96	a	
10	165.83	335.21	377	98	74	1107	0.85	a	
11	278.23	559.30	41	59	47	548	0.53	a	NET< CL
12	310.39	623.42	45	113	93	1361	1.37	a	NET< CL
13	391.95	786.02	82	89	72	947	0.99	a	
14	511.20	1023.74	93	89	71	934	1.39	a	
15	601.09	1202.96	47	88	72	846	1.58	a	NET< CL
16	633.20	1266.97	17	67	55	596	1.07	a	NET< CL
17	661.87	1324.12	19203	288	65	738	1.43	a	HiResid
18	897.87	1794.61	56	72	58	739	1.19	a	NET< CL

181593D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
19	1173.29	2343.71	16288	262	48	414	1.82 a	
20	1332.40	2660.91	14679	244	23	101	1.92 a	HiResid
21	1834.97	3662.83	40	17	9	17	1.36 a	

181593D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET091031.BKG (103118-9 LONG BKG CAL)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
5	74.45	149	136	110	143	136	110	
6	87.95	22698	328	107	22696	328	107	
14	511.20	93	89	71	50	89	72	NET<CL
17	661.87	19203	288	65	19202	288	65	
18	897.87	56	72	58	54	72	58	NET<CL

181593D09.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

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Geo 17/26

Sample ID: 110618-9 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/06/2018 09:47:44
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.50e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1889 Sec
Collection Efficiency 1.0000	Spectrum File 181593D09.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh17).EFF (Geo 17 Eff Cal)

Eff=10^[-1.47E+01 +1.58E+01*L +-5.94E+00*L^2 +6.70E-01*L^3] 11/06/2018

Eff.=10^[-4.97E+00 +4.67E+00*L +-1.91E+00*L^2 +2.19E-01*L^3] Above 300.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

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MEASURED or MDA CONCENTRATIONS

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Nuclide	ENERGY (keV)	N E T	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		5.37E+02 +- 4.32E+00	1.92E+00	9.49E-01	3.79E+06
Cd-109	88.02		6.44E+03 +- 9.31E+01	6.14E+01	3.03E+01	1.11E+04
Co-57	122.07		1.57E+02 +- 6.07E+00	6.16E+00	3.03E+00	6.50E+03
Ce-139	165.85		2.27E+02 +- 5.90E+01	9.07E+01	4.45E+01	3.30E+03
Cs-137	661.62		1.89E+02 +- 2.84E+00	1.31E+00	6.42E-01	2.64E+05
Co-60	Average:x		3.05E+02 +- 3.52E+00	. . . .	. . . .	4.62E+04
	1173.21		3.05E+02 +- 4.90E+00	1.86E+00	9.07E-01	4.62E+04
	1332.48		3.05E+02 +- 5.08E+00	1.03E+00	4.86E-01	4.62E+04
Hg-203	279.18		MDA	4.39E+06	2.15E+06	1.12E+03
Sn-113	391.68		MDA	4.40E+02r	2.14E+02	2.76E+03
Y-88	898.02		MDA	1.34E+03	6.58E+02	2.56E+03

MEASURED TOTAL: 7.85E+03 +- 1.69E+02 pCi/g

==========

UNKNOWN,SUM or ESCAPE PEAKS

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PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.13	102.55	-39	104	86	1830	0.55	Deleted

181593D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	49.23	102.77	-62	104	86	1830	0.43	Deleted
3	56.89	118.02	6247	330	239	6650	2.19	Unknown
5	74.45	153.05	143	136	110	2454	0.89	Unknown
7	102.85	209.65	73	71	57	790	0.45	Unknown
9	136.36	276.46	575	114	85	1340	0.96	Unknown
11	278.23	559.30	41	59	47	548	0.53	Deleted
12	310.39	623.42	45	113	93	1361	1.37	Deleted
13	391.95	786.02	82	89	72	947	0.99	Unknown
14	511.20	1023.74	50	89	72	934	1.39	Deleted
15	601.09	1202.96	47	88	72	846	1.58	Deleted
16	633.20	1266.97	17	67	55	596	1.07	Deleted
18	897.87	1794.61	54	72	58	739	1.19	Deleted
21	1834.97	3662.83	40	17	9	17	1.36	Unknown

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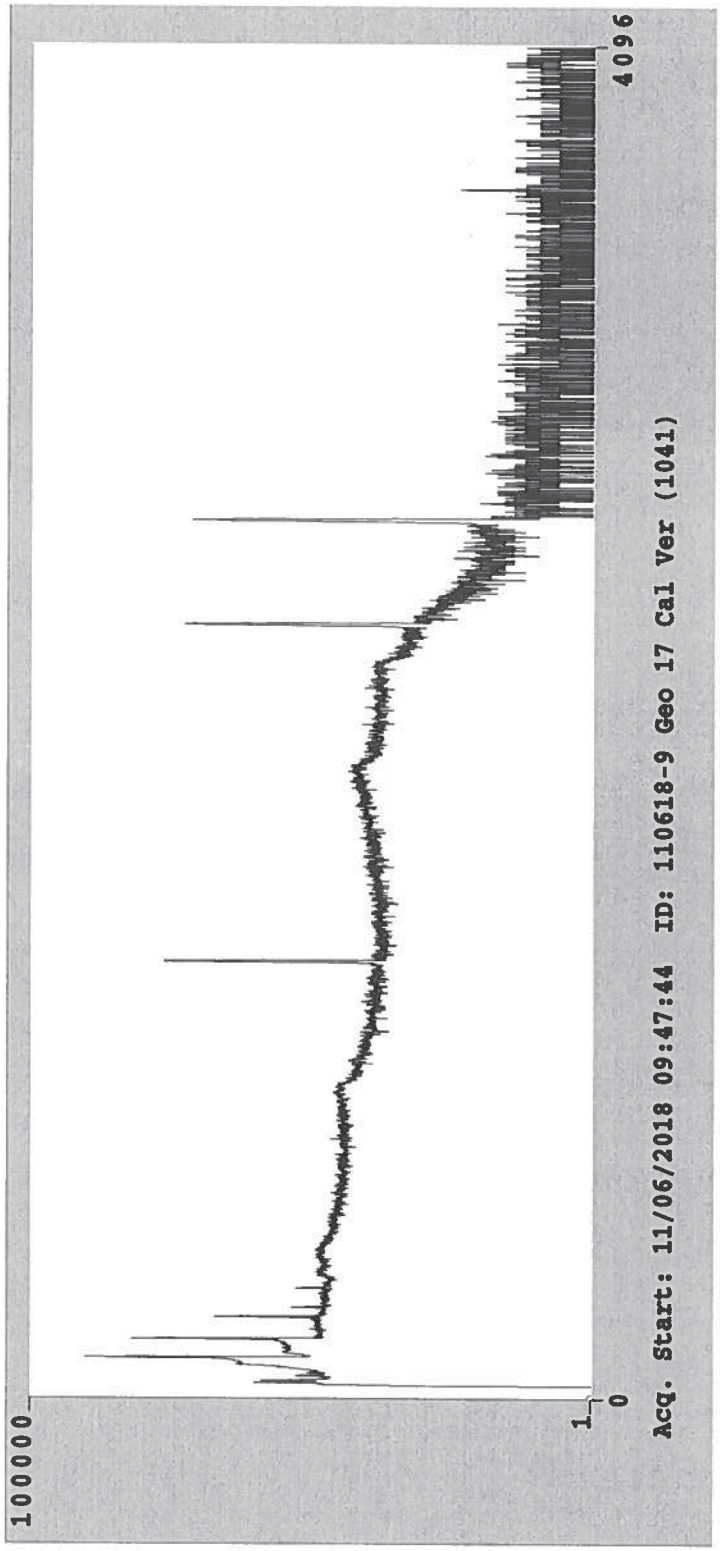
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4096
Acq. Start: 11/06/2018 09:47:44 ID: 110618-9 Geo 17 Cal Ver (1041)

#1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.6	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.926E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

ALS Laboratory Group

ANALYTICAL CHEMISTRY & TESTING SERVICES

Billable To: ALS Group USA, Corp.
Accounts Payable Department
10450 Stancliff Road Suite 210
Houston, TX 77099

Ordered By

Purchase Order FC002121

Requested By Steven White

Date 11/12/2018

Terms Net 30 Days

Status Submitted

Location Fort Collins Env Radio Chem

Vendor	Shipping
VWR International Inc P.O. Box 640169 Pittsburgh, PA 15264-0169 Phone: (856) 241-7298 Fax: 4848816594 Email: Prashant.Chukoury@vwr.com	**ALS Enviromental Laboratory** **Fort Collins Env Radio Chem** 225 Commerce Dr Fort Collins, CO 80524 Phone: (970) 490-1511 Fax:

Qty	Unit	Vendor Item	Manuf. Number	Unit Price	SubTotal
300	EA	71000-006 - Cap PTFE Silicone Septa White, 24-414, ea	CAH242005I04	$0.47	$141.00
Comments: 3 bags of 100 lids per bag - Aaron's request					
6	EA	EM1.09535.0007 - pH strips, 0-14 6/pk	600/PK	$93.97	$563.82
Comments: 6 packages of 6 please.					
12	CS	21008-771 - CENTRIFUGE TUBE PP 250ML CS102	430776	$119.56	$1,434.72
Comments: 12 cases please					
1	PK	89097-930 - VWR TAPE GRN 1/2X500 PK6RL	Q#8030717219 THRU 12/31/18	$12.89	$12.89
Comments: 1 package of 6 rolls please					
				Vendor Total	$2152.43

Special Instructions
Please ship "ATTN: RadChem"

181876D10.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 112018-10 Geo 17 Eff Cal (1090)

Sampling Start:	01/01/2018 10:00:00	Counting Start:	11/20/2018 08:24:08
Sampling Stop:	01/01/2018 10:00:00	Decay Time.	7.75E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	2400 Sec
Sample Size	2.15E+002 g	Real Time	2559 Sec
Collection Efficiency	1.0000	Spc. File	.181876D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.00 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/20/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

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PEAK SEARCH RESULTS

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PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	57.83	119.41	5976	808	652	37756	3.17	a	HiResid Wide Pk
2	59.43	122.59	50122	567	286	13910	1.07	b	HiResid
3	67.11	137.92	936	574	469	25699	2.10	a	Wide Pk
4	87.96	179.55	120939	803	331	18664	1.09	a	Wide Pk
5	89.51	182.64	5018	723	583	34261	2.64	b	
6	121.94	247.37	59529	575	250	10687	1.14	a	
7	123.39	250.26	1755	420	338	14933	1.83	b	
8	136.37	276.16	7400	316	218	8084	1.17	a	
9	165.77	334.83	37238	478	232	8501	1.23	a	Wide Pk
10	167.19	337.68	823	422	344	13815	2.14	b	
11	255.14	513.21	1062	219	172	5842	1.22	a	
12	265.74	534.37	139	139	113	3147	0.69	a	
13	279.16	561.16	2754	261	196	6696	1.45	a	
14	351.99	706.51	93	125	102	2541	0.68	a	NET< CL
15	391.72	785.80	25681	387	179	5571	1.52	a	
16	393.79	789.93	577	241	194	6190	1.64	b	
17	511.53	1024.94	636	217	173	5291	1.77	a	
18	661.81	1324.87	83708	615	172	4961	1.93	a	HiResid Wide Pk
19	662.77	1326.79	4153	389	302	9922	3.89	b	HiResid

Δ less Than 10,000 counts achieved due to greater Than 5 ½ lives elapsed TP 11/20/18

181876D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
20	813.29	1627.20	233	250	204	6141	2.87 a	
21	898.14	1796.55	30649	415	183	5725	2.34 a	HiResid
22	1173.27	2345.68	92455	638	158	3794	2.74 a	HiResid
23	1332.42	2663.32	82954	612	170	4401	2.78 a	HiResid
24	1835.40	3667.20	21089	308	83	909	3.59 a	HiResid

181876D10.SPC Analyzed by

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

ALS Laboratory Group - Fort Collins
GammaScan

Background File:. . . . . DET101114.BKG (111418-10 LONG BKG CAL)

Bkg.File Detector #: 10

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	67.11	936	574	469	899	574	469	
4	87.96	120939	803	331	120926	803	331	
5	89.51	5018	723	583	5012	723	583	
14	351.99	93	125	102	-34	126	104	NET<CL
17	511.53	636	217	173	448	217	175	
21	898.14	30649	415	183	30645	415	183	

181876D10.SPC Analyzed by

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

Sample ID: 112018-10 Geo 17 Eff Cal (1090)
Stds. Match Tolerance: 2.00 keV

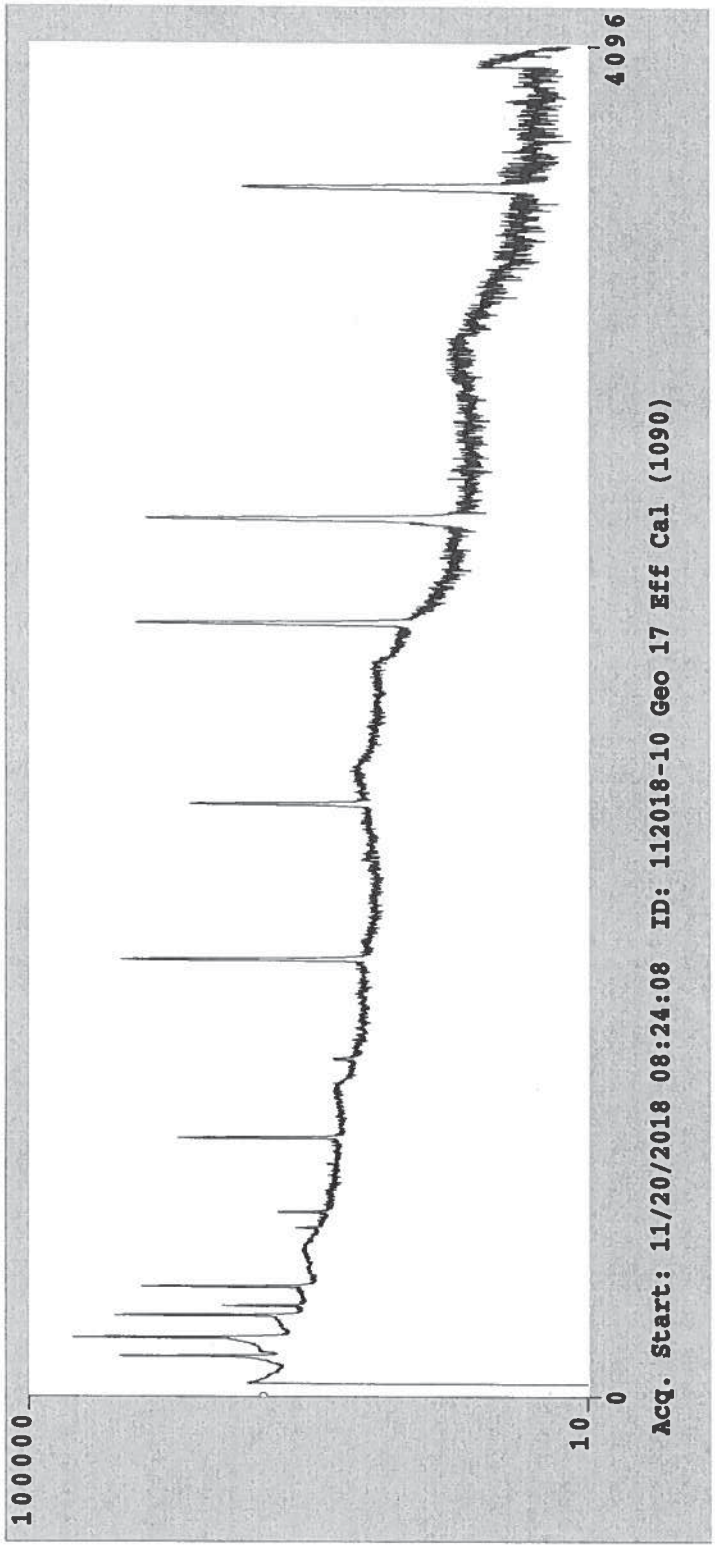
Detector Number: 10 Calibration Date. . . 11/20/2018 08:24:08
Geometry File (D10)(Sh17).eff ID. Geo 17 Eff Cal
Amount of Std. in Calib. Source: 215.000000 gm

Crossover: 300.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-5.73e+01 + 7.32e+01*En +-3.17e+01*En^2 + 4.54e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-2.63e+01 + 2.68e+01*En +-9.41e+00*En^2 + 1.07e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	1.57e-02	0.06	1.57e-02	-6.73	1.48e-02
2	88.04	4.24e-02	-0.28	4.23e-02	-1.77	4.15e-02
3	122.06	5.58e-02	0.44	5.60e-02	-0.59	5.57e-02
4	165.85	5.54e-02	-0.25	5.53e-02	-0.42	5.50e-02
5	279.00	4.46e-02	0.03	4.46e-02	1.25	4.52e-02
6	391.68	3.78e-02	0.08	3.78e-02	-0.07	3.78e-02
7	661.64	2.80e-02	-0.72	2.78e-02	-1.84	2.73e-02
8	898.02	2.18e-02	1.62	2.21e-02	-1.23	2.19e-02
9	1173.21	1.85e-02	-1.80	1.82e-02	-0.95	1.80e-02
10	1332.48	1.66e-02	0.75	1.67e-02	-1.17	1.65e-02
11	1836.01	1.42e-02	0.04	1.42e-02	-3.52	1.37e-02

Calibration Results Saved.


100000
10
0
4096
Acq. Start: 11/20/2018 08:24:08 ID: 112018-10 Geo 17 Eff Cal (1090)

Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 11/20/2018
Detector 10
Geometry 17
Crossover energy=300 keV

	EFF @ CROSSOVER	% DIFF*	MEETS ALS ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.042379	4.57%	OK
UPPER EFFICIENCY CURVE	0.040526	-4.37%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to **OR** within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental Fort Collins will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

Efficiency equations

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

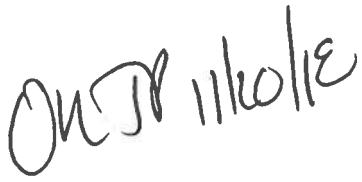
A	-5.729612E+01		
B	7.315619E+01		
C	-3.167205E+01	Calculated efficiency	0.042379
D	4.542803E+00		

En is energy in keV
Crossover energy 300

Polynomial 10^(A+B*(LOG(En))+C*(LOG(En))^2+D*(LOG(En))^3)

A	-2.628528E+01		
B	2.677837E+01		
C	-9.407346E+00	Calculated efficiency	0.040526
D	1.071349E+00		

En is energy in keV
Crossover energy 300



Standards File. Gsstd17.std
Assay Date 01/01/2018 10:00
ID.: Geo 17 Std 1090 215g Mixed Gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
1	Am-241	59.50	4.322E+02 yrs	0.35900	17.22
2	Cd-109	88.04	4.626E+02 dys	0.03720	241.06
3	Co-57	122.06	2.718E+02 dys	0.85510	5.51
4	Ce-139	165.85	1.376E+02 dys	0.80350	8.24
5	Hg-203	279.00	4.661E+01 dys	0.77300	18.83
6	Sn-113	391.68	1.151E+02 dys	0.64900	14.18
7	Cs-137	661.64	3.007E+01 yrs	0.85120	6.95
8	Y-88	898.02	1.066E+02 dys	0.93400	23.83
9	Co-60	1173.21	5.271E+00 yrs	0.99980	10.86
10	Co-60	1332.48	5.271E+00 yrs	0.99990	10.87
11	Y-88	1836.01	1.066E+02 dys	0.99380	23.71

RSO
1090
Rec'd 3-5-18

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 108579
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC001718, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2018 12:00 PM EST

MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.703E+03	1.329E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.211E+04	1.928E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.013E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.780E+03	1.424E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.837E+03	3.129E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.046E+03	1.979E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.493E+03	1.271E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.107E+03	4.785E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.066E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.337E+03	2.334E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.337E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

SRS Number: 108579

Comments:
215.00 g / ~120 mL of sand

Expiration Date: 06-March-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
Z. Dimitrova, Radiochemist

QC Approved by: _____ Date: 02-MAR-18
J. Lahr, Spectroscopist

Geometry 17 Calibration Verification: Gamma Mixed Nuclide Source

Detector 10

215-grams-Mixed nuclide source in steel can

VERIF Source: 1041 **REF DATE : 1/1/2016** **Count Date: 11/20/2018**

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB		EXPECTED ACTIVITY						
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard		DPS	pCi/L	Activity	Recovery	Pass/Fail	# of Half Lives Expired
Am-241	59.5	432.0000	1342	0.3590	215 g	Am-241	3738.2	469.9	480	102%	Pass	0.01
Cd-109	88	1.2666	1892	0.0372		Cd-109	50860.2	6393.5	6470	101%	Pass	2.28
Co-57	122	0.7441	1074	0.8551		Co-57	1256.0	157.9	157	99%	Pass	3.88
Ce-139	166	0.3768	1453	0.8035		Ce-139	1808.3	227.3	209	92%	Pass	7.66
Hg-203	279	0.1276	3230	0.7730		Hg-203	4178.5	525.3	NC	>5 h-lives	>5 h-lives	22.62
Sn-113	392	0.3151	2013	0.6490		Sn-113	3101.7	389.9	NC	>5 h-lives	>5 h-lives	9.16
Cs-137	662	30.0000	1292	0.8512		Cs-137	1517.9	190.8	199	104%	Pass	0.10
Y-88	898	0.2919	4977	0.9340		Y-88	5328.7	669.9	NC	>5 h-lives	>5 h-lives	9.88
Co-60	1173	5.2714	2429	0.9998		Co-60	2429.5	305.4	307	101%	Pass	0.55
Co-60	1332	5.2714	2433	0.9999		Co-60	2433.2	305.9	305	100%	Pass	0.55
Y-88	1836	0.2919	5269	0.9938		Y-88	5301.9	666.5	NC	>5 h-lives	>5 h-lives	9.88

NC = NOT CALCULATED DUE TO ACTIVITY BEING BELOW THE MDCa

OK JR 11/20/18

181877D10.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Geo 17/26

Sample ID: 112018-10 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/20/2018 09:15:57
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.53E+004 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15E+002 g	Real Time . . . . . 1875 Sec
Collection Efficiency 1.0000	Spc. File 181877D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.00 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/20/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	57.62	118.98	1196	352	284	11939	1.47	a	
2	59.44	122.62	38775	465	204	7069	1.07	b	
3	87.97	179.56	30176	398	159	4695	1.06	a	
4	121.97	247.41	7259	244	144	3542	1.12	a	
5	136.37	276.15	776	173	135	3099	1.12	a	
6	165.68	334.67	659	135	102	2110	0.90	a	
7	222.49	448.05	112	165	135	3578	1.19	a	NET< CL
8	351.92	706.37	163	159	129	2898	1.42	a	
9	391.85	786.07	137	106	85	1658	0.86	a	
10	510.59	1023.05	252	164	132	2924	1.94	a	
11	609.71	1220.89	90	90	72	1196	0.90	a	
12	661.81	1324.86	63148	523	119	2390	1.97	a	HiResid
13	821.46	1643.52	108	133	108	2152	2.00	a	NET< CL
14	898.17	1796.62	268	191	155	3679	2.78	a	
15	1173.25	2345.63	54737	486	108	1864	2.69	a	HiResid
16	1332.41	2663.29	50075	467	109	1821	2.78	a	HiResid
17	1835.86	3668.12	98	47	35	188	2.82	a	

181877D10.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

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Background File:. . . . . DET101114.BKG (111418-10 LONG BKG CAL)

Bkg.File Detector #: 10

BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	87.97	30176	398	159	30167	398	160	
8	351.92	163	159	129	67	159	130	NET<CL
10	510.59	252	164	132	112	164	134	NET<CL
11	609.71	90	90	72	15	90	74	NET<CL
14	898.17	268	191	155	264	192	155	

181877D10.SPC Analyzed by

SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

ALS Laboratory Group - Fort Collins
GammaScan

Geo 17/26

Sample ID: 112018-10 Geo 17 Cal Ver (1041)

Sampling Start: 01/01/2016 10:00:00	Counting Start: 11/20/2018 09:15:57
Sampling Stop: 01/01/2016 10:00:00	Decay Time. . . . . 2.53e+004 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 1800 Sec
Sample Size . . . . . 2.15e+002 g	Real Time . . . . . 1875 Sec
Collection Efficiency 1.0000	Spectrum File 181877D10.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 10 (Detector 10)
Efficiency File: (D10)(Sh17).eff (Geo 17 Eff Cal)
*Eff=10^[-5.73E+01 +7.32E+01*L +-3.17E+01*L^2 +4.54E+00*L^3] 11/20/2018
Eff.=10^[-2.63E+01 +2.68E+01*L +-9.41E+00*L^2 +1.07E+00*L^3] Above 300.00 keV
Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/g)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		4.80E+02 +- 5.76E+00	5.07E+00	2.52E+00	3.79E+06
Cd-109	88.02		6.47E+03 +- 8.53E+01	6.90E+01	3.42E+01	1.11E+04
Co-57	122.07		1.57E+02 +- 5.28E+00	6.29E+00	3.11E+00	6.50E+03
Ce-139	165.85		2.09E+02 +- 4.26E+01	6.57E+01	3.24E+01	3.30E+03
Cs-137	661.62		1.99E+02 +- 1.65E+00	7.60E-01	3.76E-01	2.64E+05
Co-60	Average:x		3.06E+02 +- 1.97E+00	. . . .	. . . .	4.62E+04
	1173.21		3.07E+02 +- 2.73E+00	1.23E+00	6.08E-01	4.62E+04
	1332.48		3.05E+02 +- 2.85E+00	1.35E+00	6.66E-01	4.62E+04
Hg-203	279.18		MDA	3.29E+06	1.63E+06	1.12E+03
Sn-113	391.68		MDA	2.80E+02r	1.38E+02	2.76E+03
Y-88	898.02		MDA	7.63E+02	3.77E+02	2.56E+03

MEASURED TOTAL: 7.82E+03 +- 1.43E+02 pCi/g

UNKNOWN,SUM or ESCAPE PEAKS

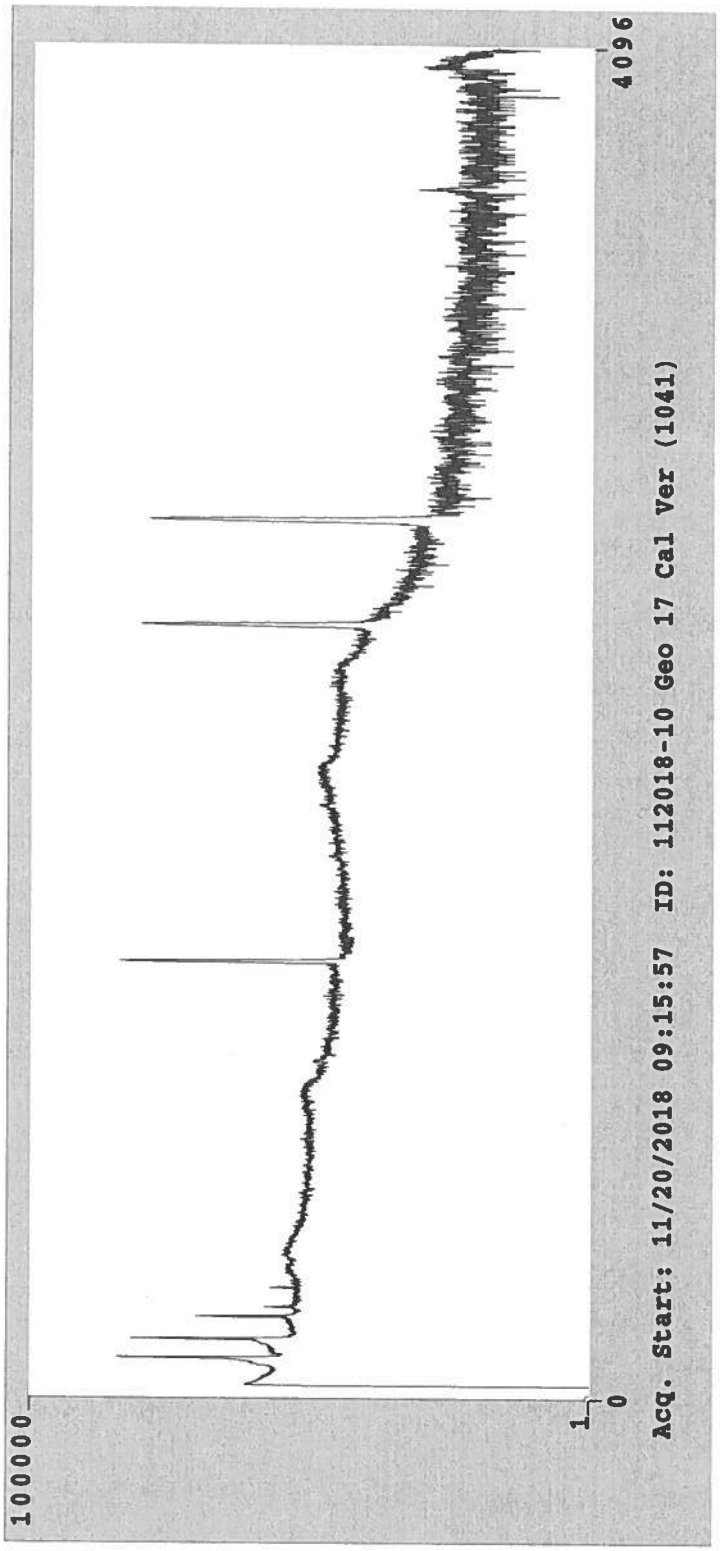
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	57.62	118.98	1196	352	284	11939	1.47	Unknown

181877D10.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
5	136.37	276.15	776	173	135	3099	1.12	Unknown
7	222.49	448.05	112	165	135	3578	1.19	Deleted
8	351.92	706.37	67	159	130	2898	1.42	Deleted
9	391.85	786.07	137	106	85	1658	0.86	Unknown
10	510.59	1023.05	112	164	134	2924	1.94	Deleted
11	609.71	1220.89	15	90	74	1196	0.90	Deleted
13	821.46	1643.52	108	133	108	2152	2.00	Deleted
14	898.17	1796.62	264	192	155	3679	2.78	Unknown
17	1835.86	3668.12	98	47	35	188	2.82	Unknown

c:\SEEKER\BIN\181877d10.res Analysis Results Saved.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0
4096
Acq. Start: 11/20/2018 09:15:57 ID: 112018-10 Geo 17 Cal Ver (1041)

#1041
Rec'd 2-25-16

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404·352·8677
Fax 404·352·2837
www.ezag.com

CERTIFICATE OF CALIBRATION
Standard Reference Source

SRS Number: 102367
Source Description: Sand in Metal Can
Product Code: 8401-EG-SAN
Customer: ALS Laboratory Group
P.O. Number: FC000928, Item 2

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Reference Date: 01-January-2016 12:00 PM EST
MGS Mixture

Isotope	Gamma-Ray Energy, keV	Half-Life, d	Activity, Bq	Flux, s^{-1}	Uncertainty u_A, %	Uncertainty u_B, %	Uncertainty U, %*	Calibration Method**
Am-241	59.5	1.580E+05	3.737E+03	1.342E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.114E+04	1.892E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.255E+03	1.074E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.816E+03	1.453E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.960E+03	3.230E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.098E+03	2.013E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.519E+03	1.292E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.312E+03	4.977E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1	———	———	5.269E+03	0.7	1.7	3.7	———
Co-60	1173.2	1.925E+03	2.433E+03	2.429E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	———	———	2.433E+03	0.7	1.8	3.9	———

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:** 4π LS - 4π Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified
3/27/2018
New Exp. Date
⇒ 03/27/2019
JP 5/21/18

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

SRS Number: 102367

Comments:
~120 mL / 215.0 g of sand

Expiration Date: 24-February-2017

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: _____
A. Herron, Radiochemist

QC Approved by: _____ Date: 24-FEB-16
J. Lahr, Spectroscopist

Gamma Spectroscopy

Quality Control Data

Weekly Background Calibrations

ALS

Gamma Spectrometer Calibration Log

Date: 11/14/18 Reviewed By/Date: SG 11/14/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.		SG	JP	SG	SG					
2.		↓	JP	↓	SG					
3.		↓	JP	↓	SG					
4.		↓	JP	↓	SG					
5.		↓	JP	↓	SG					
6.	SG	/	/	/	/					
7.		SG	JP	SG	SG					
8.		↓	JP	↓	SG					
9.		↓	JP	↓	SG					
10.		↓	JP	↓	SG					

.** Corrective Action:

*** Due to detector ____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

181662D09.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 111418-9 LONG BKG CAL

Sampling Start: 11/14/2018 14:00:00	Counting Start: 11/14/2018 14:31:39
Sampling Stop: 11/14/2018 14:00:00	Decay Time. . . . . 5.27E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60180 Sec
Collection Efficiency 1.0000	Spc. File 181662D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.33 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/14/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.30	96.96	321	76	55	620	0.84	a	
2	52.90	110.10	47	58	46	473	0.73	a	
3	63.04	130.33	481	80	55	601	0.77	a	Wide Pk
4	65.94	136.12	227	99	78	961	1.31	b	
5	69.76	143.73	107	97	78	961	1.33	c	
6	72.34	148.87	146	107	86	1082	1.52	d	
7	74.81	153.80	299	75	55	601	0.83	e	
8	76.92	157.99	281	66	47	481	0.72	f	
9	84.47	173.05	79	71	57	646	0.82	a	
10	87.23	178.55	56	50	40	388	0.45	b	
11	92.51	189.08	651	92	63	744	1.07	a	
12	112.27	228.47	35	54	43	417	0.64	a	NET< CL
13	139.69	283.15	140	57	43	407	0.74	a	
14	143.48	290.72	67	89	72	815	1.25	b	NET< CL
15	158.85	321.36	26	44	35	308	0.49	a	NET< CL
16	182.68	368.87	41	69	55	568	0.98	a	NET< CL
17	185.72	374.93	278	75	55	568	0.99	b	
18	198.33	400.06	144	80	63	679	1.19	a	
19	223.70	450.66	31	40	32	250	0.50	a	NET< CL
20	227.70	458.62	47	41	32	250	0.51	b	
21	238.61	480.38	265	67	48	465	0.88	a	

181662D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	295.22	593.25	62	55	43	374	0.82	a	
23	338.69	679.91	64	51	40	315	0.83	a	
24	351.98	706.41	238	68	49	417	1.18	a	
25	374.47	751.25	69	81	66	561	1.80	a	
26	511.22	1023.91	1397	119	76	712	2.57	a	Wide Pk
27	558.70	1118.57	187	56	40	276	1.45	a	
28	569.80	1140.70	90	46	35	241	1.11	a	
29	583.54	1168.11	102	51	39	277	1.37	a	
30	596.43	1193.80	52	39	30	208	0.82	a	
31	609.65	1220.16	170	55	40	320	1.09	a	
32	651.97	1304.53	38	48	38	250	1.47	a	NET< CL
33	669.93	1340.35	21	28	22	116	0.68	a	NET< CL
34	803.28	1606.23	92	39	28	164	1.03	a	
35	911.18	1821.35	78	44	33	190	1.86	a	
36	962.14	1922.97	40	28	21	101	0.95	a	
37	969.56	1937.76	37	33	26	135	1.30	b	
38	1120.15	2237.99	46	41	32	169	2.04	a	
39	1460.59	2916.77	147	35	21	87	1.76	a	

181662D09.SPC Analyzed by

****

SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

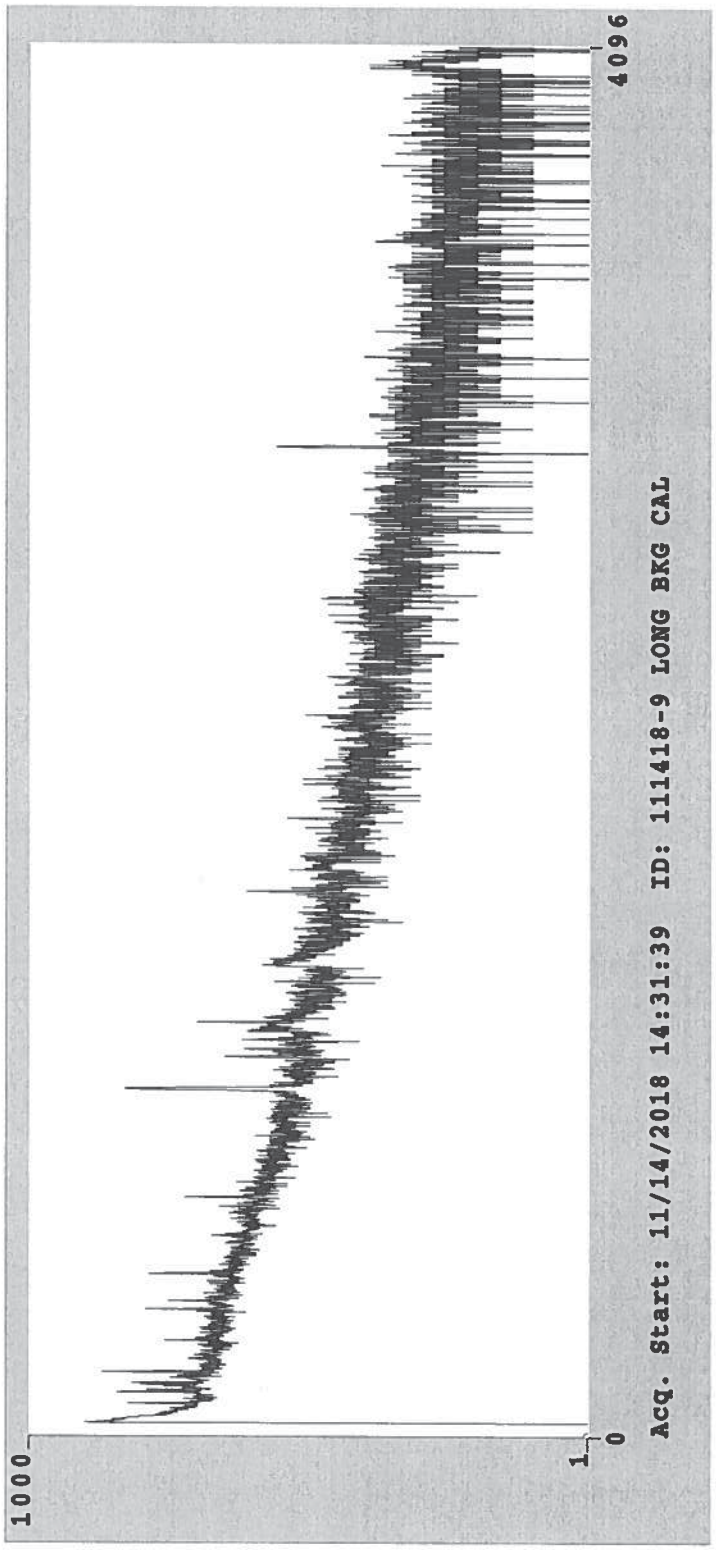
****

ID: 111418-9 LONG BKG CAL

Detector # 9 Background Q.C. Analysis for 11/14/2018 14:31:39

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	24.660	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	18.989	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	27.966	N.A.	Pass	N.A.
13	500->1000 keV Bkg	29.286	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	17.144	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.006	N.A.	Pass	N.A.

Q.C. Results Saved.


1000
1
0
4096
Acq. Start: 11/14/2018 14:31:39 ID: 111418-9 LONG BKG CAL

181838D10.SPC Analyzed by

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

****

Weekly Background Check

Sample ID: 111418-10 LONG BKG CAL

Sampling Start: 11/14/2018 14:00:00	Counting Start: 11/14/2018 14:31:47
Sampling Stop: 11/14/2018 14:00:00	Decay Time. . . . . 5.30E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60180 Sec
Collection Efficiency 1.0000	Spc. File 181838D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.06 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/14/2018
FWHM(keV) = 0.99 + 0.002*En + 8.54E-04*En^2 + 0.00E+00*En^3 11/15/2017
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.31	96.54	271	134	107	2100	0.93	a	
2	53.45	110.80	285	155	125	2464	1.30	a	
3	63.34	130.53	655	162	127	2543	1.39	a	HiResid Wide Pk
4	66.08	135.99	939	152	114	2225	1.21	b	HiResid
5	71.57	146.95	531	335	273	6357	3.22	c	HiResid
6	74.73	153.27	892	137	102	1907	1.04	d	HiResid
7	76.91	157.62	1222	169	127	2543	1.31	e	HiResid
8	84.22	172.21	200	121	97	1741	0.93	a	
9	87.00	177.75	313	123	97	1741	0.94	b	
10	89.82	183.38	153	121	97	1741	0.95	c	
11	92.58	188.88	1275	177	133	2612	1.40	d	
12	139.77	283.08	725	147	113	2013	1.24	a	
13	143.75	291.01	233	127	102	1762	1.09	b	
14	163.13	329.70	56	85	69	1063	0.58	a	NET< CL
15	185.78	374.91	1314	147	105	2027	1.39	a	
16	198.30	399.89	807	130	96	1831	1.16	a	
17	205.15	413.56	95	116	94	1735	1.15	a	
18	238.64	480.40	981	125	89	1551	1.13	a	
19	241.83	486.76	799	132	98	1773	1.23	b	
20	258.59	520.22	99	117	94	1649	1.35	a	

181838D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	295.18	593.23	1791	140	92	1559	1.28	a	
22	338.36	679.41	203	91	71	1076	0.97	a	
23	351.96	706.56	3181	152	83	1282	1.38	a	
24	511.15	1024.27	4684	217	139	2272	2.78	a	Wide Pk
25	558.53	1118.84	586	92	64	840	1.33	a	
26	569.94	1141.60	321	137	109	1758	2.52	a	Wide Pk
27	583.48	1168.63	482	102	76	1057	1.60	a	
28	596.24	1194.09	129	71	55	696	1.02	a	Wide Pk
29	598.28	1198.17	374	163	131	2423	2.70	b	
30	609.51	1220.58	2512	158	100	1847	1.62	a	
31	651.18	1303.75	77	63	50	572	0.97	a	
32	670.06	1341.43	93	89	71	941	1.70	a	
33	692.99	1387.19	131	56	42	433	0.90	a	Wide Pk
34	695.60	1392.39	518	177	141	2287	3.65	b	
35	768.50	1537.89	291	119	94	1204	2.72	a	Wide Pk
36	786.48	1573.77	85	72	57	639	1.40	a	
37	803.28	1607.30	448	84	60	668	1.69	a	
38	881.60	1763.61	53	63	50	522	1.23	a	
39	898.89	1798.13	110	107	86	1062	2.62	a	
40	911.47	1823.22	296	71	51	560	1.45	a	
41	934.40	1869.00	63	67	53	573	1.57	a	
42	962.44	1924.96	274	105	82	964	3.09	a	Wide Pk
43	969.02	1938.10	283	85	65	711	2.29	b	
44	1001.58	2003.07	103	75	59	621	2.07	a	
45	1063.92	2127.49	61	88	71	838	2.38	a	NET< CL
46	1120.51	2240.44	505	85	59	646	1.96	a	
47	1210.25	2419.53	55	54	43	409	1.24	a	
48	1238.17	2475.25	188	70	53	521	2.02	a	
49	1326.96	2652.46	60	76	61	568	2.82	a	NET< CL
50	1377.34	2753.01	226	82	63	568	3.15	a	
51	1460.75	2919.48	1179	91	49	418	2.32	a	
52	1509.24	3016.26	58	52	41	314	1.90	a	
53	1729.34	3455.54	146	62	47	332	2.73	a	
54	1764.28	3525.27	592	74	46	322	2.83	a	
55	1846.85	3690.06	65	37	28	164	1.46	a	

181838D10.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

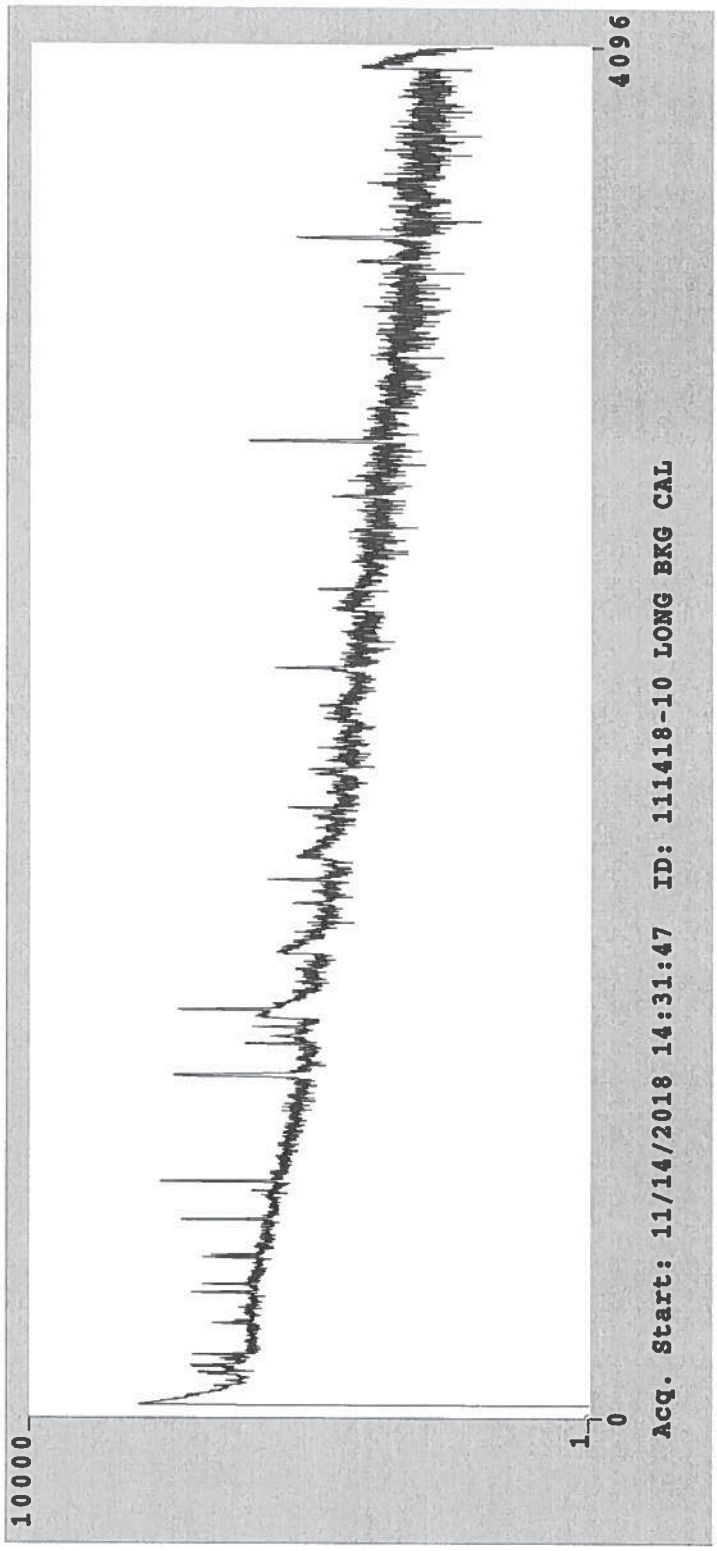
****

ID: 111418-10 LONG BKG CAL

Detector # 10 Background Q.C. Analysis for 11/14/2018 14:31:47

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	63.570	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	52.990	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	84.548	N.A.	Pass	N.A.
13	500->1000 keV Bkg	100.114	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	62.713	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	8.156	N.A.	Pass	N.A.

Q.C. Results Saved.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1
0
4096
Acq. Start: 11/14/2018 14:31:47 ID: 111418-10 LONG BKG CAL

ALS

Gamma Spectrometer Calibration Log

Date: 11/28/18 Reviewed By/Date: SG 11/28/18

Det. No.	Out Of Service	Background Started	Background OK	Source Check Started	Source Check OK	Failed Parameter(s)	Repeat Source Check OK	Repeat Source Check Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.		SG	SG	SG	SG					
2.		↓	SG	↓	SG					
3.			SG		SG					
4.			SG		SG					
5.		↓	SG	↓ OK SG 11/20	SG					
6.	SG	/	/	/	/					
7.		SG	SG	SG	SG					
8.		↓	SG	↓	SG					
9.			SG							
10.		↓		↓	SG					

.** **Corrective Action:**

~~Det 5 failed 250 → 500 keV BKG~~

~~-rerun Background~~ SG 11/20

OK

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of __________

481739 **A**

Form 754r16a.doc (10/27/11)

182110D01.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-1 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:52:56
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.82E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60079 Sec
Collection Efficiency 1.0000	Spc. File 182110D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.97 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.66 + 0.012*En + 6.94E-04*En^2 + 0.00E+00*En^3 08/21/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	65.95	135.61	98	101	81	1133	1.19 a	
2	69.57	142.83	38	78	63	809	0.84 b	NET< CL
3	74.95	153.57	76	44	34	314	0.40 a	
4	92.39	188.39	109	79	63	736	0.95 a	
5	139.91	283.25	144	70	54	598	0.80 a	
6	185.59	374.46	105	70	55	614	0.85 a	
7	198.38	400.00	110	69	55	599	0.85 a	
8	238.63	480.35	151	75	59	635	1.01 a	
9	264.52	532.04	53	58	46	433	0.90 a	
10	295.17	593.23	40	68	55	558	1.04 a	NET< CL
11	351.82	706.34	176	81	63	582	1.43 a	
12	378.49	759.58	27	43	34	261	0.57 a	NET< CL
~~13~~	~~511.15~~	~~1024.45~~	~~1316~~	~~127~~	~~86~~	~~902~~	~~2.56 a~~	~~Wide Pk~~
14	558.50	1118.97	208	53	37	270	1.20 a	
15	569.82	1141.58	74	37	27	179	0.67 a	
16	583.63	1169.14	76	62	49	396	1.60 a	
17	596.11	1194.06	57	70	56	523	1.61 a	
18	609.28	1220.36	107	48	36	291	0.88 a	
19	803.08	1607.28	124	45	32	203	1.42 a	
20	898.08	1796.94	32	37	29	171	1.37 a	
21	911.94	1824.61	59	50	40	251	2.06 a	

182110D01.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	1461.09	2920.99	432	49	21	80	1.94	a
23	1764.77	3527.28	60	29	20	68	2.25	a

182110D01.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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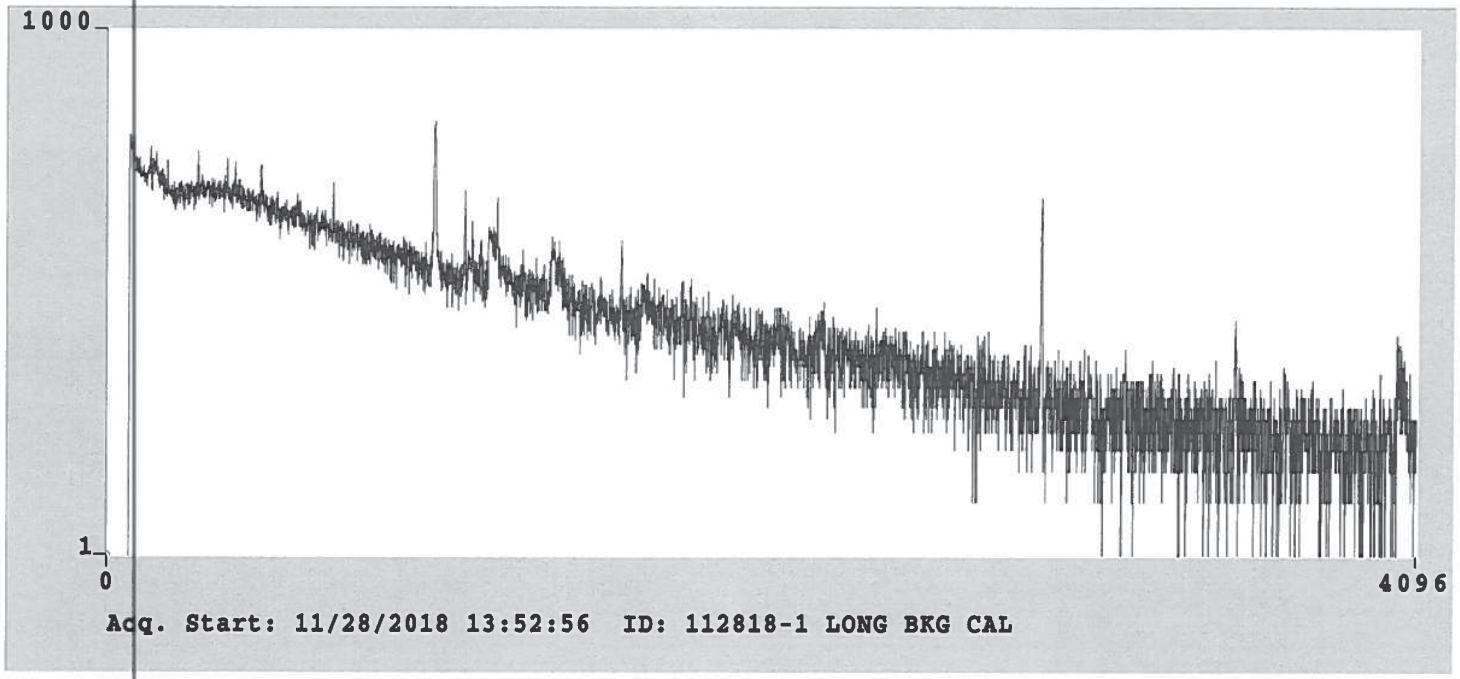
ID: 112818-1 LONG BKG CAL

Detector # 1 Background Q.C. Analysis for 11/28/2018 13:52:56

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	40-> 50 keV Bkg	3.631	N.A.	Pass	N.A.
11	50-> 150 keV Bkg	26.393	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	33.643	N.A.	Pass	N.A.
13	500->1000 keV Bkg	32.696	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	18.074	N.A.	Pass	N.A.
15	150-> 250 keV Bkg	23.003	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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Acq. Start: 11/28/2018 13:52:56 ID: 112818-1 LONG BKG CAL

182143D02.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-2 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:53:03
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.84E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60079 Sec
Collection Efficiency 1.0000	Spc. File 182143D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -1.37 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.97 + 0.002*En + 9.30E-04*En^2 + 0.00E+00*En^3 07/31/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	53.44	109.43	60	61	49	587	0.53 a	
2	66.15	134.80	289	131	104	1612	1.45 a	Wide Pk
3	70.05	142.59	103	106	86	1254	1.07 b	
4	71.44	145.37	121	184	150	2508	2.26 c	NET< CL
5	75.01	152.50	232	207	169	2867	2.60 d	
6	92.47	187.35	214	90	70	904	0.95 a	
7	139.76	281.77	125	77	60	733	0.76 a	
8	158.25	318.68	65	91	74	923	1.18 a	NET< CL
9	185.74	373.55	373	92	69	929	1.22 a	
10	198.30	398.63	220	89	69	938	1.13 a	
11	238.62	479.13	322	102	79	1072	1.46 a	
12	295.36	592.41	76	67	53	595	0.96 a	
13	351.82	705.13	229	81	62	672	1.39 a	
14	511.18	1023.29	1644	131	85	932	2.45 a	Wide Pk
15	558.45	1117.66	198	60	44	396	1.35 a	
16	569.62	1139.95	115	74	58	592	1.75 a	
17	583.21	1167.09	109	49	36	305	0.95 a	
18	595.54	1191.71	80	48	36	303	1.03 a	
19	597.16	1194.94	94	85	68	784	1.93 b	
20	609.27	1219.13	152	74	57	631	1.46 a	
21	669.86	1340.08	42	38	29	210	0.86 a	

182143D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	803.03	1605.96	173	68	52	412	2.23	a
23	911.39	1822.28	81	42	32	211	1.52	a
24	961.68	1922.69	89	49	37	261	1.81	a
25	1461.02	2919.61	359	53	31	154	2.50	a
26	1764.83	3526.15	59	32	24	99	2.20	a

182143D02.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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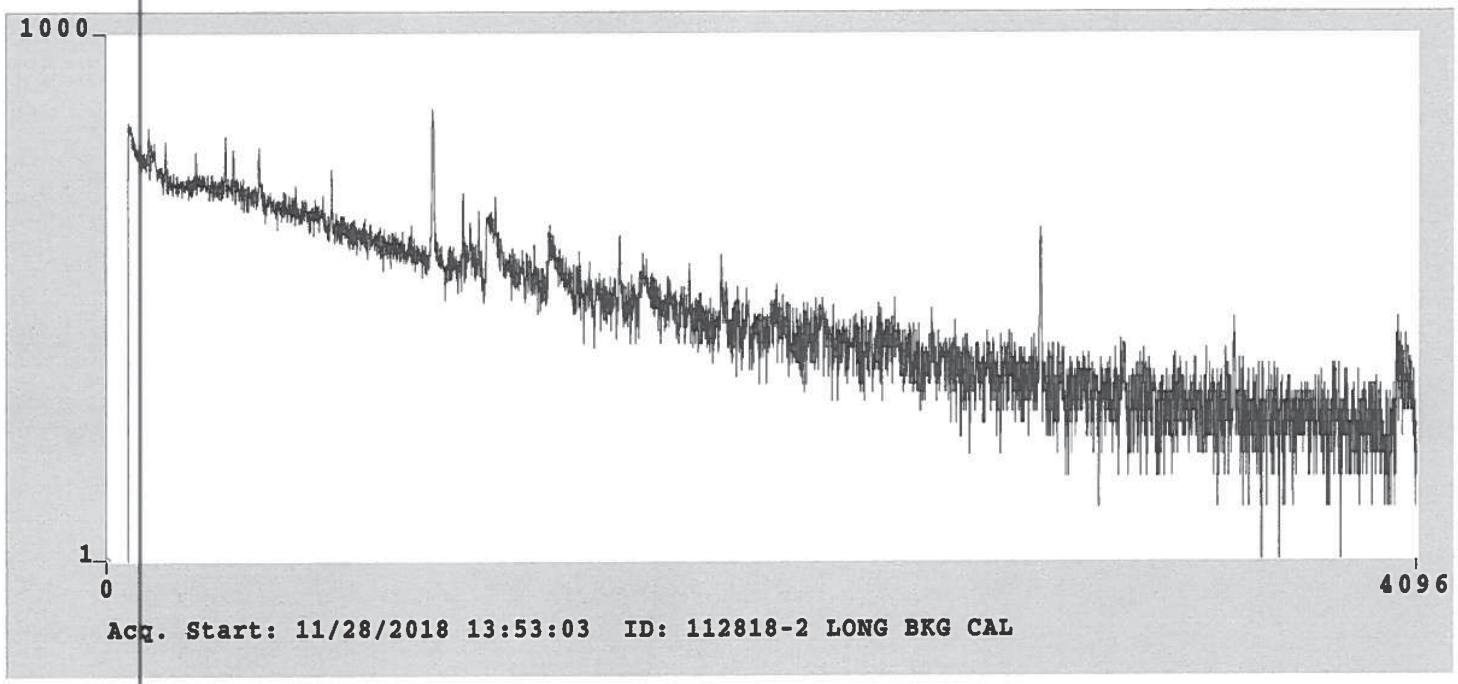
ID: 112818-2 LONG BKG CAL

Detector # 2 Background Q.C. Analysis for 11/28/2018 13:53:03

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	32.201	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	26.419	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	39.403	N.A.	Pass	N.A.
13	500->1000 keV Bkg	40.799	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	23.239	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	4.702	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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Acq. Start: 11/28/2018 13:53:03 ID: 112818-2 LONG BKG CAL

182626D03.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Weekly Background Check

Sample ID: 112818-3 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:04:14
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 7.06E-002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60086 Sec
Collection Efficiency 1.0000	Spc. File 182626D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.42 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.79 + 0.012*En + 1.05E-03*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

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PEAK SEARCH RESULTS

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PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	53.97	110.50	51	91	74	939	1.11	a	NET< CL
2	63.28	129.07	96	75	60	723	0.87	a	
3	66.43	135.36	227	98	77	1013	1.11	b	
4	69.76	141.99	59	74	60	723	0.82	c	NET< CL
5	71.46	145.39	73	64	51	579	0.57	d	
6	77.17	156.78	62	85	69	881	1.04	a	NET< CL
7	84.66	171.72	57	70	56	631	0.75	a	
8	92.60	187.56	318	82	61	684	1.02	a	
9	139.87	281.86	133	99	79	932	1.49	a	
10	185.77	373.43	309	103	80	941	1.44	a	
11	198.30	398.44	226	107	85	995	1.57	a	
12	221.55	444.81	35	48	38	364	0.74	a	NET< CL
13	238.88	479.38	232	69	51	552	0.98	a	
14	242.05	485.72	63	85	69	828	1.54	b	NET< CL
15	295.47	592.29	122	66	52	524	1.18	a	
16	338.38	677.90	32	57	46	447	0.97	a	NET< CL
17	351.94	704.95	251	70	51	480	1.36	a	
18	432.20	865.07	34	46	37	283	1.01	a	NET< CL
19	511.17	1022.61	1545	124	79	826	2.93	a	Wide Pk
20	558.72	1117.47	152	53	38	299	1.30	a	
21	570.10	1140.18	84	39	28	199	0.85	a	

182626D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	583.58	1167.07	130	69	54	460	2.07	a
23	609.62	1219.01	161	60	44	406	1.33	a
24	803.70	1606.19	144	57	43	315	2.28	a
25	911.79	1821.84	61	53	42	285	2.38	a
26	962.24	1922.49	33	38	30	190	1.51	a
27	1461.48	2918.47	162	40	26	116	2.08	a
28	1765.72	3525.42	45	27	20	71	2.02	a

182626D03.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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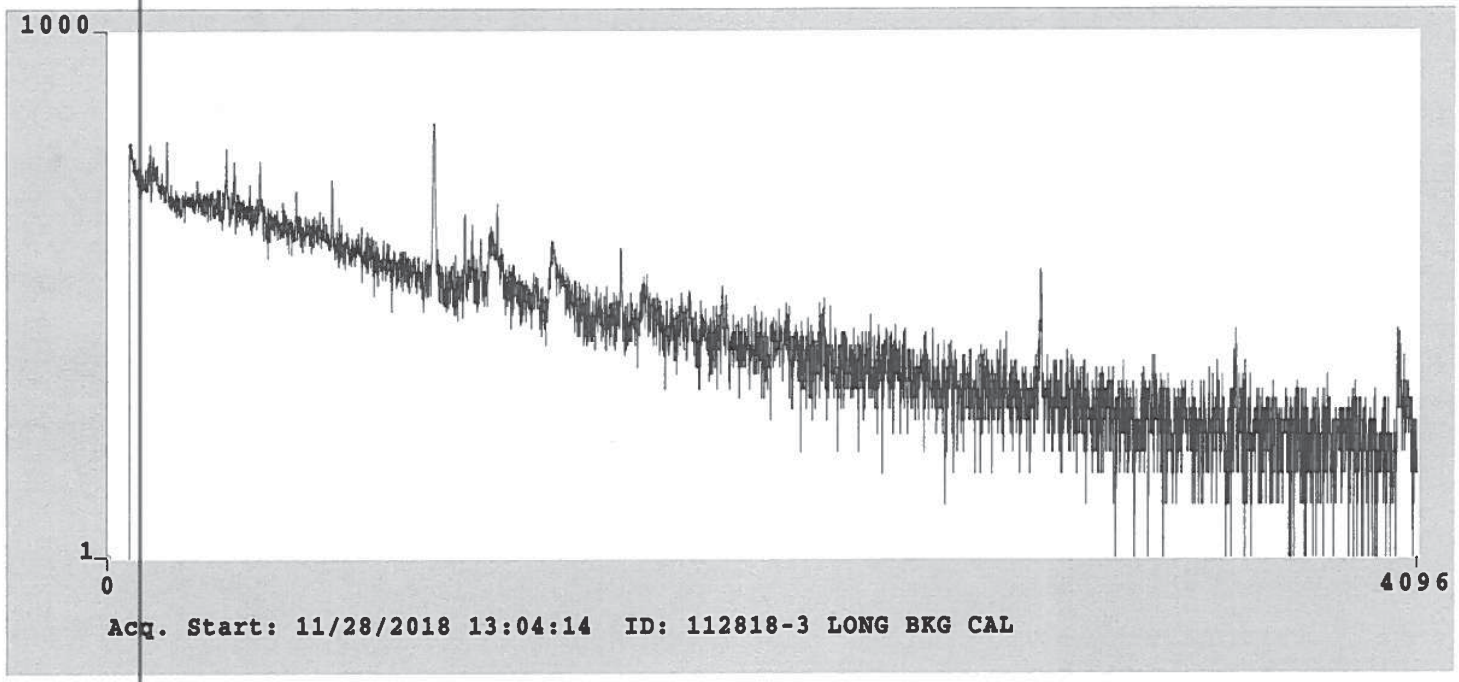
ID: 112818-3 LONG BKG CAL

Detector # 3 Background Q.C. Analysis for 11/28/2018 13:04:14

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	24.816	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	20.265	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	30.299	N.A.	Pass	N.A.
13	500->1000 keV Bkg	31.238	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	17.574	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.387	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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Acq. Start: 11/28/2018 13:04:14 ID: 112818-3 LONG BKG CAL

182624D04.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-4 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:53:13
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.87E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60079 Sec
Collection Efficiency 1.0000	Spc. File 182624D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -1.56 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.82 + 0.019*En + 7.17E-04*En^2 + 0.00E+00*En^3 09/25/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	53.63	110.17	132	82	65	781	0.99	a	
2	63.25	129.37	182	87	68	853	1.04	a	
3	66.32	135.51	65	53	42	426	0.53	b	
4	84.02	170.83	67	68	54	589	0.82	a	
5	92.47	187.71	569	89	62	708	1.01	a	
6	132.16	266.93	51	69	55	567	0.91	a	NET< CL
7	139.85	282.28	152	80	62	662	1.19	a	
8	144.00	290.56	61	53	41	378	0.58	b	
9	185.65	373.70	410	76	53	592	1.04	a	
10	191.75	385.89	44	58	47	493	0.82	b	NET< CL
11	198.28	398.91	152	82	65	770	1.24	a	
12	238.75	479.70	109	50	37	341	0.73	a	
13	295.00	591.98	80	62	49	468	1.21	a	
14	324.93	651.73	29	46	37	307	0.81	a	NET< CL
15	351.77	705.30	128	64	49	450	1.32	a	
16	416.17	833.87	53	59	47	437	1.43	a	
17	511.07	1023.30	1306	115	74	724	2.93	a	Wide Pk
18	558.45	1117.89	162	57	42	327	1.60	a	
19	569.55	1140.05	40	36	28	196	0.86	a	
20	575.97	1152.85	26	57	46	391	1.56	b	NET< CL
21	583.34	1167.57	47	49	39	313	1.23	c	

182624D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	596.24	1193.31	50	48	38	306	1.07	a
23	598.56	1197.94	80	62	49	437	1.60	b
24	609.06	1218.90	117	65	51	472	1.70	a
25	692.88	1386.23	67	56	44	360	1.61	a
26	803.17	1606.39	110	43	31	197	1.40	a
27	898.28	1796.25	80	60	47	317	3.17	a
28	962.30	1924.05	67	45	34	209	2.18	a
29	1460.99	2919.51	139	36	23	91	2.09	a

182624D04.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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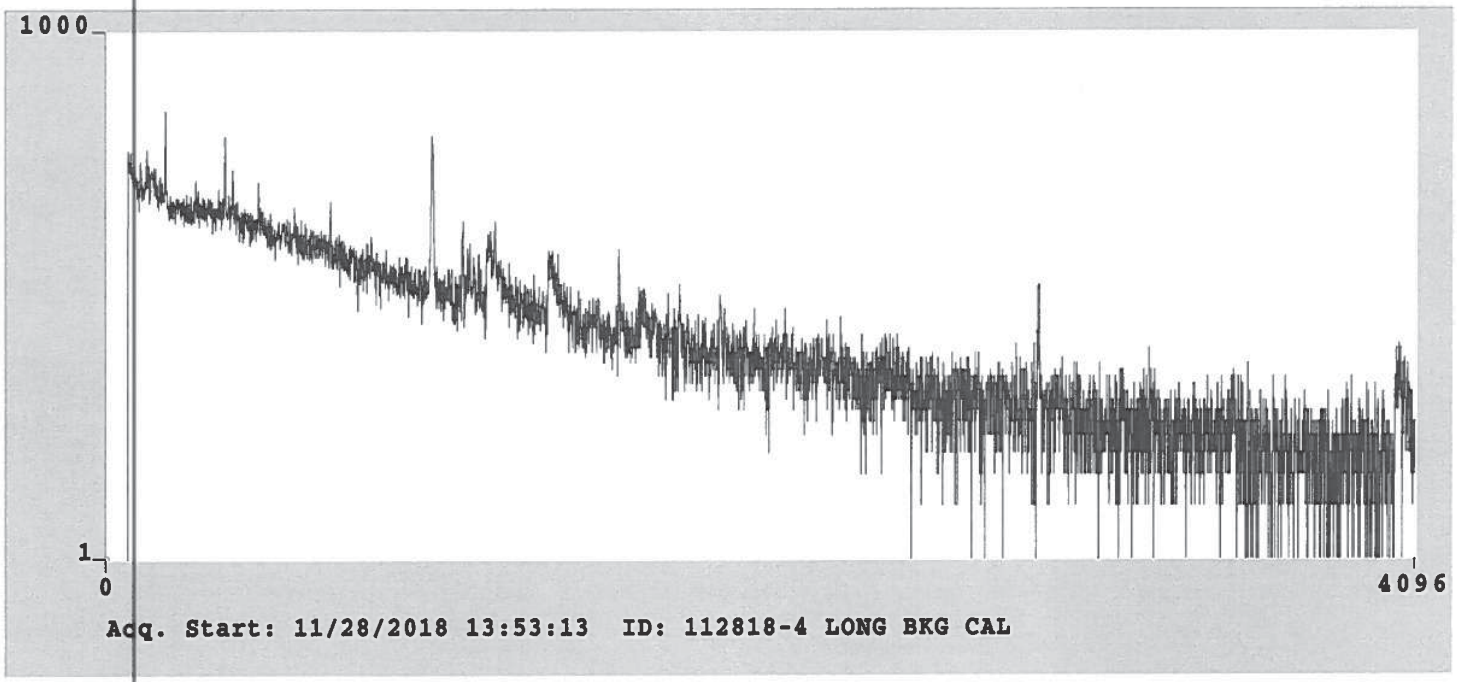
ID: 112818-4 LONG BKG CAL

Detector # 4 Background Q.C. Analysis for 11/28/2018 13:53:13

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	23.888	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	18.715	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	26.724	N.A.	Pass	N.A.
13	500->1000 keV Bkg	27.855	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	15.319	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.069	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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Acq. Start: 11/28/2018 13:53:13 ID: 112818-4 LONG BKG CAL

181865D05.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-5 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:53:28
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.91E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60098 Sec
Collection Efficiency 1.0000	Spc. File 181865D05.SPC

Detector #: 5 (Detector 5)

Energy(keV)= -0.69 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.65 + -0.002*En + 2.17E-03*En^2 +-2.42E-05*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	52.09	105.42	36	61	49	587	0.56	a	NET< CL
2	62.92	127.06	83	88	70	1000	0.89	a	
3	66.25	133.72	227	103	81	1200	0.98	b	
4	69.52	140.24	21	47	38	400	0.40	c	NET< CL
5	75.13	151.46	71	74	59	776	0.66	a	
6	92.60	186.36	202	89	69	881	1.01	a	
7	96.93	195.00	39	51	40	404	0.41	a	NET< CL
8	101.50	204.14	34	61	49	539	0.60	b	NET< CL
9	128.92	258.92	39	71	58	672	0.79	a	NET< CL
10	139.86	280.77	225	77	58	688	0.81	a	
11	163.60	328.19	57	91	73	919	1.10	a	NET< CL
12	185.84	372.62	295	85	64	762	0.97	a	
13	198.39	397.70	268	77	57	663	0.89	a	
14	238.61	478.03	200	72	55	608	0.75	a	
15	295.11	590.92	78	62	49	488	0.77	a	
16	319.46	639.56	69	77	62	716	1.28	a	
17	338.24	677.08	65	62	49	511	0.93	a	
18	352.05	704.65	186	59	43	416	0.81	a	
19	493.23	986.69	33	37	29	207	0.71	a	
20	507.58	1015.35	69	50	39	320	0.92	a	Wide Pk
21	510.99	1022.16	1737	131	83	852	2.61	b	

181865D05.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	558.42	1116.93	186	62	46	408	1.43	a	
23	570.12	1140.29	74	67	53	524	1.61	a	
24	583.34	1166.70	88	47	35	289	1.06	a	
25	596.64	1193.27	189	73	56	579	1.60	a	
26	609.52	1219.00	187	78	61	677	1.65	a	
27	693.72	1387.21	73	51	40	347	1.15	a	Wide Pk
28	694.62	1389.00	113	120	97	1091	3.65	b	
29	802.97	1605.46	180	52	37	259	1.39	a	
30	898.29	1795.87	89	67	53	425	2.81	a	
31	911.46	1822.19	62	37	27	173	1.16	a	
32	962.45	1924.05	79	54	42	309	2.06	a	
33	969.24	1937.61	25	46	37	261	1.80	b	NET< CL
34	1120.27	2239.32	34	36	28	175	1.39	a	
35	1327.04	2652.39	32	31	24	122	1.41	a	
36	1461.12	2920.23	440	53	27	126	2.06	a	HiResid
37	1765.06	3527.41	35	30	23	97	1.89	a	

181865D05.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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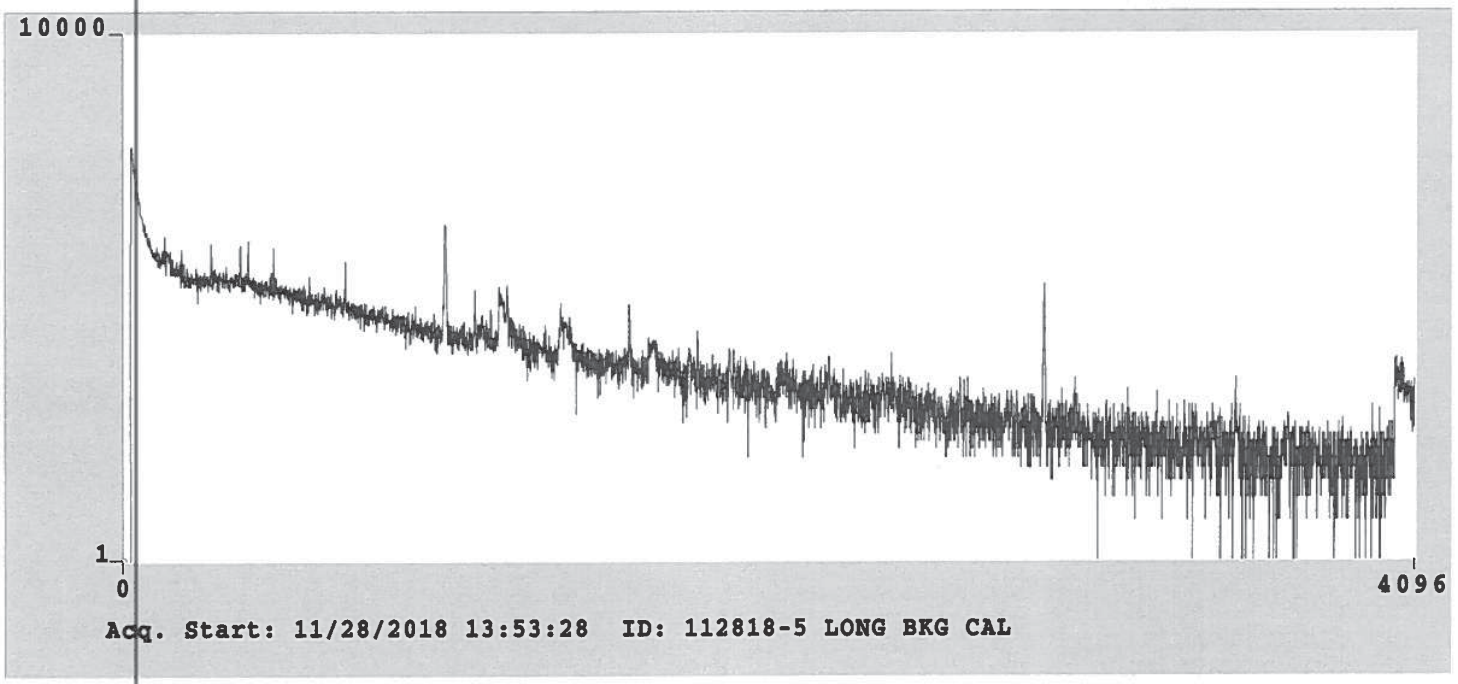
ID: 112818-5 LONG BKG CAL

Detector # 5 Background Q.C. Analysis for 11/28/2018 13:53:28

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	32.226	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	26.156	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	39.677	N.A.	Pass	N.A.
13	500->1000 keV Bkg	40.304	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	22.832	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	4.931	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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4096
Acq. Start: 11/28/2018 13:53:28 ID: 112818-5 LONG BKG CAL

181973D07.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-7 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:53:38
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.94E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60195 Sec
Collection Efficiency 1.0000	Spc. File 181973D07.SPC

Detector #: 7 (Detector 7)

Energy(keV)= -2.46 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.77 + 0.005*En + 8.11E-04*En^2 + 0.00E+00*En^3 09/24/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.04	96.71	89	95	77	1009	1.07 a	
2	53.62	111.82	70	72	57	665	0.79 a	
3	55.22	115.01	64	72	57	665	0.76 b	
4	63.05	130.64	142	89	70	918	1.01 a	
5	66.29	137.09	186	80	62	765	0.84 b	
6	69.58	143.66	38	76	62	765	0.88 c	NET< CL
7	74.90	154.26	140	69	53	626	0.65 a	
8	76.98	158.42	130	90	71	939	0.95 b	
9	84.55	173.51	73	92	74	935	1.14 a	NET< CL
10	92.63	189.63	358	86	64	747	0.99 a	
11	95.10	194.54	35	49	39	374	0.46 b	NET< CL
12	122.91	250.00	21	45	37	331	0.47 a	NET< CL
13	139.70	283.49	132	78	62	703	1.04 a	
14	146.66	297.36	32	48	38	358	0.48 a	NET< CL
15	185.61	375.03	264	73	53	576	0.83 a	
16	198.52	400.78	276	79	59	650	1.06 a	
17	202.98	409.66	51	46	36	325	0.51 b	
18	238.76	481.03	280	72	52	547	0.78 a	
19	282.79	568.82	39	64	52	498	0.90 a	NET< CL
20	295.40	593.97	102	60	47	443	0.82 a	
21	338.47	679.86	38	47	37	305	0.63 a	

181973D07.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
22	351.96	706.74	178	58	43	369	0.79	a	
23	511.19	1024.27	1679	125	78	778	2.53	a	Wide Pk
24	558.75	1119.12	217	58	41	309	1.37	a	
25	569.82	1141.20	109	56	43	338	1.27	a	
26	583.90	1169.26	154	65	49	400	1.56	a	
27	596.82	1195.04	69	68	54	514	1.44	a	
28	609.54	1220.39	151	67	51	478	1.25	a	
29	618.39	1238.05	49	61	49	419	1.54	a	
30	651.55	1304.18	39	36	28	177	0.88	a	
31	670.40	1341.75	29	44	35	247	1.14	a	NET< CL
32	691.96	1384.74	6	33	27	182	0.74	a	NET< CL
33	693.68	1388.17	40	46	36	273	0.90	b	
34	727.74	1456.09	57	44	34	219	1.32	a	
35	749.33	1499.15	19	30	24	138	0.76	a	NET< CL
36	802.96	1606.10	109	46	33	227	1.34	a	
37	880.98	1761.67	51	39	30	177	1.45	a	
38	911.71	1822.95	86	48	36	230	1.85	a	
39	961.88	1923.00	46	43	34	208	1.59	a	
40	1460.65	2917.60	266	47	27	132	2.13	a	
41	1764.15	3522.81	43	26	19	69	1.64	a	

181973D07.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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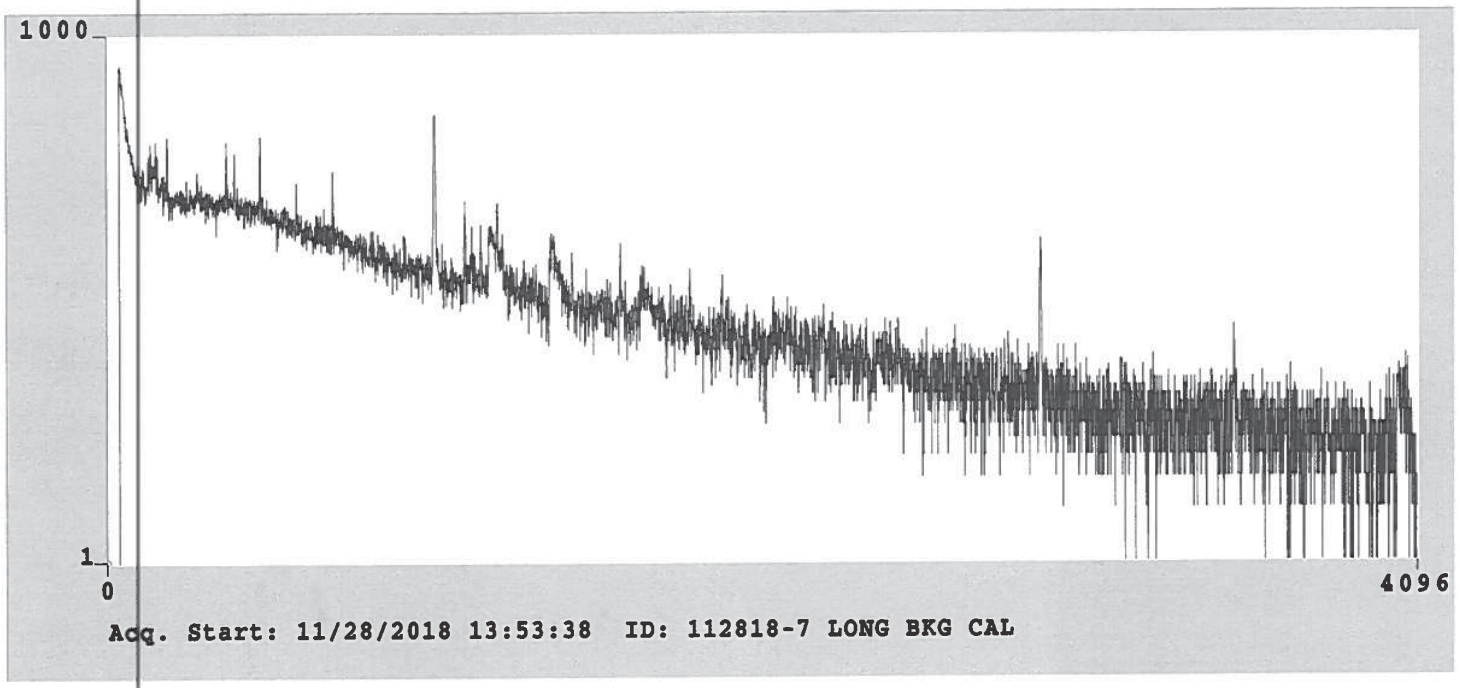
ID: 112818-7 LONG BKG CAL

Detector # 7 Background Q.C. Analysis for 11/28/2018 13:53:38

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	26.758	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	22.502	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	33.367	N.A.	Pass	N.A.
13	500->1000 keV Bkg	35.073	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	19.353	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.294	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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4096
Acq. Start: 11/28/2018 13:53:38 ID: 112818-7 LONG BKG CAL

181912D08.SPC Analyzed by

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

Weekly Background Check

Sample ID: 112818-8 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:53:49
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 8.97E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60194 Sec
Collection Efficiency 1.0000	Spc. File 181912D08.SPC

Detector #: 8 (Detector 8)

Energy(keV)= -2.34 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.65 + 0.012*En + 6.79E-04*En^2 + 0.00E+00*En^3 04/17/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.42	97.24	345	73	52	595	0.74	a	
2	53.46	111.29	96	95	76	994	1.07	a	
3	63.20	130.70	582	92	65	842	0.82	a	HiResid
4	66.32	136.93	171	83	65	842	0.78	b	HiResid
5	69.53	143.34	26	56	45	505	0.42	c	NET< CL HiResid
6	74.79	153.83	256	73	54	635	0.70	a	
7	77.16	158.55	265	83	63	794	0.74	b	
8	84.39	172.97	195	98	77	1007	1.20	a	
9	86.98	178.14	87	75	60	719	0.83	b	
10	92.60	189.35	781	91	59	711	0.88	a	
11	98.15	200.42	18	68	56	622	0.75	a	NET< CL
12	102.46	209.00	8	48	39	373	0.42	b	NET< CL
13	108.47	221.00	16	49	40	385	0.42	a	NET< CL
14	112.61	229.24	15	59	48	513	0.62	b	NET< CL
15	135.06	274.03	28	45	36	319	0.44	a	NET< CL
16	139.61	283.11	247	86	66	744	1.08	b	
17	143.73	291.31	157	84	66	744	1.18	c	
18	159.43	322.64	51	48	38	353	0.45	a	
19	185.76	375.15	316	65	45	451	0.70	a	
20	198.24	400.03	224	71	53	569	0.83	a	

181912D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
21	238.60	480.52	345	79	57	600	0.95	a	
22	245.36	494.00	40	45	35	309	0.53	a	
23	295.27	593.55	143	68	52	505	1.02	a	
24	338.59	679.95	72	61	48	434	0.92	a	
25	352.11	706.90	202	59	42	360	0.87	a	
26	368.10	738.80	54	57	45	381	1.02	a	
27	386.76	776.01	29	57	46	389	1.05	a	NET< CL
28	411.77	825.90	41	61	49	413	1.07	a	NET< CL
29	470.09	942.22	49	48	38	299	0.97	a	
30	511.25	1024.30	1763	126	78	809	2.37	a	Wide Pk
31	525.54	1052.80	41	57	46	368	1.52	a	NET< CL
32	558.75	1119.03	238	56	39	297	1.08	a	
33	569.99	1141.44	110	49	37	287	1.06	a	
34	583.64	1168.66	100	61	48	396	1.54	a	
35	609.58	1220.41	189	73	56	543	1.48	a	
36	618.02	1237.23	46	52	41	339	1.12	a	
37	651.44	1303.89	45	40	31	206	0.96	a	
38	669.83	1340.56	40	46	36	263	1.19	a	
39	692.32	1385.42	20	34	27	176	0.71	a	NET< CL
40	694.69	1390.14	92	66	52	439	1.72	b	
41	803.20	1606.55	173	47	32	215	1.36	a	
42	881.37	1762.47	50	41	32	206	1.31	a	
43	898.67	1796.95	93	76	61	439	3.51	a	Wide Pk
44	911.43	1822.41	78	40	29	178	1.38	a	
45	962.48	1924.22	68	43	33	202	1.65	a	
46	1120.79	2239.96	25	30	23	125	1.06	a	
47	1460.75	2917.97	204	41	24	116	1.75	a	
48	1764.82	3524.40	44	23	16	57	1.36	a	

181912D08.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

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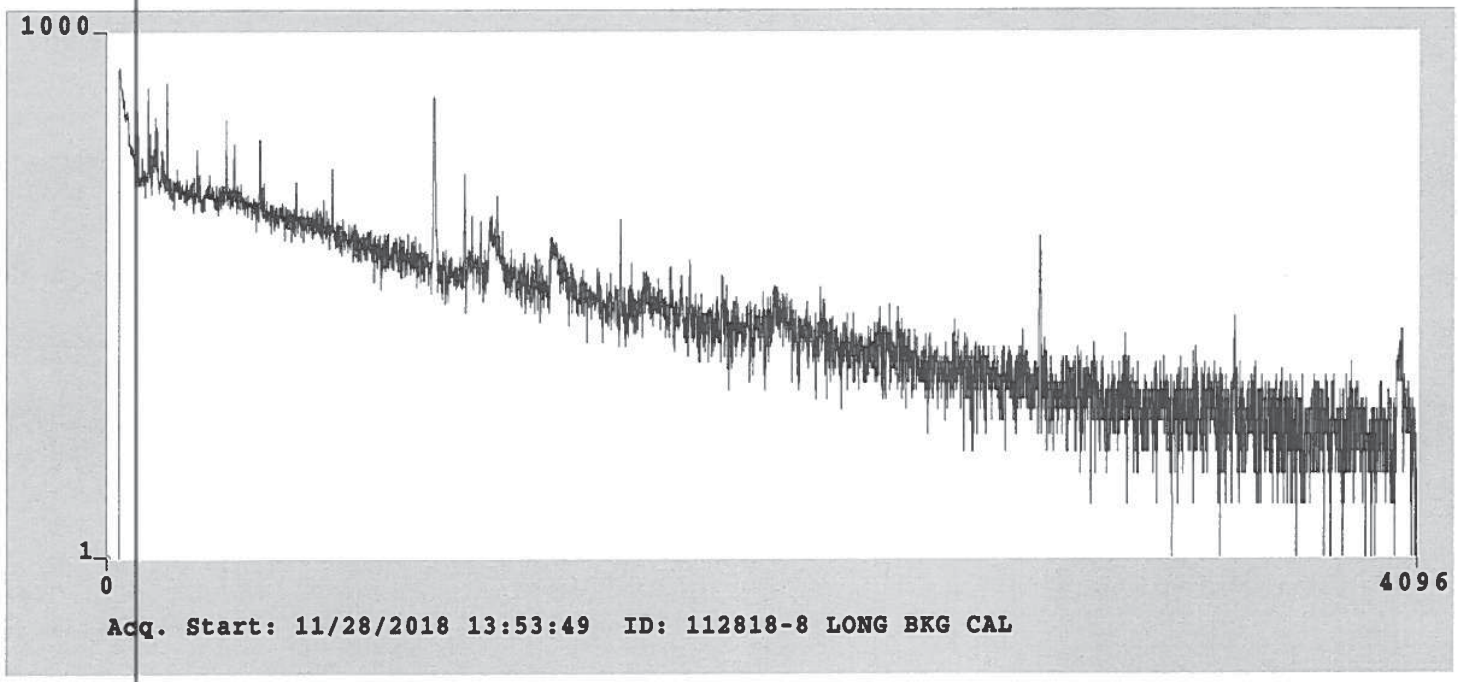
ID: 112818-8 LONG BKG CAL

Detector # 8 Background Q.C. Analysis for 11/28/2018 13:53:49

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	29.260	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	22.775	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	34.208	N.A.	Pass	N.A.
13	500->1000 keV Bkg	37.184	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	21.663	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.743	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.


1000
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4096
Acq. Start: 11/28/2018 13:53:49 ID: 112818-8 LONG BKG CAL

181776D09.SPC Analyzed by SS

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Weekly Background Check

Sample ID: 112818-9 LONG BKG CAL

Sampling Start: 11/28/2018 13:00:00	Counting Start: 11/28/2018 13:04:30
Sampling Stop: 11/28/2018 13:00:00	Decay Time. . . . . 7.50E-002 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60237 Sec
Collection Efficiency 1.0000	Spc. File 181776D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -2.29 + 0.502*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 0.76 + 0.007*En + 6.45E-04*En^2 + 0.00E+00*En^3 11/01/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.32	96.94	332	93	70	846	1.16	a	
2	53.36	110.97	77	69	55	617	0.85	a	
3	62.99	130.17	338	84	62	773	0.85	a	HiResid Wide Pk
4	65.42	135.02	-0	710	584	10363	10.94	b	NET< CL HiResid
5	65.88	135.94	86	109	88	1237	1.24	c	NET< CL HiResid
6	74.82	153.77	195	68	51	580	0.69	a	
7	76.98	158.07	207	78	60	725	0.74	b	
8	84.49	173.05	81	90	72	888	1.15	a	
9	87.03	178.10	87	71	56	634	0.83	b	
10	92.61	189.25	610	83	55	604	0.90	a	
11	139.72	283.18	120	64	50	499	0.77	a	
12	143.80	291.31	97	55	42	399	0.71	b	
13	179.87	363.23	36	60	49	477	0.85	a	NET< CL
14	185.73	374.91	304	69	49	488	0.83	a	
15	198.28	399.94	206	66	49	481	0.86	a	
16	238.50	480.15	263	68	49	482	0.79	a	
17	270.50	543.94	42	62	50	467	0.91	a	NET< CL
18	295.21	593.22	80	56	44	388	0.80	a	

181776D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
19	327.03	656.67	37	38	30	216	0.55	a	
20	338.43	679.39	36	38	29	213	0.55	a	
21	352.08	706.61	172	58	43	340	0.96	a	
22	371.20	744.74	49	52	42	320	1.02	a	
23	511.15	1023.80	1555	120	75	690	2.67	a	Wide Pk
24	537.72	1076.79	36	41	32	218	0.97	a	
25	558.71	1118.63	190	51	35	246	1.12	a	
26	570.08	1141.31	76	63	50	410	1.58	a	
27	583.66	1168.38	104	53	40	297	1.39	a	
28	609.58	1220.08	105	51	38	309	0.97	a	
29	692.31	1385.03	32	46	37	271	1.15	a	NET< CL Wide Pk
30	694.01	1388.42	68	83	67	581	2.54	b	
31	803.07	1605.89	84	41	30	176	1.14	a	
32	911.61	1822.33	54	28	20	98	0.89	a	
33	961.97	1922.74	27	34	27	150	1.28	a	NET< CL
34	1460.50	2916.80	154	38	23	104	1.78	a	
35	1763.73	3521.43	39	32	24	89	2.72	a	

181776D09.SPC Analyzed by

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SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

****

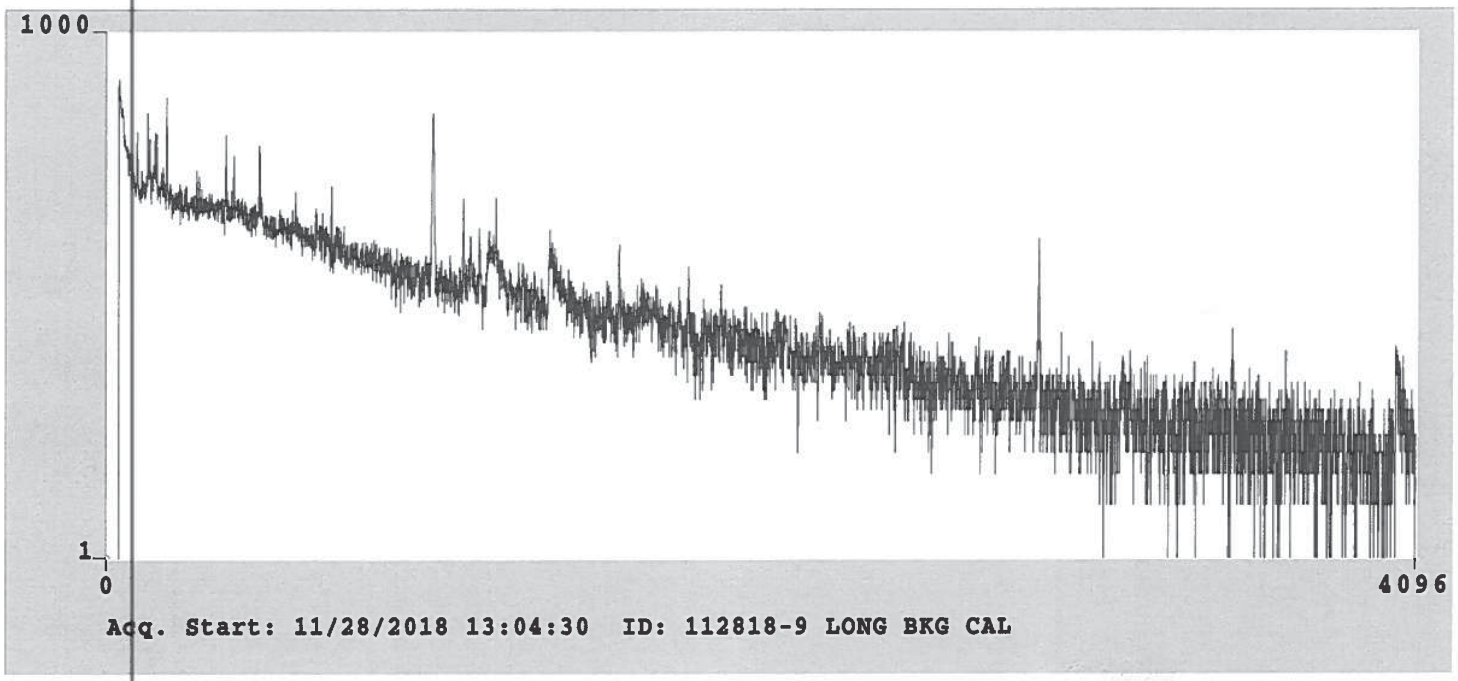
ID: 112818-9 LONG BKG CAL

Detector # 9 Background Q.C. Analysis for 11/28/2018 13:04:30

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	25.455	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	19.781	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	29.138	N.A.	Pass	N.A.
13	500->1000 keV Bkg	30.963	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	17.634	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.055	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.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4096
Acq. Start: 11/28/2018 13:04:30 ID: 112818-9 LONG BKG CAL

181951D10.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

ALS Laboratory Group - Fort Collins
GammaScan

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Weekly Background Check

Sample ID: 112818-10 LONG BKG CAL

Sampling Start: 11/28/2018 14:00:00	Counting Start: 11/28/2018 14:49:53
Sampling Stop: 11/28/2018 14:00:00	Decay Time. . . . . 8.31E-001 Hrs
Buildup Time. . . . . 0.00E+000 Hrs	Live Time . . . . . 60000 Sec
Sample Size . . . . . 1.00E+000 L	Real Time . . . . . 60196 Sec
Collection Efficiency 1.0000	Spc. File 181951D10.SPC

Detector #: 10 (Detector 10)

Energy(keV)= -2.10 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 11/28/2018
FWHM(keV) = 1.03 + -0.007*En + 1.30E-03*En^2 + 0.00E+00*En^3 11/15/2018
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.34	96.67	298	201	163	3682	1.58 a	
2	53.60	111.16	205	159	128	2612	1.25 a	
3	63.25	130.42	459	172	137	2964	1.24 a	
4	66.17	136.24	632	143	110	2223	1.06 b	
5	74.78	153.43	741	176	138	2999	1.27 a	
6	77.03	157.92	937	163	124	2624	1.10 b	
7	84.37	172.57	163	129	104	1987	1.03 a	
8	87.11	178.04	205	114	91	1656	0.77 b	
9	92.60	188.99	1193	167	125	2471	1.31 a	
10	139.54	282.67	506	122	93	1611	0.95 a	
11	143.80	291.17	146	130	105	1880	1.09 b	
12	185.75	374.89	1328	169	125	2576	1.56 a	
~~13~~	~~198.33~~	~~399.99~~	~~927~~	~~134~~	~~98~~	~~1099~~	~~1.15 a~~	
14	238.70	480.56	1049	138	100	1840	1.35 a	
15	241.85	486.85	812	134	100	1840	1.26 b	
16	258.65	520.37	60	74	60	875	0.64 a	
17	269.20	541.43	53	72	58	830	0.64 a	NET< CL
18	270.74	544.52	95	95	77	1245	1.01 b	
19	295.13	593.18	1576	138	92	1577	1.28 a	
20	338.56	679.86	195	83	64	936	0.79 a	
21	351.97	706.62	3138	159	93	1503	1.51 a	

181951D10.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	439.31	880.92	111	100	81	1131	1.55 a	
23	511.09	1024.19	4958	213	132	2380	2.82 a	Wide Pk
24	537.56	1077.01	73	89	72	1003	1.50 a	
25	558.61	1119.01	751	102	71	972	1.47 a	
26	569.85	1141.45	317	115	90	1423	1.75 a	
27	583.61	1168.91	581	112	84	1229	1.74 a	
28	596.25	1194.14	149	111	89	1405	1.82 a	Wide Pk
29	599.00	1199.64	605	206	164	3323	3.27 b	
30	609.50	1220.58	2324	159	104	1987	1.68 a	
31	651.31	1304.04	134	89	70	918	1.57 a	
32	669.75	1340.83	74	64	50	587	1.03 a	
33	692.26	1385.76	84	66	52	632	0.91 a	Wide Pk
34	694.55	1390.32	404	171	137	2311	3.29 b	
35	768.17	1537.25	335	121	95	1329	2.90 a	Wide Pk
36	803.29	1607.34	508	91	65	813	1.82 a	
37	836.19	1672.99	349	151	120	1772	3.93 a	Wide Pk
38	839.39	1679.38	278	102	79	1113	2.21 b	
39	860.96	1722.43	75	75	60	761	1.47 a	
40	880.69	1761.80	96	74	59	698	1.59 a	
41	898.10	1796.56	140	75	58	685	1.63 a	
42	911.46	1823.21	404	83	60	696	1.73 a	
43	934.39	1868.97	88	64	51	540	1.50 a	
44	962.55	1925.19	273	118	93	1167	3.41 a	Wide Pk
45	969.31	1938.68	242	75	56	611	1.78 b	
46	1001.02	2001.95	38	52	42	410	1.07 a	NET< CL
47	1063.87	2127.40	53	87	70	841	2.24 a	NET< CL
48	1116.14	2231.71	176	116	93	1120	3.58 a	Wide Pk
49	1120.39	2240.19	573	85	58	611	2.00 b	
50	1237.93	2474.76	165	73	56	578	1.91 a	
51	1280.82	2560.37	66	54	43	368	1.71 a	
52	1377.66	2753.63	122	64	49	432	2.12 a	
53	1408.03	2814.23	52	61	49	437	1.98 a	
54	1460.60	2919.16	1213	93	51	447	2.34 a	
55	1509.14	3016.04	77	44	33	236	1.41 a	
56	1660.97	3319.05	50	58	46	330	2.87 a	
57	1729.16	3455.13	143	70	54	418	3.04 a	
58	1763.96	3524.58	532	73	46	336	2.57 a	

181951D10.SPC Analyzed by

****

SEEKER B A C K G R O U N D Q. C. A N A L Y S I S Version 2.2.2

****

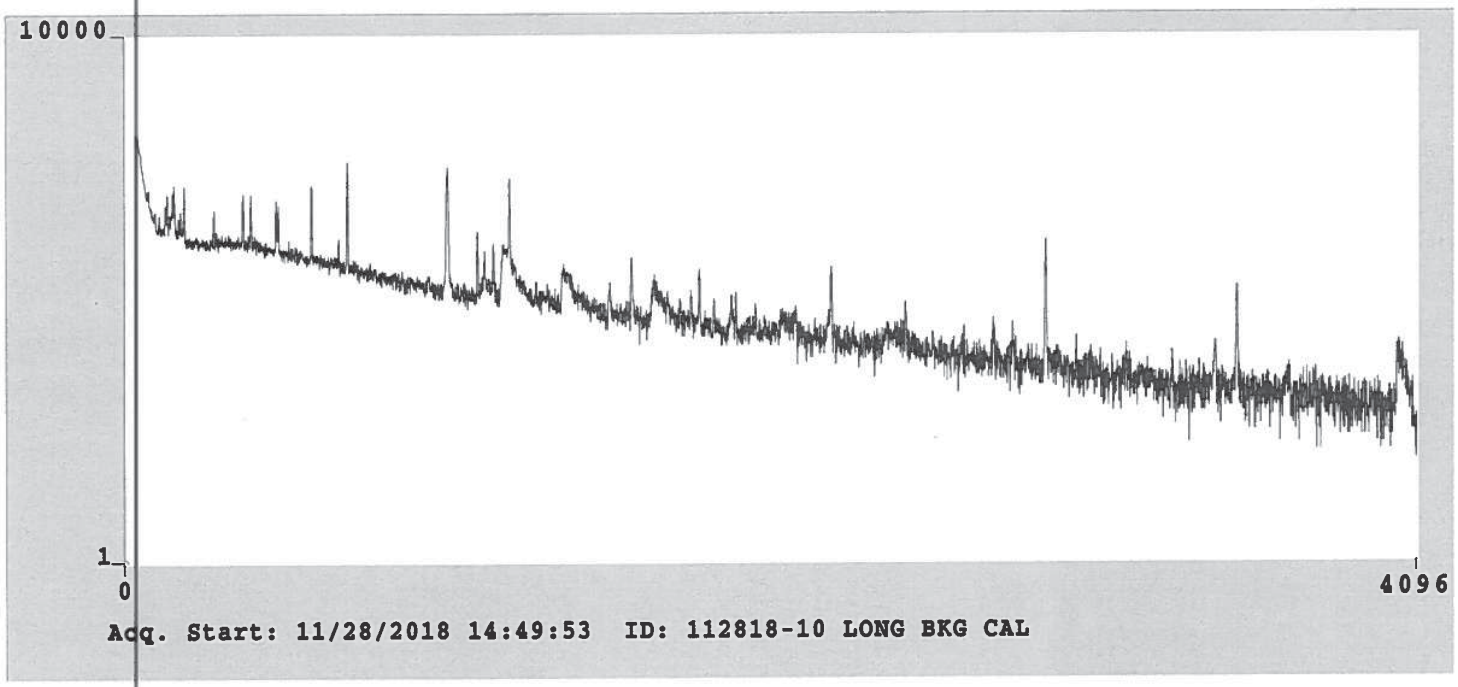
ID: 112818-10 LONG BKG CAL

Detector # 10 Background Q.C. Analysis for 11/28/2018 14:49:53

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
10	50-> 150 keV Bkg	65.940	N.A.	Pass	N.A.
11	150-> 250 keV Bkg	55.040	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	87.468	N.A.	Pass	N.A.
13	500->1000 keV Bkg	106.254	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	65.865	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	8.211	N.A.	Pass	N.A.

Q.C. Results Saved.

RE-CALC QC HEADER for Overwritten Results.


10000
1
0
4096
Acq. Start: 11/28/2018 14:49:53 ID: 112818-10 LONG BKG CAL

Gamma Spectroscopy

Quality Control Data

Daily Instrument Performance Checks

ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 · U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

PAII00720

66354A-307

215 Grams of Sand in Metal Can

This standard radionuclide source was prepared using aliquots measured gravimetrically from master radionuclide solution sources. The Am-241 was calibrated by 4 pi alpha liquid scintillation counting. All other radionuclides were calibrated using a germanium gamma spectrometer system. Calibration and purity were checked using a germanium gamma spectrometer system. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Analytics maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Rev. 1, February, 1979.

Calibration date: July 1, 2003 12:00 EST

ISOTOPE	GAMMA-RAY ENERGY	HALF-LIFE		GAMMA-RAYS PER SECOND	TOTAL UNCERTAINTY %
Am-241	59.5	432	y	1316	3.0
Cd-109	88	462.6	d	1879	3.3
Co-57	122	271.79	d	1042	2.8
Ce-139	166	137.6	d	1432	2.8
Hg-203	279	46.61	d	3223	2.7
Sn-113	392	115.1	d	1978	2.6
Cs-137	662	30.07	y	1272	3.0
Y-88	898	106.6	d	5106	2.6
Co-60	1173	5.2714	y	2424	2.7
Co-60	1332	5.2714	y	2449	2.6
Y-88	1836	106.6	d	5335	2.6

Approximately 126.5 mL of customer supplied sand.
P O NUMBER EW060303, Item 4

SOURCE PREPARED BY: M. D. Currie
M. D. Currie, Radiochemist

Q A APPROVED: [signature] 8-1-03

This standard will expire one year after the calibration date.

ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 • U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

RSO #767
Rec'd 8/13/04
DJB

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

68681-307

215 Grams of Sand in Metal Can

This standard radionuclide source was prepared using aliquots measured gravimetrically from master radionuclide solution sources. The Am-241 was calibrated by 4 pi alpha liquid scintillation counting. All other radionuclides were calibrated using a germanium gamma spectrometer system. Calibration and purity were checked using a germanium gamma spectrometer system. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Analytics maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Rev. 1, February, 1979.

Calibration date: July 1, 2004 12:00 EST

ISOTOPE	GAMMA-RAY ENERGY	HALF-LIFE		GAMMA-RAYS PER SECOND	TOTAL UNCERTAINTY %
Am-241	59.5	432	y	1355	3.0
Cd-109	88	462.6	d	1900	3.3
Co-57	122	271.79	d	995.1	3.0
Ce-139	166	137.6	d	1411	2.8
Hg-203	279	46.61	d	3241	2.7
Sn-113	392	115.1	d	1939	2.6
Cs-137	662	30.07	y	1247	3.0
Y-88	898	106.6	d	4853	2.6
Co-60	1173	5.2714	y	2457	2.7
Co-60	1332	5.2714	y	2474	2.6
Y-88	1836	106.6	d	5064	2.6

140 mL of customer supplied sand.
P O NUMBER 70564, Item 4

SOURCE PREPARED BY: [signature] for
M. D. Currie, Radiochemist

Q A APPROVED: [signature] 8-9-04

This standard will expire one year after the calibration date.

≈ 203 μCi

ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 · U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

PAI ID 0636
recd 8-02-02

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

64122-307

215 Grams of Sand in Metal Can

This standard radionuclide source was prepared using aliquots measured gravimetrically from master radionuclide solution sources. The Am-241 was calibrated by 4 pi alpha liquid scintillation counting. All other radionuclides were calibrated using a germanium gamma spectrometer system. Calibration and purity were checked using a germanium gamma spectrometer system. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Analytics maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Rev. 1, February, 1979.

Calibration date: July 1, 2002 12:00 EST

ISOTOPE	GAMMA-RAY ENERGY	HALF-LIFE		GAMMA-RAYS PER SECOND	TOTAL UNCERTAINTY %
Am-241	59.5	432	y	1301	5.0
Cd-109	88	462.6	d	1882	5.0
Co-57	122	271.79	d	994.2	4.7
Ce-139	166	137.6	d	1420	4.3
Hg-203	279	46.61	d	3085	4.1
Sn-113	392	115.1	d	2094	4.1
Cs-137	662	30.07	y	1320	4.8
Y-88	898	106.6	d	4847	4.2
Co-60	1173	5.2714	y	2354	4.1
Co-60	1332	5.2714	y	2382	4.2
Y-88	1836	106.6	d	5068	4.0

Approximately 140 mL customer supplied sand.
P O NUMBER EW060602, Item 4

SOURCE PREPARED BY: M Taskaeva
M. Taskaeva Radiochemist

Q A APPROVED: Rcdcd 7/3/02

This standard will expire one year after the calibration date.

RSO # 720 was opened and split into multiple LSC vials, as shown

720.3020.47	-1	35.8071 g	(Bal 12)
	-2	36.1586 g	
	-3	36.1325	
	-4	36.0040	
	-5	36.4197	
	-6	34.5663	

These will be used as γ daily check sources

10/30/06

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
	10/30/06		

RSO #767 was opened and split into multiple LSC vials, to be used a δ check sources, as shown

767.3020.48-	7	36.6640 g	(Bal (2)
	8	36.1858 g	
	9	36.3396 g	
	10	35.9937 g	
	11	36.7952 g	
	12	33.1100 g	

10/30/06

Continued on Page _____

Read and Understood By

Signed | Date | Signed | Date

RSO # 636 was opened and split into multiple LSC vials, to be used as 7 daily check sources, as shown

636.3020.49	-13	34.2237 g	(Bal 12)
	14	33.7917 g	
	15	34.6628	
	16	34.1622	
	17	34.2401	
	18	34.6838	

The remaining 9.1386g was transferred to a 200 ml plastic beaker and marked for disposal.

10/30/06

Continued on Page

Read and Understood By

10/30/06

Signed | Date | Signed | Date

ALS

Gamma Spectrometer Calibration Log

Date: 11/26/18 Reviewed By/Date: 11/26/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.						1332 FWHM	SG			
3.					SG					
4.					SG					
5.					SG					
6.	SG									
7.				SG	SG					
8.					SG					
9.					SG					
10.					SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

181742D09.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: daily check
Detector # 9 Detector Q.C. Analysis for 11/26/2018 07:31:45
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.668	N.A.	Pass	N.A.
2	60 keV FWHM	8.615E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.438E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.033	N.A.	Pass	N.A.
5	662 keV FWHM	1.410	N.A.	Pass	N.A.
6	662 keV Efficiency	1.373E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.956	N.A.	Pass	N.A.
8	1332 keV FWHM	2.041	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.989E-03	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 11/27/18 Reviewed By/Date: SG 11/27/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	SG					
3.				↓	SG					
4.				↓	SG					
5.				↓	SG					
6.	SG			/	/					
7.				SG	SG					
8.				↓	SG					
9.				↓	SG					
10.				↓	SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

181754D09.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: daily check
Detector # 9 Detector Q.C. Analysis for 11/27/2018 07:22:49
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.807	N.A.	Pass	N.A.
2	60 keV FWHM	8.632E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.253E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.243	N.A.	Pass	N.A.
5	662 keV FWHM	1.390	N.A.	Pass	N.A.
6	662 keV Efficiency	1.361E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.286	N.A.	Pass	N.A.
8	1332 keV FWHM	1.919	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.362E-03	N.A.	Pass	N.A.

181933D10.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: daily check
Detector # 10 Detector Q.C. Analysis for 11/27/2018 07:22:56
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.628	N.A.	Pass	N.A.
2	60 keV FWHM	1.007	N.A.	Pass	N.A.
3	60 keV Efficiency	3.908E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.759	N.A.	Pass	N.A.
5	662 keV FWHM	1.907	N.A.	Pass	N.A.
6	662 keV Efficiency	4.412E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.013	N.A.	Pass	N.A.
8	1332 keV FWHM	2.778	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.641E-02	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 11/28/18

Reviewed By/Date: SG 11/28/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	SG					
3.				↓	SG					
4.				↓	SG					
5.				↓	SG					
6.	SG			/	/					
7.				SG	SG					
8.				↓	SG					
9.				↓						
10.				↓	SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

481739 A

Form 754r16a.doc (10/27/11)

181942D10.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 10 Detector Q.C. Analysis for 11/28/2018 07:56:05
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.777	N.A.	Pass	N.A.
2	60 keV FWHM	1.027	N.A.	Pass	N.A.
3	60 keV Efficiency	3.908E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.936	N.A.	Pass	N.A.
5	662 keV FWHM	1.824	N.A.	Pass	N.A.
6	662 keV Efficiency	4.483E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.322	N.A.	Pass	N.A.
8	1332 keV FWHM	2.807	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.620E-02	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 12/4/18 Reviewed By/Date: SG 12/4/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	SG					
3.					SG					
4.					SG					
5.				↓	SG					
6.	SG			/	/					
7.				SG	SG					
8.				↓	SG					
9.					SG					
10.				↓	SG					

**** Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

182150D01.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 1 Detector Q.C. Analysis for 12/04/2018 07:48:38
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.491	N.A.	Pass	N.A.
2	60 keV FWHM	8.584E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.766E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1324.602	N.A.	Pass	N.A.
5	662 keV FWHM	1.474	N.A.	Pass	N.A.
6	662 keV Efficiency	1.528E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.527	N.A.	Pass	N.A.
8	1332 keV FWHM	2.190	N.A.	Pass	N.A.
9	1332 keV Efficiency	6.728E-03	N.A.	Pass	N.A.

182180D02.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 12/04/2018 07:48:45

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.337	N.A.	Pass	N.A.
2	60 keV FWHM	1.102	N.A.	Pass	N.A.
3	60 keV Efficiency	4.198E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1323.280	N.A.	Pass	N.A.
5	662 keV FWHM	1.731	N.A.	Pass	N.A.
6	662 keV Efficiency	1.875E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.124	N.A.	Pass	N.A.
8	1332 keV FWHM	2.599	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.254E-03	N.A.	Pass	N.A.

182662D03.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 3 Detector Q.C. Analysis for 12/04/2018 07:48:51
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.392	N.A.	Pass	N.A.
2	60 keV FWHM	9.253E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	9.588E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1322.423	N.A.	Pass	N.A.
5	662 keV FWHM	1.981	N.A.	Pass	N.A.
6	662 keV Efficiency	1.582E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.404	N.A.	Pass	N.A.
8	1332 keV FWHM	2.953	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.687E-03	N.A.	Pass	N.A.

Q.C. Results Saved.
RE-CALC QC HEADER for Overwritten Results.

182677D04.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 4 Detector Q.C. Analysis for 12/04/2018 07:48:56

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.633	N.A.	Pass	N.A.
2	60 keV FWHM	9.452E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.388E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1323.373	N.A.	Pass	N.A.
5	662 keV FWHM	1.782	N.A.	Pass	N.A.
6	662 keV Efficiency	1.604E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.031	N.A.	Pass	N.A.
8	1332 keV FWHM	2.481	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.533E-03	N.A.	Pass	N.A.

181892D05.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 5 Detector Q.C. Analysis for 12/04/2018 07:49:01

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	120.133	N.A.	Pass	N.A.
2	60 keV FWHM	6.750E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.738E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1322.873	N.A.	Pass	N.A.
5	662 keV FWHM	1.505	N.A.	Pass	N.A.
6	662 keV Efficiency	2.016E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.145	N.A.	Pass	N.A.
8	1332 keV FWHM	2.357	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.174E-03	N.A.	Pass	N.A.

182010D07.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 7 Detector Q.C. Analysis for 12/04/2018 07:49:08

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	123.234	N.A.	Pass	N.A.
2	60 keV FWHM	8.123E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.104E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1324.196	N.A.	Pass	N.A.
5	662 keV FWHM	1.565	N.A.	Pass	N.A.
6	662 keV Efficiency	1.567E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.916	N.A.	Pass	N.A.
8	1332 keV FWHM	2.252	N.A.	Pass	N.A.
9	1332 keV Efficiency	8.498E-03	N.A.	Pass	N.A.

181950D08.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 8 Detector Q.C. Analysis for 12/04/2018 07:49:14

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.976	N.A.	Pass	N.A.
2	60 keV FWHM	7.134E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.577E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.354	N.A.	Pass	N.A.
5	662 keV FWHM	1.282	N.A.	Pass	N.A.
6	662 keV Efficiency	1.569E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.583	N.A.	Pass	N.A.
8	1332 keV FWHM	1.858	N.A.	Pass	N.A.
9	1332 keV Efficiency	8.386E-03	N.A.	Pass	N.A.

181811D09.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 9 Detector Q.C. Analysis for 12/04/2018 07:49:19

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.855	N.A.	Pass	N.A.
2	60 keV FWHM	8.534E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.354E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.605	N.A.	Pass	N.A.
5	662 keV FWHM	1.418	N.A.	Pass	N.A.
6	662 keV Efficiency	1.383E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.227	N.A.	Pass	N.A.
8	1332 keV FWHM	1.826	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.902E-03	N.A.	Pass	N.A.

181985D10.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 10 Detector Q.C. Analysis for 12/04/2018 07:49:27
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.596	N.A.	Pass	N.A.
2	60 keV FWHM	1.033	N.A.	Pass	N.A.
3	60 keV Efficiency	3.944E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.708	N.A.	Pass	N.A.
5	662 keV FWHM	1.920	N.A.	Pass	N.A.
6	662 keV Efficiency	4.508E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.880	N.A.	Pass	N.A.
8	1332 keV FWHM	2.905	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.618E-02	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 12/5/18 Reviewed By/Date: SG 12/5/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	SG					
3.					SG					
4.					SG					
5.					SG					
6.	SG				/					
7.				SG	SG					
8.				↓	SG					
9.					SG					
10.					SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

182160D01.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 1 Detector Q.C. Analysis for 12/05/2018 07:59:43

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.561	N.A.	Pass	N.A.
2	60 keV FWHM	8.356E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.863E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1324.685	N.A.	Pass	N.A.
5	662 keV FWHM	1.535	N.A.	Pass	N.A.
6	662 keV Efficiency	1.613E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.755	N.A.	Pass	N.A.
8	1332 keV FWHM	2.044	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.632E-03	N.A.	Pass	N.A.

182190D02.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 2 Detector Q.C. Analysis for 12/05/2018 07:59:50
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.312	N.A.	Pass	N.A.
2	60 keV FWHM	1.098	N.A.	Pass	N.A.
3	60 keV Efficiency	4.146E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1323.365	N.A.	Pass	N.A.
5	662 keV FWHM	1.750	N.A.	Pass	N.A.
6	662 keV Efficiency	1.827E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.371	N.A.	Pass	N.A.
8	1332 keV FWHM	2.505	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.118E-03	N.A.	Pass	N.A.

182670D03.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 3 Detector Q.C. Analysis for 12/05/2018 07:59:55
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.358	N.A.	Pass	N.A.
2	60 keV FWHM	9.368E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.025E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1322.387	N.A.	Pass	N.A.
5	662 keV FWHM	2.011	N.A.	Pass	N.A.
6	662 keV Efficiency	1.550E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.827	N.A.	Pass	N.A.
8	1332 keV FWHM	2.554	N.A.	Pass	N.A.
9	1332 keV Efficiency	6.672E-03	N.A.	Pass	N.A.

182686D04.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 4 Detector Q.C. Analysis for 12/05/2018 08:00:00

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.626	N.A.	Pass	N.A.
2	60 keV FWHM	1.033	N.A.	Pass	N.A.
3	60 keV Efficiency	1.450E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1323.382	N.A.	Pass	N.A.
5	662 keV FWHM	1.769	N.A.	Pass	N.A.
6	662 keV Efficiency	1.540E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.122	N.A.	Pass	N.A.
8	1332 keV FWHM	2.352	N.A.	Pass	N.A.
9	1332 keV Efficiency	6.680E-03	N.A.	Pass	N.A.

181900D05.SPC Analyzed by SG

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 5 Detector Q.C. Analysis for 12/05/2018 08:00:05

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	120.145	N.A.	Pass	N.A.
2	60 keV FWHM	6.644E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.958E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1322.967	N.A.	Pass	N.A.
5	662 keV FWHM	1.595	N.A.	Pass	N.A.
6	662 keV Efficiency	2.000E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.213	N.A.	Pass	N.A.
8	1332 keV FWHM	2.276	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.440E-03	N.A.	Pass	N.A.

182019D07.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 7 Detector Q.C. Analysis for 12/05/2018 08:00:11

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	123.286	N.A.	Pass	N.A.
2	60 keV FWHM	8.468E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	3.862E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1324.296	N.A.	Pass	N.A.
5	662 keV FWHM	1.541	N.A.	Pass	N.A.
6	662 keV Efficiency	1.502E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.265	N.A.	Pass	N.A.
8	1332 keV FWHM	2.169	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.694E-03	N.A.	Pass	N.A.

181955D08.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 8 Detector Q.C. Analysis for 12/05/2018 08:00:16

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.993	N.A.	Pass	N.A.
2	60 keV FWHM	7.121E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.700E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.418	N.A.	Pass	N.A.
5	662 keV FWHM	1.344	N.A.	Pass	N.A.
6	662 keV Efficiency	1.651E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.785	N.A.	Pass	N.A.
8	1332 keV FWHM	1.903	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.285E-03	N.A.	Pass	N.A.

181817D09.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 9 Detector Q.C. Analysis for 12/05/2018 08:00:21

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.862	N.A.	Pass	N.A.
2	60 keV FWHM	8.489E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.244E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.615	N.A.	Pass	N.A.
5	662 keV FWHM	1.369	N.A.	Pass	N.A.
6	662 keV Efficiency	1.339E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.098	N.A.	Pass	N.A.
8	1332 keV FWHM	1.939	N.A.	Pass	N.A.
9	1332 keV Efficiency	6.971E-03	N.A.	Pass	N.A.

181995D10.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 10 Detector Q.C. Analysis for 12/05/2018 08:00:26

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.631	N.A.	Pass	N.A.
2	60 keV FWHM	1.001	N.A.	Pass	N.A.
3	60 keV Efficiency	3.891E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.622	N.A.	Pass	N.A.
5	662 keV FWHM	1.868	N.A.	Pass	N.A.
6	662 keV Efficiency	4.512E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.785	N.A.	Pass	N.A.
8	1332 keV FWHM	2.770	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.481E-02	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 12/6/18 Reviewed By/Date: SG 12/6/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	SG					
3.					/	1332 FWHM	SG			
4.					SG					
5.				↓	SG					
6.	SG			/	/					
7.				SG	SG					
8.				↓	SG					
9.					SG					
10.					SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

182196D02.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 12/06/2018 07:30:53

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.344	N.A.	Pass	N.A.
2	60 keV FWHM	1.009	N.A.	Pass	N.A.
3	60 keV Efficiency	4.091E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1323.488	N.A.	Pass	N.A.
5	662 keV FWHM	1.743	N.A.	Pass	N.A.
6	662 keV Efficiency	1.890E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.491	N.A.	Pass	N.A.
8	1332 keV FWHM	2.502	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.137E-03	N.A.	Pass	N.A.

182673D03.SPC Analyzed by SG

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 3 Detector Q.C. Analysis for 12/06/2018 07:30:58

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.439	N.A.	Pass	N.A.
2	60 keV FWHM	9.494E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.010E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1322.473	N.A.	Pass	N.A.
5	662 keV FWHM	1.931	N.A.	Pass	N.A.
6	662 keV Efficiency	1.557E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.425	N.A.	Pass	N.A.
8	1332 keV FWHM	3.122	N.A.	<FAIL>	N.A.
9	1332 keV Efficiency	6.922E-03	N.A.	Pass	N.A.

182675D03.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 3 Detector Q.C. Analysis for 12/06/2018 08:05:25
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.449	N.A.	Pass	N.A.
2	60 keV FWHM	9.922E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.047E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1322.533	N.A.	Pass	N.A.
5	662 keV FWHM	1.972	N.A.	Pass	N.A.
6	662 keV Efficiency	1.591E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.135	N.A.	Pass	N.A.
8	1332 keV FWHM	3.033	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.143E-03	N.A.	Pass	N.A.

182695D04.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 4 Detector Q.C. Analysis for 12/06/2018 07:31:05

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.685	N.A.	Pass	N.A.
2	60 keV FWHM	9.782E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.364E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1323.624	N.A.	Pass	N.A.
5	662 keV FWHM	1.693	N.A.	Pass	N.A.
6	662 keV Efficiency	1.550E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.483	N.A.	Pass	N.A.
8	1332 keV FWHM	2.559	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.251E-03	N.A.	Pass	N.A.

181906D05.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 5 Detector Q.C. Analysis for 12/06/2018 07:31:10
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	120.228	N.A.	Pass	N.A.
2	60 keV FWHM	7.147E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.922E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1322.932	N.A.	Pass	N.A.
5	662 keV FWHM	1.587	N.A.	Pass	N.A.
6	662 keV Efficiency	1.962E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2663.183	N.A.	Pass	N.A.
8	1332 keV FWHM	2.432	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.068E-03	N.A.	Pass	N.A.

Q.C. Results Saved.
RE-CALC QC HEADER for Overwritten Results.

182024D07.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 7 Detector Q.C. Analysis for 12/06/2018 07:31:16

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	123.259	N.A.	Pass	N.A.
2	60 keV FWHM	9.000E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.137E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1324.346	N.A.	Pass	N.A.
5	662 keV FWHM	1.564	N.A.	Pass	N.A.
6	662 keV Efficiency	1.531E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.480	N.A.	Pass	N.A.
8	1332 keV FWHM	2.038	N.A.	Pass	N.A.
9	1332 keV Efficiency	8.041E-03	N.A.	Pass	N.A.

181960D08.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 8 Detector Q.C. Analysis for 12/06/2018 07:31:22

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	123.045	N.A.	Pass	N.A.
2	60 keV FWHM	7.205E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.779E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.592	N.A.	Pass	N.A.
5	662 keV FWHM	1.320	N.A.	Pass	N.A.
6	662 keV Efficiency	1.657E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.051	N.A.	Pass	N.A.
8	1332 keV FWHM	1.881	N.A.	Pass	N.A.
9	1332 keV Efficiency	8.992E-03	N.A.	Pass	N.A.

181822D09.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 9 Detector Q.C. Analysis for 12/06/2018 07:31:27
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.922	N.A.	Pass	N.A.
2	60 keV FWHM	8.562E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.200E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.691	N.A.	Pass	N.A.
5	662 keV FWHM	1.417	N.A.	Pass	N.A.
6	662 keV Efficiency	1.354E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.439	N.A.	Pass	N.A.
8	1332 keV FWHM	1.825	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.732E-03	N.A.	Pass	N.A.

182001D10.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2

****

ID: DAILY CHECK

Detector # 10 Detector Q.C. Analysis for 12/06/2018 07:31:33

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.676	N.A.	Pass	N.A.
2	60 keV FWHM	1.047	N.A.	Pass	N.A.
3	60 keV Efficiency	4.009E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.693	N.A.	Pass	N.A.
5	662 keV FWHM	1.883	N.A.	Pass	N.A.
6	662 keV Efficiency	4.468E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.920	N.A.	Pass	N.A.
8	1332 keV FWHM	2.881	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.546E-02	N.A.	Pass	N.A.

ALS

Gamma Spectrometer Calibration Log

Date: 12/7/18 Reviewed By/Date: SG 12/7/18

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				SG	SG					
2.				↓	✓	1332 Cent.	SG		Gain Adj	
3.					SG					
4.					SG					
5.				↓	SG					
6.	SG			✓	✓					
7.				SG	SG					
8.				↓	SG					
9.					SG					
10.					SG					

.** **Corrective Action:**

*** Due to detector____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ____ is online for the date of _____

182684D03.SPC Analyzed by

****

SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 3 Detector Q.C. Analysis for 12/07/2018 07:59:45
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.302	N.A.	Pass	N.A.
2	60 keV FWHM	9.557E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.056E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1322.226	N.A.	Pass	N.A.
5	662 keV FWHM	2.004	N.A.	Pass	N.A.
6	662 keV Efficiency	1.545E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2659.964	N.A.	Pass	N.A.
8	1332 keV FWHM	3.092	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.064E-03	N.A.	Pass	N.A.

182733D04.SPC Analyzed by

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SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 4 Detector Q.C. Analysis for 12/07/2018 07:59:51

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	121.550	N.A.	Pass	N.A.
2	60 keV FWHM	9.415E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.377E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1323.206	N.A.	Pass	N.A.
5	662 keV FWHM	1.734	N.A.	Pass	N.A.
6	662 keV Efficiency	1.580E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.475	N.A.	Pass	N.A.
8	1332 keV FWHM	2.744	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.014E-03	N.A.	Pass	N.A.

181915D05.SPC Analyzed by SB

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SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK

Detector # 5 Detector Q.C. Analysis for 12/07/2018 07:59:58

Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	120.139	N.A.	Pass	N.A.
2	60 keV FWHM	6.766E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.458E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1322.778	N.A.	Pass	N.A.
5	662 keV FWHM	1.529	N.A.	Pass	N.A.
6	662 keV Efficiency	1.951E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2662.808	N.A.	Pass	N.A.
8	1332 keV FWHM	2.477	N.A.	Pass	N.A.
9	1332 keV Efficiency	9.364E-03	N.A.	Pass	N.A.

182033D07.SPC Analyzed by

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SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

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ID: DAILY CHECK
Detector # 7 Detector Q.C. Analysis for 12/07/2018 08:00:04
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	123.073	N.A.	Pass	N.A.
2	60 keV FWHM	8.547E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.083E-03	N.A.	Pass	N.A.
4	662 keV Centroid	1323.735	N.A.	Pass	N.A.
5	662 keV FWHM	1.553	N.A.	Pass	N.A.
6	662 keV Efficiency	1.550E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2660.142	N.A.	Pass	N.A.
8	1332 keV FWHM	2.243	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.998E-03	N.A.	Pass	N.A.

181831D09.SPC Analyzed by

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SEEKER D E T E C T O R Q. C. A N A L Y S I S Version 2.2.2

****

ID: DAILY CHECK
Detector # 9 Detector Q.C. Analysis for 12/07/2018 08:00:18
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.704	N.A.	Pass	N.A.
2	60 keV FWHM	8.756E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	5.322E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.166	N.A.	Pass	N.A.
5	662 keV FWHM	1.406	N.A.	Pass	N.A.
6	662 keV Efficiency	1.374E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.545	N.A.	Pass	N.A.
8	1332 keV FWHM	1.936	N.A.	Pass	N.A.
9	1332 keV Efficiency	7.608E-03	N.A.	Pass	N.A.

182008D10.SPC Analyzed by

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 SEEKER         D E T E C T O R   Q. C.    A N A L Y S I S   Version 2.2.2
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ID: DAILY CHECK
Detector # 10 Detector Q.C. Analysis for 12/07/2018 08:00:24
Standards File #: 97 (Daily Performance Check(S SOURCES 1-12))

#	Parameter	Value	n Sigma Test	Bounds Test	T-Test
1	60 keV Centroid	122.406	N.A.	Pass	N.A.
2	60 keV FWHM	1.032	N.A.	Pass	N.A.
3	60 keV Efficiency	4.007E-02	N.A.	Pass	N.A.
4	662 keV Centroid	1324.069	N.A.	Pass	N.A.
5	662 keV FWHM	1.888	N.A.	Pass	N.A.
6	662 keV Efficiency	4.638E-02	N.A.	Pass	N.A.
7	1332 keV Centroid	2661.721	N.A.	Pass	N.A.
8	1332 keV FWHM	2.689	N.A.	Pass	N.A.
9	1332 keV Efficiency	2.621E-02	N.A.	Pass	N.A.