

The order of this data package is as follows:

1. Chain-of-Custody/Lab Request
2. Copies of field COCs
3. Validation Report
4. Laboratory analysis

Comments:

[illegible]

## SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11366

EVENT NAME: Mortandad/Sandia (Cr Inv) MY2017 Q4

SAMPLE ID: CAMO-17-142310

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	8/2/17	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1017		MEDIA:	UA	
PRS ID:	OK		SAMPLE TECH CODE:	GSP	
LOCATION ID:	R-45 S1		FIELD PREP:	UF	
LOCATION TYPE:	OK		FIELD QC TYPE:	REG	
TOP DEPTH:			SAMPLE USAGE:	INV	
BOTTOM DEPTH:			EXCAVATED:		YES / NO / <u>NA</u>

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	MSGP-Hg	1000 500 ML POLY AS 8/2/17	1	HNO3	Y	NA
	WSP-CN(T)	250 ML POLY	1	NAOH		
	WSP-LL-H-3	1 LITER POLY	1	NONE		
✓	WSP-TKN+TOC	500 ML AMBER GLASS	1	H2SO4	✓	✓

SAMPLE COMMENTS: Sampled 40 ft. from running diesel generator

LOCATION COMMENTS: slight breeze

## FIELD PARAMETERS:

Sample Time	1017	HH:MM	Dissolved Oxygen	7.19	Flow (in gpm)	3.06
Oxidation-Reduction Potential	227.9		pH	7.73	Specific Conductance	191.6
Temperature	20.9		Turbidity	0.27		

COLLECTED BY (PRINT): K. TOW, D. Hughes

RELINQUISHED BY (Printed Name) (Signature)	Date/Time 8/2/17 1320	RECEIVED BY (Printed Name) (Signature)	Date/Time 8/2/17 1320
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time



## SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11366

EVENT NAME: Mortandad/Sandia (Cr Inv) MY2017 Q4

SAMPLE ID: CAMO-17-142311

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	8/2/17	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1229		MEDIA:	UA	
PRS ID:	OK		SAMPLE TECH CODE:	GSP	
LOCATION ID:	R-45 S2		FIELD PREP:	UF	
LOCATION TYPE:	OK		FIELD QC TYPE:	REG	
TOP DEPTH:	↓		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:		↓	EXCAVATED:		YES / NO / <u>NA</u>

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	MSGP-Hg	1000 500 ML POLY AS 8/2/17	1	HNO3	Y	NA
↓	WSP-CN(T)	250 ML POLY	1	NAOH	↓	↓
↓	WSP-LL-H-3	1 LITER POLY	1	NONE	↓	↓
↓	WSP-TKN+TOC	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS: Sampled 40 ft. from running diesel generator

LOCATION COMMENTS: Breezy while sampling

## FIELD PARAMETERS:

Sample Time	1229	HH:MM	Dissolved Oxygen	6.32	Flow (in gpm)	3.44
Oxidation-Reduction Potential	232.7		pH	8.04	Specific Conductance	173.8
Temperature	21.6		Turbidity	0.33		

COLLECTED BY (PRINT): K. TOLW, D. Hughes

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RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

## SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11366

EVENT NAME: Mortandad/Sandia (Cr Inv) MY2017 Q4

SAMPLE ID: CAMO-17-142312

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	7/28/2017	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1403		MEDIA:	UA	
PRS ID:	NA		SAMPLE TECH CODE:	GSP	
LOCATION ID:	R-50 S1		FIELD PREP:	UF	
LOCATION TYPE:	NA		FIELD QC TYPE:	REG	
TOP DEPTH:	↓	↓	SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / <u>NA</u>

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	MSGP-Hg	1000 500-ML POLY ET 7/28/17	1	HNO3	Y	NA
↓	WSP-CN(T)	250 ML POLY	1	NAOH	↓	↓
↓	WSP-LL-H-3	1 LITER POLY	1	NONE	↓	↓
↓	WSP-TKN+TOC	500 ML AMBER GLASS	1	H2SO4	↓	↓

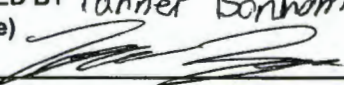

SAMPLE COMMENTS: Sampled 40 ft from running diesel generator  
30

LOCATION COMMENTS: None

## FIELD PARAMETERS:

Sample Time	1403	HH:MM	Dissolved Oxygen	6.61	Flow (in gpm)	2.63
Oxidation-Reduction Potential	215.7		pH	7.69	Specific Conductance	190.1
Temperature	21.3		Turbidity	0.25		

COLLECTED BY (PRINT): T. Bonham &amp; D. Jaramillo

RELINQUISHED BY (Printed Name) (Signature)	Tanner Bonham 	Date/Time 7/28/17 1443	RECEIVED BY (Printed Name) (Signature)	K. Greene 	Date/Time 7/28/17 2:42
RELINQUISHED BY (Printed Name) (Signature)		Date/Time	RECEIVED BY (Printed Name) (Signature)		Date/Time

Report Date: 07/25/2017



## SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11366

EVENT NAME: Mortandad/Sandia (Cr Inv) MY2017 Q4

SAMPLE ID: CAMO-17-142313

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	7/28/17	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1234		MEDIA:	UA	
PRS ID:	NA		SAMPLE TECH CODE:	GSP	
LOCATION ID:	R-50 S2		FIELD PREP:	UF	
LOCATION TYPE:	NA		FIELD QC TYPE:	REG	
TOP DEPTH:			SAMPLE USAGE:	INV	
BOTTOM DEPTH:			EXCAVATED:		YES / NO (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	MSGP-Hg	1000 500 ML POLY ET 7/28/17	1	HNO3	Y	NA
	WSP-CN(T)	250 ML POLY	1	NAOH		
	WSP-LL-H-3	1 LITER POLY	1	NONE		
	WSP-TKN+TOC	500 ML AMBER GLASS	1	H2SO4		

SAMPLE COMMENTS: Samped 30 ft from running diesel generator

LOCATION COMMENTS: None

## FIELD PARAMETERS:

Sample Time	1234	HH:MM	Dissolved Oxygen	7.92	Flow (in gpm)	2.65
Oxidation-Reduction Potential	220.0		pH	7.78	Specific Conductance	136.7
Temperature	20.7		Turbidity	0.30		

COLLECTED BY (PRINT): T. Bonham &amp; T. Vander Vis

RELINQUISHED BY (Printed Name) Tanya Vander Vis (Signature) <i>Tanya Vander Vis</i>	Date/Time 7/28/17 1443	RECEIVED BY (Printed Name) K. Guzman (Signature) <i>K. Guzman</i>	Date/Time 7/28/17 2:43
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

## SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11366

EVENT NAME: Mortandad/Sandia (Cr Inv) MY2017 Q4

SAMPLE ID: CAMO-17-142315

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	8/2/17	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1017 1021 AS 8/2/17		MEDIA:	UA	
PRS ID:	OK		SAMPLE TECH CODE:	GSP	
LOCATION ID:	R-45 S1		FIELD PREP:	UF	
LOCATION TYPE:	OK		FIELD QC TYPE:	FD	
TOP DEPTH:	↓	↓	SAMPLE USAGE:	QC	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	MSGP-Hg	1000 500 ML POLY AS 8/2/17	1	HNO3	Y	NA
↓	WSP-CN(T)	250 ML POLY	1	NAOH	↓	↓
↓	WSP-LL-H-3	1 LITER POLY	1	NONE	↓	↓
↓	WSP-TKN+TOC	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Sample Time \_\_\_\_\_ HH:MM \_\_\_\_\_ Dissolved Oxygen \_\_\_\_\_ Flow (in gpm) \_\_\_\_\_  
 Oxidation-Reduction \_\_\_\_\_ pH \_\_\_\_\_ Specific \_\_\_\_\_  
 Potential \_\_\_\_\_ Conductance \_\_\_\_\_  
 Temperature \_\_\_\_\_ Turbidity \_\_\_\_\_

COLLECTED BY (PRINT): K. TOWNS D. Hughes

RELINQUISHED BY (Printed Name) (Signature)	Date/Time 8/2/17 1320	RECEIVED BY (Printed Name) (Signature)	Date/Time 8/2/17 1320
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

Report Date: 07/25/2017

## DATA VALIDATION REPORT

Chain Of Custody No. 2017-2313

### 1. Distribution Of Samples In EDD.

SDG	Analytical Method	Regular Samples	Field Duplicates	Trip Blanks	Field Blanks	Equipment Blanks
ARS1-17-02341	Generic:Low_Level_Tritium	2				
ARS1-17-02341	Generic:Low_Level_Tritium	2	1			

SDG	Analytical Method	Analysis Lot ID	Prep Lot ID	Regular Samples	Field Duplicates	Trip Blanks	Field Blanks	Equipment Blanks	Method Blanks	Matrix Spikes	Matrix Spike Dups	Analytical Spikes	Post-Digestion Spikes	Lab Control Samples	Lab Control Sample Dups	Blank Spike	Blank Spike Dups	Lab Duplicates	Storage Blanks	Preparation Blanks	Reagent Blanks
ARS1-17-02341	Generic:Low_Level_Tritium	ARS1-B17-	ARS1-B17-	4	1				1					1	1						

### 2. Distribution Of Analytes In EDD.

Analytical Method	Analytical Method Category	Field Sample ID	Lab Sample ID	Sample Purpose	Target Analytes	Surrogates	Spiked Compounds	TICS
Generic:Low_Level_Tritium	RAD	CAMO-17-142310	ARS1-B17-01698-13	REG	1	0	0	0
Generic:Low_Level_Tritium	RAD	CAMO-17-142311	ARS1-B17-01698-15	REG	1	0	0	0
Generic:Low_Level_Tritium	RAD	CAMO-17-142312	ARS1-B17-01698-16	REG	1	0	0	0
Generic:Low_Level_Tritium	RAD	CAMO-17-142313	ARS1-B17-01698-17	REG	1	0	0	0
Generic:Low_Level_Tritium	RAD	CAMO-17-142315	ARS1-B17-01698-14	FD	1	0	0	0
Generic:Low_Level_Tritium	RAD	LCS	ARS1-B17-01698-01	LCS	0	0	1	0
Generic:Low_Level_Tritium	RAD	LCSD	ARS1-B17-01698-02	LCSD	0	0	1	0
Generic:Low_Level_Tritium	RAD	MB	ARS1-B17-01698-03	MB	1	0	0	0

### 3. Are any analytes missing?

No.

### 4. Were any holding times exceeded?

No.

### 5. Any contaminants in blanks?



## DATA VALIDATION REPORT

No.

6. Any surrogate recoveries outside the control limits?

No.

7. Any MS/MSD recoveries or RPDs outside the control limits?

No.

8. Any LCS/LCSD or BS/BSD recoveries or RPDs outside the control limits?

LCS Lab Sample	LCSD Lab	Analytical Method	Parameter Name	Lab Lot ID	Analysis	Sample Matrix	LCS Spike Recovery	LCSD Spike Recovery	Upper Limit	Lower Limit	Upper Rejection Limit	Lower Rejection Limit	RPD	RPD Limit
ARS1-B17-01698-01	ARS1-B17-01698-02	Generic:Low_Level_Tritium	Tritium	ARS1-B17-01698	09-18-2017	W	72.0000	86.0000	120.00	80.000		10	15.804	

9. Any Field Duplicate RPDs outside the desired limits?

No.

10. Any Lab Duplicate RPDs outside the desired limits?

No.

11. Any required reporting limits exceeded?

No.

## DATA VALIDATION REPORT

12. Additional Validator's Comments.

13. Display Flagged Data.

Location ID	COC Number	Field Sample ID	Sample Purpose	Analysis Type Code	Analytical Suite	Analytical Method	Parameter Name	Lab Qualifier	Validation Qualifier	Validation Reason Codes	Detect Flag	Lab Result	Lab Units	Report Result	Report Units	Report MDA	Report Uncertainty	Lab Matrix	Sample Date	Percent	Analysis Lot ID	Validation Status Code	Use Flag
R-45 S1	2017-2313	CAMO-17-142310	REG	INIT	RAD	Generic:Low_Level_Tritium	Tritium	U	U	R5	N	2.279	pCi/L	2.279	pCi/L	2.551	0.865	W	08/02/2017		ARS1-B17-01698	VAL	Y
R-45 S2	2017-2313	CAMO-17-142311	REG	INIT	RAD	Generic:Low_Level_Tritium	Tritium		J-	R12a	Y	3.003	pCi/L	3.003	pCi/L	2.453	0.899	W	08/02/2017		ARS1-B17-01698	VAL	Y
R-50 S1	2017-2313	CAMO-17-142312	REG	INIT	RAD	Generic:Low_Level_Tritium	Tritium		J-	R12a	Y	18.081	pCi/L	18.081	pCi/L	2.148	2.863	W	07/28/2017		ARS1-B17-01698	VAL	Y
R-50 S2	2017-2313	CAMO-17-142313	REG	INIT	RAD	Generic:Low_Level_Tritium	Tritium	U	U	R5	N	-1.454	pCi/L	-1.454	pCi/L	2.747	0.811	W	07/28/2017		ARS1-B17-01698	VAL	Y
R-45 S1	2017-2313	CAMO-17-142315	FD	INIT	RAD	Generic:Low_Level_Tritium	Tritium		J-	R12a	Y	2.751	pCi/L	2.751	pCi/L	2.276	0.831	W	08/02/2017		ARS1-B17-01698	VAL	Y

### Reason Code

### Description

R12a	The LCS percent recovery was <the LAL but >10%. Follow the external laboratory limits located within the associated data package.
R5	Analyte is not detected because the amount reported is less than the MDC.

14. Usable Result Count.

Field Sample ID	Location ID	Sample Purpose	Analytical Method	No. Unuseable Records	Total Records
CAMO-17-142310	R-45 S1	REG	Generic:Low_Level_Tritium	0	1
CAMO-17-142311	R-45 S2	REG	Generic:Low_Level_Tritium	0	1
CAMO-17-142312	R-50 S1	REG	Generic:Low_Level_Tritium	0	1
CAMO-17-142313	R-50 S2	REG	Generic:Low_Level_Tritium	0	1
CAMO-17-142315	R-45 S1	FD	Generic:Low_Level_Tritium	0	1



**ARS International, LLC**

**Laboratory Analysis Report**

**ARS1-17-02341**

*Prepared for:*

**Los Alamos National Laboratory**

**Nita Patel  
P.O. Box 1663  
MS M992  
Los Alamos, NM 87545**

**npatel@lanl.gov  
sherwoods@lanl.gov**

**Phone: 505-665-9273  
Fax: 505-665-9972**

**Project Manager Review**

**Management Review**

Notes: ARS International, LLC assumes no liability for the use or the interpretation of any analytical results provided other than the cost of the analysis itself. Reproduction of this report in less than full requires the written consent of the client.

**Contact Person: Questions regarding this analytical report should be addressed to:**

**Project Manager  
ProjectManagers@amrad.com**

**Phone: 225.381.2991  
Fax: 225.381.2996**







2609 North River Road • Port Allen, Louisiana 70767

1 (800) 401-4277 • Fax (225) 381-2996

September 27, 2017

Nita Patel  
Sherri Sherwood  
Los Alamos National Laboratory  
505-665-9273  
npatel@lanl.gov

ARS SDG: **ARS1-17-02341**  
Project Description: **RN2017-2313**  
Charge Code: **ADEP**

Dear Nita Patel,

On August 4, 2017, ARS International received five (5) samples to be analyzed for Enriched H-3.

The samples were processed and counted using the appropriate equipment and techniques for these types of analyses. Results of all the analyses are attached in the data package.

The client and QA/QC samples were counted with a count time sufficient to meet quality control parameters for counting equipment and were within acceptance criteria and statistical sound detection limits.

If you have any questions, please do not hesitate to call at 255.381.2991 or email [ProjectManagers@amrad.com](mailto:ProjectManagers@amrad.com).

Sincerely,

Susan Leese  
Project Management  
**ARS International**



**PROJECT SAMPLE IDENTIFICATION  
CROSS-REFERENCE  
TO ARS SAMPLE LABORATORY IDs**

Client Sample ID NUMBER	American Radiation Services SAMPLE ID NUMBER(S)
CAMO-17-142310	ARS1-17-02341-001
CAMO-17-142315	ARS1-17-02341-002
CAMO-17-142311	ARS1-17-02341-003
CAMO-17-142312	ARS1-17-02341-004
CAMO-17-142313	ARS1-17-02341-005

**SAMPLE RECEIPT/PREP**

The samples arrived in good condition. The samples were screened for radioactive contamination as per procedure ARS-062 "Sample Receiving". Turnaround time was set at 40 calendar days.

**ANALYTICAL METHODS**

Enriched H-3 analysis was performed using ARS-040, "Tritium Assay in Water Samples Using Electrolytic Enrichment".

Screening analysis was performed using ARS-054, "Tritium in Water (EPA 906.0)".

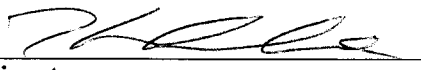
**ANALYTICAL RESULTS**

All QC criteria were met.

**American Radiation Services Project Manager/Laboratory Director's Comments:**

*"I certify that this sample data package is in compliance with SOW requirements, both technically and for completeness, other than the conditions detailed above. Release of the data contained in this sample data package and the computer-readable EDD, as applicable, submitted on diskette or by modem, has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature."*

*"I certify that this electronic image and all hardcopies produced from this image accurately represent the data and is in compliance with client specific requirements, both technically and for completeness, other than the conditions detailed above or in the sample data package narrative. Release, by submission through email, the data contained in this electronic image and the computer-readable EDD (as applicable), has been authorized by the laboratory Manager/Technical Director or the Manager's designee."*

  
Signature

Laboratory Management, ARS International  
Title

9-27-17  
Date



2609 North River Road, Port Allen, Louisiana 70767

1 (800) 401-4277 FAX (225) 381-2996

ARS Sample Delivery Group: ARS1-17-02341

Client Sample ID: CAMO-17-142310

Sample Collection Date: 08/02/17

Sample Matrix: Aqueous

Percent Solids: N/A

Request or PO Number: 2017-2313

ARS Sample ID: ARS1-17-02341-001

Date Received: 08/04/17

Report Date: 09/25/17

## Radiochemistry

Analysis Description	Analysis Results	CSU +/-1s	MDC	DLC	CRDL	Qual	Analysis Units	Method	Analysis Date/Time	Analysis Technician	Tracer/Chem Recovery
Enriched H-3	2.279	0.865	2.551	1.236	3.221	U	pCi/L	ARS-040/	09/21/17 15:17	MMORGAN	N/A

Project Manager Review

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ARS Sample Delivery Group: ARS1-17-02341

Client Sample ID: CAMO-17-142315

Sample Collection Date: 08/02/17

Sample Matrix: Aqueous

Percent Solids: N/A

Request or PO Number: 2017-2313

ARS Sample ID: ARS1-17-02341-002

Date Received: 08/04/17

Report Date: 09/25/17

## Radiochemistry

Analysis Description	Analysis Results	CSU +/-1s	MDC	DLC	CRDL	Qual	Analysis Units	Method	Analysis Date/Time	Analysis Technician	Tracer/Chem Recovery
Enriched H-3	2.751	0.831	2.276	1.103	3.221		pCi/L	ARS-040/	09/21/17 20:59	MMORGAN	N/A

Project Manager Review

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ARS Sample Delivery Group: ARS1-17-02341

Client Sample ID: CAMO-17-142311

Sample Collection Date: 08/02/17

Sample Matrix: Aqueous

Percent Solids: N/A

Request or PO Number: 2017-2313

ARS Sample ID: ARS1-17-02341-003

Date Received: 08/04/17

Report Date: 09/25/17

## Radiochemistry

Analysis Description	Analysis Results	CSU +/-1s	MDC	DLC	CRDL	Qual	Analysis Units	Method	Analysis Date/Time	Analysis Technician	Tracer/Chem Recovery
Enriched H-3	3.003	0.899	2.453	1.189	3.221		pCi/L	ARS-040/	09/22/17 2:41	MMORGAN	N/A

Project Manager Review

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1 (800) 401-4277 FAX (225) 381-2996

ARS Sample Delivery Group: ARS1-17-02341  
Client Sample ID: CAMO-17-142312  
Sample Collection Date: 07/28/17  
Sample Matrix: Aqueous  
Percent Solids: N/A

Request or PO Number: 2017-2313  
ARS Sample ID: ARS1-17-02341-004  
Date Received: 08/04/17  
Report Date: 09/25/17

## Radiochemistry

Analysis Description	Analysis Results	CSU +/-1s	MDC	DLC	CRDL	Qual	Analysis Units	Method	Analysis Date/Time	Analysis Technician	Tracer/Chem Recovery
Enriched H-3	18.081	2.863	2.148	1.041	3.221		pCi/L	ARS-040/	09/22/17 8:23	MMORGAN	N/A

Project Manager Review

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1 (800) 401-4277 FAX (225) 381-2996

ARS Sample Delivery Group: ARS1-17-02341

Client Sample ID: CAMO-17-142313

Sample Collection Date: 07/28/17

Sample Matrix: Aqueous

Percent Solids: N/A

Request or PO Number: 2017-2313

ARS Sample ID: ARS1-17-02341-005

Date Received: 08/04/17

Report Date: 09/25/17

## Radiochemistry

Analysis Description	Analysis Results	CSU +/-1s	MDC	DLC	CRDL	Qual	Analysis Units	Method	Analysis Date/Time	Analysis Technician	Tracer/Chem Recovery
Enriched H-3	-1.454	0.811	2.747	1.331	3.221	U	pCi/L	ARS-040/	09/22/17 14:05	MMORGAN	N/A

Project Manager Review

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## QC Results per Analytical Batch

Analytical Batch	ARS1-B17-01698
SDG	ARS1-17-02341
Analysis	Low Level Tritium by Electrolytic Enrichment
Analysis Test Method	ARS-040/
Analysis Code	LSC-LLH3-AQ
Report Units	pCi/L

### Acceptable QC Performance Ranges

QC Sample Type	Performance Items and Ranges		
Laboratory Control Sample	Recovery (%):	> 80	< 120
Matrix Spike	Recovery (%):	> 60	< 140
Duplicate	Replicate Error Ratio (RER):	< 1	
	Duplicate Error Ratio (DER):	< 3	
	Relative Percent Difference (RPD %):	≤ 25	

<b>Laboratory Control Sample</b>			Analysis Date	09/19/17 00:37	Analysis Technician	MMORGAN	
Analysis Batch Sample ID	QC Type	Analyte	Results	CSU (1s)	Expected Value	LCS Rec (%)	MDC
ARS1-B17-01698-02	LCSD	ENRICHED H-3	28.620	4.460	33.182	86.3	2.638

<b>Duplicate RER/DER/RPD</b>			Analysis Date	09/19/17 00:37	Analysis Technician	MMORGAN	
Analyte	Results LCS	CSU LCS (1s)	Results LCSD	CSU LCSD (1s)	RER	DER	RPD
ENRICHED H-3	24.428	3.831	28.620	4.460	0.506	0.713	15.8

<b>Method Blank</b>			Analysis Date	09/19/17 06:19	Analysis Technician	MMORGAN	
Analysis Batch Sample ID	QC Type	Analyte	Results	CSU (1s)	MDC	Qual	
ARS1-B17-01698-03	MBL	ENRICHED H-3	-1.618	0.751	2.521	U	

Project Manager Review

Notes: American Radiation Services, Inc. assumes no liability for the use or interpretation of any analytical results provided other than the cost of the analysis itself. Reproduction of this report in less than full requires the written consent of the client.

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## Notes (Case Narrative):

### Comments:

- 1.0) All MDA/MDC values are calculated on a sample specific basis.
- 2.0) Soil and Sludge analysis are reported on a wet basis or an as received basis unless otherwise indicated.
- 3.0) Data in this report are within the limits of uncertainty specified in the reference method unless otherwise specified.
- 4.0) Modified analysis procedures are procedures that are modified to meet the certain specifications. An example may be the use of a water method to analyze a solid matrix due to the lack of an officially recognized procedure for the analysis of the solid matrix. Modified analyses are indicated by the subsequent addition of "m" to the procedure number (i.e. 900.0M).
- 5.0) Total activity is actually total gamma activity and is determined utilizing the prominent gamma emitters from the naturally occurring radioactive decay chains and other prominent radioactive nuclides. Total activity may be lower than the actual total activity due to the extent of secular equilibrium achieved in the various decay chains at the time of analysis. The total activity is not representative of nuclides that emit solely alpha or beta particles.
- 6.0) Ra-228 is determined via secular equilibrium with its daughter, Actinium 228 (Gamma Spectroscopy only).
- 7.0) U-238 is determined via secular equilibrium with its daughter, Thorium 234 (Gamma Spectroscopy only).
- 8.0) All gamma spectroscopy was performed utilizing high purity germanium detectors (**HPGe**).
- 9.0) ARS makes every attempt to match sample density to calibrated density; however, in some cases, it is not practical or possible to do so and data results may be affected (Gamma Spectroscopy only).
- 10.0) Gamma spectroscopy results are calculated values based on the **ORTEC**® GammaVision ENV32 Analysis Engine.
- 11.0) ACLASS DOD and ISO 17025 certification applies only to the following analytes and methods: Gross Alpha and Gross Beta (EPA 900, SM7110B&C, SW846 9310); Radium 226 (EPA 903, EPA 903.1, SM 7500 Ra-B, SW846 9315); Radium 228 (EPA 904, SM 7500 Ra-B SW846 9320); Iodine-131 (EPA 901.1); Uranium by ICPMS (EPA 200.8); Strontium 89/90 (EPA 905, Eichrom SRW01, HASL 300 Sr-03-RC); Tritium (EPA 906, EPA 906M); Gamma Emitters (EPA 901.1, SM7120B, HASL 300 Ga-01-R); Americium-241, Curium 242/244, Plutonium 239/240 and 241, Thorium 228/230/232, Uranium 234/233 and 238 (Eichrom ACW03 VBS); Lead 210 (HASL 300 Pb-01-RC, Eichrom OTW01); Polonium 210 (HASL 300 Po-01-RC, HASL 300 Po-02-RC); Technetium-99 (Eichrom TCW02, Eichrom TCS01M).

### Method References:

- 1.0) **EPA 600/4-80-032**; Prescribed Procedures for the Measurements of Radioactivity in Drinking Water, August 1980.
- 2.0) **Standard Methods for the Examination of Water and Wastewater** (On-Line Edition)
- 3.0) **EPA SW-846**; Test Methods for Evaluating Solid Waste, (On-Line edition)
- 4.0) **EPA 600/4-79-020**; Methods for Chemical Analysis of Water and Waste, March 1983.
- 5.0) **HASL 300**; The Procedures Manual of the Environmental Measurements Laboratory, Volume I, 28th Edition February, 1997.

### Definitions:

<b>CRDL</b>	Contract Required Detection Limit
<b>CSU</b>	Combined Standard Uncertainty
<b>DLC</b>	Decision Level Concentration (ANSI N42.23) or critical level
<b>DO</b>	Duplicate Original
<b>DUP</b>	Method Duplicate
<b>LCS/LCSD</b>	Laboratory Control Sample/Laboratory Control Sample Duplicate
<b>MDA</b>	Minimum Detectable Activity
<b>MDC</b>	(Minimum Detectable Concentration) minimum concentration of the analyte that ARS can detect utilizing the specific analysis
<b>MBL</b>	Method Blank
<b>MS/MSD</b>	Matrix Spike/Matrix Spike Duplicate
<b>N/A</b>	Not Applicable
<b>NP</b>	Not Provided
<b>NR</b>	Not Referenced
<b>LOD</b>	Limit of Detection
<b>LOQ</b>	Limit of Quantitation

### Data Qualifiers:

<b>B</b>	The analyte is found in both the associated method blank and the sample. This flag indicates probable blank contamination.
<b>D</b>	Sample analysis accomplished through dilution.
<b>J</b>	The reported result is an estimated value above the limit of detection but outside of quantitation range (e.g., matrix interference was observed).
<b>Q</b>	One or more quality control criteria failed (e.g., LCS recovery, surrogate spike recovery, or CCV recovery).
<b>U</b>	Activity is below the MDC, MDA, MDL, or LOD
<b>N</b>	The analyte is a tentatively identified compound using mass spectrometry or any non-customer requested compounds that are tentatively identified.
<b>*</b>	LCS/LCSD or MS/MSD fails RPD criteria.
<b>S</b>	Spike
<b>SC</b>	Subcontracted out to another qualified laboratory
<b>H</b>	Holding time exceeded

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