

**LABORATORY DATA CONSULTANTS, INC.**

7750 El Camino Real, Suite 2L Carlsbad, CA 92009 Phone: 760/634-0437 Fax: 760/634-0439

Northgate Environmental Management, Inc.  
1100 Quail Street Ste. 102  
New Port beach, CA 92660  
ATTN: Ms. Cindy Arnold

January 11, 2010

SUBJECT: Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada, Data Validation

Dear Ms. Arnold,

Enclosed are the revised data validation reports for the fractions listed below. Please replace the previously submitted reports & associated CD with the enclosed revised reports and CD.

**LDC Project # 21990:**

**SDG #**

**Fraction**

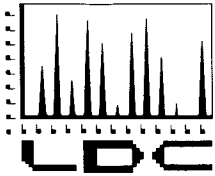
237785, 237885

Isotopic Uranium & Isotopic Thorium

Please feel free to contact us if you have any questions.

Sincerely,

Erlinda T. Rauto  
Operations Manager/Senior Chemist



**LABORATORY DATA CONSULTANTS, INC.**

7750 El Camino Real, Suite 2L Carlsbad, CA 92009 Phone: 760/634-0437 Fax: 760/634-0439

Northgate Environmental Management, Inc.  
1100 Quail Street Ste. 102  
Newport Beach, CA 92660  
ATTN: Ms. Cindy Arnold

December 15, 2009

SUBJECT: Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada, Data Validation

Dear Ms. Arnold,

Enclosed are the final validation reports for the fractions listed below. These SDGs were received on November 10, 2009. Attachment 1 is a summary of the samples that were reviewed for each analysis.

**LDC Project # 21990:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
233580, 233776, 234964 235177, 235208, 235782 235860, 236043, 237785 237795, 237885, 238405 238477	Radium-226 & Radium-228, Isotopic Uranium & Isotopic Thorium

The data validation was performed under Stage 2B & 4 guidelines. The analyses were validated using the following documents, as applicable to each method:

- Standard Operating Procedures (SOP) 40, Data Review/Validation, BRC 2009
- Quality Assurance Project Plan Tronox LLC Facility, Henderson Nevada, June 2009
- NDEP Guidance, May 2006
- Multi Agency Radiological Laboratory Analytical Protocols (MARLAP) Manual, July 2004
- USEPA, Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004

Please feel free to contact us if you have any questions.

Sincerely,

Erlinda T. Rauto  
Operations Manager/Senior Chemist

LDC #21990 (Tronox LLC-Northgate, Henderson NV / Tronox Phase B 2009)

Stage 2B/4

LDC	SDG#	DATE REC'D	(3) DATE DUE	Ra-226 (903.1)		Ra-228 (904.0)		Iso. Th (300)		Iso. U (300)		W		S		W		S		W		S		W		S		W		S		W		S			
				W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S		
Matrix: Water/Soil																																					
A	233580	11/10/09	12/14/09	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0	13	0		
B	233776	11/10/09	12/14/09	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0		
C	234964	11/10/09	12/14/09	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	
D	235177	11/10/09	12/14/09	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	
E	235208	11/10/09	12/14/09	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	19	1	
F	235782	11/10/09	12/14/09	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	17	1	
G	235860	11/10/09	12/14/09	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	20	1	
H	236043	11/10/09	12/14/09	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	
I	237785	11/10/09	12/14/09	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	
J	237795	11/10/09	12/14/09	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	
K	237885	11/10/09	12/14/09	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0	8	0
L	238405	11/10/09	12/14/09	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	17	2	
M	238477	11/10/09	12/14/09	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	
Total				35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	162	35	
T/LR																																					

EDD CHECKLIST

.DC #: 21990  
 IDG #: 233580, 233776, 234964, 235177,  
235208, 235782, 235860, 236043,  
237785, 237795, 237885, 238405, 238477

Tronox Northgate Henderson Worksheet

EDD Area	Yes	No	NA	Findings/Comments
<b>I. Completeness</b>				
Is there an EDD for the associated Tronox validation report?	X			
<b>II. EDD Qualifier Population</b>				
Were all qualifiers from the validation report populated into the EDD?	X			
<b>III. EDD Lab Anomalies</b>				
Were EDD anomalies identified?	X			
If yes, were they corrected or documented for the client?	X			See EDD_discrepancy_ form LDC21990_121109.doc
<b>IV. EDD Delivery</b>				
Was the final EDD sent to the client?	X			

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Data Validation Reports  
LDC #21990**

Radium-226 & Radium-228

**LDC**

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** July 15 through July 27, 2009

**LDC Report Date:** December 11, 2009

**Matrix:** Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 233580

### Sample Identification

M-92BDISS  
M-97B  
TR-6B  
EB-071709-GW  
M-33B  
CLD-4RB  
MW-6RB  
M-52B  
M-35B  
M-11B  
M-11BDISS  
M-11009B  
M-11009BDISS  
M-92BDISSMS  
M-92BDISSDUP

## Introduction

This data review covers 15 water samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB-071709-GW was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Sample FB080409-GW (from SDG 233776) was identified as a field blank. No radium-226 or radium-228 was found in this blank with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080409-GW	8/4/09	Radium-228 Radium-226	2.33 pCi/L 0.396 pCi/L	M-97B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified with the following exceptions:

Sample	Isotope	Reported Activity	Modified Final Activity
M-97B	Radium-226	0.605 pCi/L	1.00U pCi/L

Sample MC-3B-Filt (from SDG 230340) was identified as a filter blank. No radium-226 or radium-228 was found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
MC-3B-Filt	5/21/09	Radium-228	3.35 pCi/L	M-92BDISS M-11BDISS M-11009BDISS

Sample concentrations were compared to concentrations detected in the filter blanks as required by the QAPP. No sample data was qualified.

Sample PB100209-A2 (from SDG 237885) was identified as a pump blank. No radium-226 or radium-228 was found in this blank.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

##### c. Chemical Recovery

All chemical recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs.

#### VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 233580	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples M-11B and M-11009B and samples M-11BDISS and M-11009BDISS were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-11BDISS	M-11009BDISS				
Radium-228	2.46	0.283U	-	2.177 ( $\leq 3.00$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 233580**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
233580	M-92BDISS M-97B TR-6B EB-071709-GW M-33B CLD-4RB MW-6RB M-52B M-35B M-11B M-11BDISS M-11009B M-11009BDISS	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 233580**

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
233580	M-97B	Radium-226	1.00U pCi/L	A	bf

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Filter Blank Data Qualification Summary - SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Pump Blank Data Qualification Summary - SDG 233580**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990A29  
 SDG #: 233580  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET

Stage 2B

Date: 11-20-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>7-15-09 through 7-27-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVb.	Laboratory control samples	A	<u>LCS</u>
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	<u>D = 10*12, D = 11+13</u>
XIV.	Field blanks	SW	<u>EB = *4, FB = FB080409-GW (SDG: 233776)</u>

Pump Blank = \*PB100209-A2 (SDG: 237835)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples: all water

Filter Blank = MC-3B-Filt (SDG: 230340)

1	M-92BDISS	11	M-11BDISS	21		31	
2	M-97B	12	M-11009B	22		32	
3	TR-6B	13	M-11009BDISS	23		33	
4	EB-071709-GW	14	M-92BDISSMS <sup>226 228</sup>	24		34	
5	M-33B	15	M-92BDISSDUP <sup>226 228</sup>	25		35	
6	CLD-4RB	16	<u>PBW</u>	26		36	
7	MW-6RB	17		27		37	
8	M-52B	18		28		38	
9	M-35B	19		29		39	
10	M-11B	20		30		40	

Notes: \_\_\_\_\_

LDC #: 21990A29  
 SDG #: 233580

**VALIDATION FINDINGS WORKSHEET**  
**Field Blanks**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:    

METHOD: Radiochemistry (Method: see cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
 Blank units: pci/L Associated sample units: pci/L  
 Sampling date: 8-4-09

Qual: U bf

Field blank type: (circle one) Field Blank Rinsate / Other:     Associated Samples: 2

Analyte	Blank ID	Blank Action Limit	Sample Identification																	
<u>Ra-228</u>	<u>409-GW</u>	<u>2.33</u>	<u>2</u>																	
<u>Ra-226</u>	<u>0.396</u>	<u>0.605/1.00</u>																		

Blank units:     Associated sample units:      
 Sampling date:      
 Field blank type: (circle one) Field Blank / Rinsate / Other:     Associated Samples:    

Analyte	Blank ID	Blank Action Limit	Sample Identification																	

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990A29  
 SDG #: 233580

**VALIDATION FINDINGS WORKSHEET**  
Field Blanks

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: L

METHOD: Radiochemistry (Method: see cover)

Y/N N/A Were field blanks identified in this SDG?  
X/N N/A Were target isotopes detected in the field blanks?  
 Blank units: Pci/L Associated sample units: Pci/L  
 Sampling date: 5-21-09

Qual: J+ br

Field blank type: (circle one) Filter Blank / Rinsate / Other Associated Samples: 1, 11, 13 (all diss.) (< RL or N.D.)

Analyte	Blank ID	Blank Action Limit	Sample Identification												
<u>MC-238</u>	<u>3B-Filt</u>		<u>+</u>	<u>No</u>	<u>Samples</u>	<u>were</u>	<u>qualified</u>								
Ra-228	3.35	33.50													

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
 Sampling date: \_\_\_\_\_  
 Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_

Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification												

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990A29  
 SDG #: 233580

VALIDATION FINDINGS WORKSHEET  
Field Duplicates

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?

Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/L )		by difference RPD
	11	13	
Ra-228	2.46	0.283 U	2.177 ( $\leq 3.00$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** July 20 through August 4, 2009

**LDC Report Date:** December 1, 2009

**Matrix:** Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 233776

### Sample Identification

M-77B  
M-77BDISS  
M-50B  
M-31-AB  
M-31-ABDISS  
M-21B  
FB080409-GW  
M-77BMS  
M-77BDUP

## **Introduction**

This data review covers 9 water samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UJ Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample FB080409-GW was identified as a field blank. No radium-226 or radium-228 was found in this blank with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080409-GW	8/4/09	Radium-228 Radium-226	2.33 pCi/L 0.396 pCi/L	M-21B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified with the following exceptions:

Sample	Isotope	Reported Activity	Modified Final Activity
M-21B	Radium-226	0.716 pCi/L	1.00U pCi/L

Sample MC-3B-Filt (from SDG 230340) was identified as a filter blank. No radium-226 or radium-228 was found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
MC-3B-Filt	5/21/09	Radium-228	3.35 pCi/L	M-77BDISS M-31-ABDISS

Sample concentrations were compared to concentrations detected in the filter blanks as required by the QAPP. No sample data was qualified.

Sample PB100209-A2 (from SDG 237885) was identified as a pump blank. No radium-226 or radium-228 was found in this blank.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

##### c. Chemical Recovery

All chemical recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs.

#### VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 233776	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## **VII. Overall Assessment of Data**

Data flags are summarized at the end of this report if data has been qualified.

## **VIII. Field Duplicates**

No field duplicates were identified in this SDG.

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 233776**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
233776	M-77B M-77BDISS M-50B M-31-AB M-31-ABDISS M-21B FB080409-GW	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 233776**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 233776**

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
233776	M-21B	Radium-226	1.00U pCi/L	A	bf

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Filter Blank Data Qualification Summary - SDG 233776**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Pump Blank Data Qualification Summary - SDG 233776**


No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990B29  
 SDG #: 233776  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET

Stage 2B

Date: 11-20-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: 

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 7-20-09 through 8-4-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	9mB ASW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	A	LCS
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	N	
XIV.	Field blanks	SW	FB = 7

Pump Blank = \*PB100209-A2 (SDG: 237885)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:  
 all water

Filter Blank = MC-3B-Filt (SDG: 230340)

1	M-77B	11		21		31	
2	M-77BDISS	12		22		32	
3	M-50B	13		23		33	
4	M-31-AB	14		24		34	
5	M-31-ABDISS	15		25		35	
6	M-21B	16		26		36	
7	FB080409-GW	17		27		37	
8	M-77BMS 226 228	18		28		38	
9	M-77BDUP 226 228	19		29		39	
10	PBW	20		30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



LDC #: 21990B29  
SDG #: 233776

# VALIDATION FINDINGS WORKSHEET Field Blanks

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: *W*

METHOD: Radiochemistry (Method): See cover

N/A Were field blanks identified in this SDG?  
 N/A Were target isotopes detected in the field blanks?  
Blank units: pCi/L Associated sample units: pCi/L  
Sampling date: 8-4-09

*Qual: U bf*

Field blank type: (circle one)  Field Blank  Rinsate / Other: 6 Associated Samples: 6

Analyte	Blank ID	Blank Action Limit	Sample Identification
	7		
Ra-228	2.33		
Ra-226	0.396	0.716/1.00	

*RL*  
*RL*

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
Sampling date: \_\_\_\_\_  
Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990B29  
 SDG #: 233776

# VALIDATION FINDINGS WORKSHEET

## Field Blanks

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: (Signature)

METHOD: Radiochemistry (Method: SEE COVER)

N  N/A  
 N  N/A  
 Were field blanks identified in this SDG? Yes  
 Were target isotopes detected in the field blanks? Yes  
 Blank units: PC/L Associated sample units: PC/L  
 Sampling date: 5-21-09

Qual: J+ br

Field blank type: (circle one) Field Blank / Rinsate / **Other** Filter Blank Associated Samples: 2, 5 (all diss.) (N.D.)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified
<u>MG-3B-Filt</u>				
Ra-228	3.35	33.50		

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
 Sampling date: \_\_\_\_\_  
 Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 7 through August 10, 2009

**LDC Report Date:** December 1, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 234964

### Sample Identification

RSAM8-10B	SA92-10BMS
RSAM8-20B	SA92-10BDUP
RSAM8009-20B	EB081009-SO2MS
RSAM8-31B	EB081009-SO2DUP
SA62-10B	
SA62-24B	
SA144-10B	
SA144009-10B	
SA144-28B	
SA92-10B	
SA92-20B	
SA92-31B	
SA119-0.5B	
SA119-10B	
SA119-30B	
SA119-48B	
SA158-10B	
SA158-20B	
SA158-31B	
EB081009-SO2	

## Introduction

This data review covers 21 soil samples and 3 water samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UJ Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB081009-SO<sub>2</sub> was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
SA92-10BDUP (RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA158-10B SA158-20B SA158-31B)	Radium-226	-	0.826 pCi/g (≤0.50)	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### c. Chemical Recovery

All chemical recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
RSAM8-20B	Radium-228	0.618	0.5	None	P
SA62-10B	Radium-228	0.600	0.5	None	P
SA144-10B	Radium-228	0.731	0.5	None	P
SA144009-10B	Radium-228	0.719	0.5	None	P
SA119-30B	Radium-228	0.570	0.5	None	P

The MDA was greater than the PQL as listed above.

### V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 234964	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples RSAM8-20B and RSAM8009-20B and samples SA144-10B and SA144009-10B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAM8-20B	RSAM8009-20B				
Radium-228	0.671	1.06	-	0.389 ( $\leq 0.50$ )	-	-
Radium-226	1.61	1.04	-	0.57 ( $\leq 0.50$ )	J (all detects)	A

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA144-10B	SA144009-10B				
Radium-228	1.01	0.991	-	0.019 ( $\leq 0.50$ )	-	-
Radium-226	1.24	0.788	-	0.452 ( $\leq 0.50$ )	-	-



**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 234964**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
234964	RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA158-10B SA158-20B SA158-31B	Radium-226	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
234964	RSAM8-20B SA62-10B SA144-10B SA144009-10B SA119-30B	Radium-228	None	P	Minimum detectable activity (PQL)
234964	RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA119-0.5B SA119-10B SA119-30B SA119-48B SA158-10B SA158-20B SA158-31B EB081009-SO2	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
234964	RSAM8-20B RSAM8009-20B	Radium-226	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 234964**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG  
234964**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 234964**

No Sample Data Qualified in this SDG

Tronex Northgate Henderson

LDC #: 21990C29

VALIDATION COMPLETENESS WORKSHEET

Date: 11-20-09

SDG #: 237964 234964

Stage 2B

Page: 1 of 1

Laboratory: GEL Laboratories LLC

Reviewer: MG

2nd Reviewer:                     

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 8-7-09 through 8-10-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	MS/DUP
IVb.	Laboratory control samples	A	LCS
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D=2+3, D=7+8
XIV.	Field blanks	ND	EB=20, FB=FB072909-50 (SDG:234267) FB=FB080309-50 (SDG:234414)

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:

1	RSAM8-10B	S	11	SA92-20B	S	21	SA92-10BMS <sup>226 228</sup>	S	31
2	RSAM8-20B		12	SA92-31B		22	SA92-10BDUP <sup>226 228</sup>	↓	32
3	RSAM8009-20B		13	SA119-0.5B		23	EB081009-SO2MS <sup>226 228</sup>	W	33
4	RSAM8-31B		14	SA119-10B		24	EB081009-SO2DUP <sup>226 228</sup>	↓	34
5	SA62-10B		15	SA119-30B		25	PBS		35
6	SA62-24B		16	SA119-48B		26	PBW		36
7	SA144-10B		17	SA158-10B		27			37
8	SA144009-10B		18	SA158-20B		28			38
9	SA144-28B		19	SA158-31B		29			39
10	SA92-10B		20	EB081009-SO2	W	30			40

Notes:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

VALIDATION FINDINGS WORKSHEET  
 Duplicate Analysis

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a duplicate sample analyzed the required frequency of 5% in this SDG? Act = sample activity  $\delta = 1$  sigma error  
 Y N N/A Were all duplicate sample duplicate error ratio (DER)  $\leq 1.42$ ?  $DER = \frac{|Act_1 - Act_2|}{2 \sqrt{\delta_1^2 + \delta_2^2}} \cdot 1/2$

LEVEL IV ONLY:  
 Y N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Duplicate ID	Matrix	Isotope	by difference DER (Limits)		Associated Samples	Qualifications
1	22	soil	Ra-226	0.826	PC/g ( $\leq 0.50$ )	1 $\rightarrow$ 12, 17 $\rightarrow$ 19	J/US/A Id

Comments: \_\_\_\_\_

VALIDATION FINDINGS WORKSHEET  
Minimum Detectable Activities

METHOD: Radiochemistry (Method: SEE COVER)

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP POL RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	2	Ra-228	0.5 (pci/g)	0.618 (pci/g)	Lab DL > GAPP POL	None / P
2	5			0.600		
3	7			0.731		
4	8			0.719		
5	15			0.570		

Comments:

LDC #: 21990C29  
 SDG #: 234964

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

- N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity (Pci/g)		by difference Qual parent only RPD
	2	3	
Ra-228	0.671	1.06	0.389 ( $\leq 0.50$ )
Ra-226	1.61	1.04	0.57 ( $\downarrow$ ) Jdets/A f

Isotopes	Activity (Pci/g)		by difference RPD
	7	8	
Ra-228	1.01	0.991	0.019 ( $\leq 0.50$ )
Ra-226	1.24	0.788	0.452 ( $\downarrow$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 11, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235177

### Sample Identification

SA107-0.5B	EB081109-SO
SA107-10B	RSAU6-0.5BMS
SA107009-10B	RSAU6-0.5BDUP
SA107-29B	
SA61-10B	
SA61-30B	
SA155-0.5B	
SA155009-0.5B	
SA155-10B	
SA155-30B	
SA115-0.5B	
SA115-10B	
SA115009-10B	
SA115-25B	
SA115-40B	
SA115-51B	
RSAU6-0.5B	
RSAU6-10B	
RSAU6-25B	
RSAU6-40B	

## Introduction

This data review covers 22 soil samples and one water sample listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.



The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB081109-SO1 was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
RSAU6-0.5BDUP (SA115-0.5B SA115-10B SA115009-10B SA115-25B SA115-40B SA115-51B RSAU6-0.5B RSAU6-10B RSAU6-25B RSAU6-40B)	Radium-226	-	0.558 pCi/g ( $\leq 0.50$ )	J (all detects) JJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

### c. Chemical Recovery

All chemical recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs.

### V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235177	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

### VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

### VIII. Field Duplicates

Samples SA107-10B and SA107009-10B, samples SA155-0.5B and SA155009-0.5B, and samples SA115-10B and SA115009-10B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA107-10B	SA107009-10B				
Radium-228	0.618	0.837	-	0.219 ( $\leq 0.50$ )	-	-
Radium-226	1.51	1.84	-	0.33 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA155-0.5B	SA155009-0.5B				
Radium-228	1.21	0.768	-	0.442 ( $\leq 0.50$ )	-	-
Radium-226	1.09	0.789	-	0.301 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA115-10B	SA115009-10B				
Radium-228	0.701	0.955	-	0.254 ( $\leq 0.50$ )	-	-
Radium-226	1.28	1.72	-	0.44 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 235177**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235177	SA115-0.5B SA115-10B SA115009-10B SA115-25B SA115-40B SA115-51B RSAU6-0.5B RSAU6-10B RSAU6-25B RSAU6-40B	Radium-226	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
235177	SA107-0.5B SA107-10B SA107009-10B SA107-29B SA61-10B SA61-30B SA155-0.5B SA155009-0.5B SA155-10B SA155-30B SA115-0.5B SA115-10B SA115009-10B SA115-25B SA115-40B SA115-51B RSAU6-0.5B RSAU6-10B RSAU6-25B RSAU6-40B EB081109-SO	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 235177**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 235177**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 235177**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

VALIDATION COMPLETENESS WORKSHEET

LDC #: 21990D29

SDG #: 235177

Laboratory: GEL Laboratories LLC

Stage 2B

Date: 12-1-09

Page: 1 of 1

Reviewer: MG

2nd Reviewer: ✓

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 8-11-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	MS/DUP
IVb.	Laboratory control samples	A	LCS/LCSD
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D=2+3, D=7+8, D=12+13
XIV.	Field blanks	ND	EB=21 FB=FB072909-50 (SDG: 234267)

FB = FB080309-50 (SDG: 234414)

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:

1	SA107-0.5B	S	11	SA115-0.5B	S	21 <sup>2</sup>	EB081109-SO	W	31
2	SA107-10B		12	SA115-10B		22	RS AU6-0.5BMS <sup>226 228</sup>	S	32
3	SA107009-10B		13	SA115009-10B		23	RS AU6-0.5BDUP <sup>226 228</sup>	↓	33
4	SA107-29B		14	SA115-25B		24 <sup>1</sup>	PBS		34
5	SA61-10B		15	SA115-40B		25 <sup>2</sup>	PBW		35
6	SA61-30B		16	SA115-51B		26			36
7	SA155-0.5B		17	RS AU6-0.5B		27			37
8	SA155009-0.5B		18	RS AU6-10B		28			38
9	SA155-10B		19	RS AU6-25B		29			39
10	SA155-30B	↓	20	RS AU6-40B	↓	30			40

Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**VALIDATION FINDINGS WORKSHEET**

Duplicate Analysis

METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a duplicate sample analyzed the required frequency of 5% in this SDG?  
Y N N/A Were all duplicate sample duplicate error ratio (DER) ≤ 1.42?  $DER = \frac{|\text{Act}_1 - \text{Act}_2|}{2 \sqrt{\delta_1^2 + \delta_2^2}}^{1/2}$  Act = sample activity δ = 1 sigma error

LEVEL IV ONLY:  
Y N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Duplicate ID	Matrix	Isotope	DER (Limits)	Associated Samples	Qualifications
1	23	soil	Ra-226	by difference 0.558 pc/g (±0.50)	QA <del>soil</del> 11 → 20	J/UJ/A 1d

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990D29  
 SDG #: 235177

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: ✓

METHOD: Radiochemistry (Method: see cover)

N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference
	2	3	<del>RPD</del>
Ra-228	0.618	0.837	0.219 ( $\leq 0.50$ )
Ra-226	1.51	1.84	0.33 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference
	7	8	<del>RPD</del>
Ra-228	1.21	0.768	0.442 ( $\leq 0.50$ )
Ra-226	1.09	0.789	0.301 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference
	12	13	<del>RPD</del>
Ra-228	0.701	0.955	0.254 ( $\leq 0.50$ )
Ra-226	1.28	1.72	0.44 ( ↓ )

Isotopes	Activity ( )		RPD



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 11 through August 20, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235208

### Sample Identification

RSAU6-53B	SA70-10BMS
SA86-10B	SA70-10BDUP
SA86009-10B	
SA86-28B	
RSAM6-10B	
RSAM6-28B	
RSAM6009-28B	
SA70-10B	
SA70-30B	
SA167-0.5B	
SA167-10B	
SA167009-10B	
SA167-28B	
EB081909-SO1	
SA197-10B	
SA197009-10B	
SA197-21B	
SA104-10B	
SA104009-10B	
SA104-30B	

## Introduction

This data review covers 21 soil samples and one water sample listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB081909-SO1 was identified as an equipment blank. No radium-226 or radium-228 was found in these blanks.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

### **b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Although the LCS/LCSD relative percent difference (RPD) was not within QC limits for one isotope, the LCS/LCSD percent recoveries (%R) were within QC limits and no data were qualified.

### c. Chemical Recovery

All chemical recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAM6-28B	Radium-228	0.635	0.50	None	P
SA167-0.5B	Radium-228	0.567	0.50	None	P
SA167-10B	Radium-228	0.533	0.50	None	P
SA167-28B	Radium-228	0.624	0.50	None	P
SA197-21B	Radium-228	0.538	0.50	None	P
SA104-10B	Radium-228	0.681	0.50	None	P
SA104009-10B	Radium-228	0.667	0.50	None	P

The MDA was greater than the PQL as listed above.

### VI. Sample Result Verification and Project Quantitation Limit

All sample result verifications were acceptable.

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235208	All isotopes reported below the PQL.	J (all detects)	A

### VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA86-10B and SA86009-10B, samples RSAM6-28B and RSAM6009-28B, samples SA167-10B and SA167009-10B, samples SA197-10B and SA197009-10B, and samples SA104-10B and SA104009-10B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA86-10B	SA86009-10B				
Radium-228	0.912	1.03	-	0.118 ( $\leq 0.50$ )	-	-
Radium-226	1.04	1.59	-	0.55 ( $\leq 0.50$ )	J (all detects)	A

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAM6-28B	RSAM6009-28B				
Radium-228	0.980	0.965	-	0.015 ( $\leq 0.50$ )	-	-
Radium-226	1.95	1.56	-	0.39 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA167-10B	SA167009-10B				
Radium-228	1.20	1.10	-	0.10 ( $\leq 0.50$ )	-	-
Radium-226	2.09	1.59	-	0.50 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA197-10B	SA197009-10B				
Radium-228	1.35	1.65	-	0.30 ( $\leq 0.50$ )	-	-
Radium-226	1.88	1.58	-	0.30 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA104-10B	SA104009-10B				
Radium-228	1.17	1.19	-	0.02 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA104-10B	SA104009-10B				
Radium-226	0.931	0.793	-	0.138 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 235208**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235208	RSAM6-28B SA167-0.5B SA167-10B SA167-28B SA197-21B SA104-10B SA104009-10B	Radium-228	None	P	Minimum detectable activity (PQL)
235208	RSAU6-53B SA86-10B SA86009-10B SA86-28B RSAM6-10B RSAM6-28B RSAM6009-28B SA70-10B SA70-30B SA167-0.5B SA167-10B SA167009-10B SA167-28B EB081909-SO1 SA197-10B SA197009-10B SA197-21B SA104-10B SA104009-10B SA104-30B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
235208	SA86-10B SA86009-10B	Radium-226	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 235208**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 235208**

No Sample Data Qualified in this SDG



**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 235208**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990E29  
 SDG #: 235208  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**

Stage 4

Date: 12-1-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: \_\_\_\_\_

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-11-09 through 8-20-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	SW	LCS/LCSD
IVc.	Chemical recovery	A	
V.	Sample result verification	A	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D=2+3, D=6+7, D=11+12, D=15+16, D=18+19
XIV.	Field blanks	ND	EB= <u>14</u> , FB= <u>FB072909-SO (SDG:234267)</u>

FB= FB080309-SO (SDG:234414)

Note: A = Acceptable      ND = No compounds detected      D = Duplicate  
 N = Not provided/applicable      R = Rinsate      TB = Trip blank  
 SW = See worksheet      FB = Field blank      EB = Equipment blank

**Validated Samples:**

1	RSAU6-53B	S	11	SA167-10B	S	21	SA70-10BMS <sup>226 228</sup>	S	31
2	SA86-10B	↓	12	SA167009-10B	↓	22	SA70-10BDUP <sup>226 228</sup>	↓	32
3	SA86009-10B	↓	13	SA167-28B	↓	23	PBS		33
4	SA86-28B	↓	14 <sup>2</sup>	EB081909-SO1	W	24 <sup>2</sup>	PBW		34
5	RSAM6-10B	↓	15	SA197-10B	S	25			35
6	RSAM6-28B	↓	16	SA197009-10B	↓	26			36
7	RSAM6009-28B	↓	17	SA197-21B	↓	27			37
8	SA70-10B	↓	18	SA104-10B	↓	28			38
9	SA70-30B	↓	19	SA104009-10B	↓	29			39
10	SA167-0.5B	↓	20	SA104-30B	↓	30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990E29  
 SDG #: 235208

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer: [Signature]

Method: Radiochemistry (EPA Method See cover )

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
All technical holding times were met.	✓			
<b>II. Calibration</b>				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the required frequency and within laboratory control limits?	✓			
<b>III. Blanks</b>				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
<b>IV. Matrix spikes and Duplicates</b>				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / <u>Water</u>		✓		
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.	✓			
Was a duplicate sample analyzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error ratios (DER) $\leq 1.42$ ?	✓			
<b>V. Laboratory control samples</b>				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%		✓		
<b>VI. Sample Chemical/Carrier Recovery</b>				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
<b>VII. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
<b>VIII. Sample Result Verification</b>				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) $< RL$ ?		✓		

LDC #: 21990E29  
 SDG #: 235208

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: MG  
 2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>IX. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	✓			
<b>X. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
<b>XI. Field blanks</b>				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.		✓		

LDC #: 21990 E29  
SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Laboratory Control Sample (LCS)**

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".  
 N. N/A Was a laboratory control sample (LCS) analyzed at the required frequency in this SDG?  
 N. N/A Were all LCS percent recoveries (%R) within the control limits of 75-125%?

LEVEL IV ONLY:  
 N. N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	LCS ID	Matrix	Isotope	LCS/LCSD →%R (limits)	Associated Samples	Qualifications
1	LCS/LCSD	Water	Ra-228	21.8 (± 20)	all water	* No Qual

Comments: \* Ra-228 % rec in limit for LCS/LCSD



LDC #: 21990E29  
 SDG #: 235208

VALIDATION FINDINGS WORKSHEET  
Field Duplicates

Page: 1 of 2  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: See cover)

- N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference Qual parent only RPD
	2	3	
Ra-228	0.912	1.03	0.118 ( $\leq 0.50$ )
Ra-226	1.04	1.59	0.55 ( ↓ ) Idets/A fd

Isotopes	Activity ( pCi/g )		by difference RPD
	6	7	
Ra-228	0.980	0.965	0.015 ( $\leq 0.50$ )
Ra-226	1.95	1.56	0.39 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference RPD
	11	12	
Ra-228	1.20	1.10	0.10 ( $\leq 0.50$ )
Ra-226	2.09	1.59	0.50 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference RPD
	15	16	
Ra-228	1.35	1.65	0.30 ( $\leq 0.50$ )
Ra-226	1.88	1.58	0.30 ( ↓ )

LDC #: 21990E29  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 2 of 2  
 Reviewer: MG  
 2nd reviewer: V

METHOD: Radiochemistry (Method: see cover)

- N/A Were field duplicate pairs identified in this SDG?  
 N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( $\mu\text{Ci/g}$ )		by difference <del>RPD</del>
	18	19	
Ra-228	1.17	1.19	0.02 ( $\leq 0.50$ )
Ra-226	0.931	0.793	0.138 ( $\downarrow$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD



LDC #: 21990E29  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:     

METHOD: Radiochemistry (Method: See cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recalculated using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = activity of each analyte measured in the analysis of the sample.  
 True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where, S = Original sample activity  
 D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated		Reported %R or RPD	Acceptable (Y/N)
					%R or RPD	%R or RPD		
LCS	Laboratory control sample	Ra-226	10.64 (pci/g)	11.1 (pci/g)	95.9	95.5	Y	
21	Matrix spike sample	Ra-228	78.97 (pci/g)	79.3 (pci/g)	99.6	99.6		
22	Duplicate RPD	Ra-226	1.295 (pci/g)	1.085 (pci/g)	17.6	17.7		
1	Chemical recovery	Ba-133 for Ra-228	267.7 (cpm)	308.9 (cpm)	86.7	86.7		

Comments: Refer to appropriate worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 21990E29  
 SDG #: 235208

## VALIDATION FINDINGS WORKSHEET

### Sample Calculation Verification

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".  
 Y  N  N/A    Have results been reported and calculated correctly?  
 Y  N  N/A    Are results within the calibrated range of the instruments?

Analyte results for # 1, Ra-228 reported with a positive detect were recalculated and verified using the following equation:

Activity = 
$$\frac{(cpm - bckgrd\ cpm)}{(2.22)(E)(Vol)(CF)}$$

Recalculation:

$$\frac{(1.650 - 0.468)}{(2.22)(0.6303)(1.0100g)(0.8666)} \times \frac{1}{0.993} \times \frac{1}{0.757} \times 1.058 = 1.3584 \frac{pCi}{g}$$

E = Efficiency  
 Vol = Volume  
 CF = %R, Self-absorbance, abundance, ect.

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
1	I	Ra-228	1.36	1.36	Y
		Ra-226	1.12	1.12	
2	II	Ra-228	1.20	1.20	
		Ra-226	2.09	2.10	↓

Note: \_\_\_\_\_

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 20 through August 21, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235782

### Sample Identification

SA198-10B  
SA198-27B  
SA175-10B  
SA175-28B  
SA139-0.5B  
SA139-10B  
SA139-25B  
SA139009-25B  
SA139-35B  
RSAT5-0.5B  
RSAT5-10B  
RSAT5-25B  
RSTA5-40B  
RSAT5-51B  
EB082009-SO2  
RSAO6-10B  
RSAO6-20B  
RSAO6-34B  
RSAO6-34BMS  
RSAO6-34BDUP

## Introduction

This data review covers 19 soil samples and one water sample listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBS (prep blank)	Radium-228	0.444 pCi/g	All soil samples in SDG 235782

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

Samples EB082109-SO (from SDG 235860) and EB082009-SO2 were identified as equipment blanks. No radium-226 or radium-228 was found in these blanks with the following exceptions:

Equipment Blank ID	Sampling Date	Analyte	Concentration	Associated Samples
EB082009-SO2	8/20/09	Radium-226	0.428 pCi/L	RSAT5-0.5B RSAT5-10B RSAT5-25B RSTA5-40B RSAT5-51B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Samples FB072909-SO (from SDG 234267), FB082809-SO (from SDG 236238), and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Analyte	Concentration	Associated Samples
FB082809-SO	8/28/09	Radium-228 Radium-226	3.83 pCi/L 1.75 pCi/L	SA139-0.5B SA139-10B SA139-25B SA139009-25B SA139-35B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Although the LCS/LCSD relative percent difference (RPD) was not within QC limits for one isotope, the LCS/LCSD percent recoveries (%R) were within QC limits and no data were qualified.

##### c. Chemical Recovery

All chemical recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
SA139-25B	Radium-228	0.632	0.5	None	P

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
SA139-35B	Radium-228	0.592	0.5	None	P
RSAT5-10B	Radium-228	0.523	0.5	None	P

The MDA was greater than the PQL as listed above.

## V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235782	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA139-25B and SA139009-25B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA139-25B	SA139009-25B				
Radium-228	1.16	1.16	-	0 ( $\leq 0.50$ )	-	-
Radium-226	1.23	1.13	-	0.10 ( $\leq 0.50$ )	-	-



**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 235782**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235782	SA139-25B SA139-35B RSAT5-10B	Radium-228	None	P	Minimum detectable activity (PQL)
235782	SA198-10B SA198-27B SA175-10B SA175-28B SA139-0.5B SA139-10B SA139-25B SA139009-25B SA139-35B RSAT5-0.5B RSAT5-10B RSAT5-25B RSTA5-40B RSAT5-51B EB082009-SO2 RSAO6-10B RSAO6-20B RSAO6-34B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 235782**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 235782**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 235782**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990F29  
 SDG #: 235782  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET

Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 8-20-09 through 8-21-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	SW	LCS/LCSD
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D=7+8
XIV.	Field blanks	SW	EB=15, *EB082109-S01 (SDG: 235860)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

FB = \*FB072909-S0 (SDG: 234267)

FB = FB082809-S0 (SDG: 236238)

FB = \*FB080309-S0 (SDG: 234414)

Validated Samples:

1	SA198-10B	S	11	RSAT5-10B	S	21	1	PBS	31	
2	SA198-27B		12	RSAT5-25B		22	2	PBW	32	
3	SA175-10B		13	RSTA5-40B		23			33	
4	SA175-28B		14	RSAT5-51B		24			34	
5	SA139-0.5B		15	EB082009-SO2	W	25			35	
6	SA139-10B		16	RSAO6-10B	S	26			36	
7	SA139-25B		17	RSAO6-20B		27			37	
8	SA139009-25B		18	RSAO6-34B		28			38	
9	SA139-35B		19	RSAO6-34BMS		29			39	
10	RSAT5-0.5B		20	RSAO6-34BDUP		30			40	

Notes: \_\_\_\_\_

LDC #: 21990F29  
SDG #: 235782

VALIDATION FINDINGS WORKSHEET  
Blanks

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

Y/N N/A Were blank analyses performed as required? If no, please see qualifications below.  
 Y/N N/A Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see qualifications below.

Units: pCi/g Associated Samples: all soil (> RL)

isotope	Blank ID	Blank Action Level	Sample Identification
	PBS		No samples were qualified
Ra-228	0.444		

Units: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

isotope	Blank ID	Blank Action Level	Sample Identification

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT: If there is activity in the blank above the MDA, sample results within 10x the blank activity will be qualified as not detected "U".

LDC #: 21990F29  
SDG #: 235782

### VALIDATION FINDINGS WORKSHEET Field Blanks

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See Cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
Blank units: Pci/L Associated sample units: Pci/g  
Sampling date: 8-28-09

Field blank type: (circle one) Field Blank / Rinsate / Other: Associated Samples: 5 → 9 (> 10x)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
<u>Field Blank</u>	<u>809-50</u>		No	samples were qualified
Ra-228	3.83	0.0383		
Ra-226	1.75	0.0175		

> RL  
> RL

Blank units: Pci/g Associated sample units: Pci/g  
Sampling date: 8-20-09  
Field blank type: (circle one) Field Blank / Rinsate (Other: EB) Associated Samples: 10 → 14 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
<u>Field Blank</u>	<u>15</u>		No	samples were qualified
Ra-226	0.428			

RL

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".





LDC #: 21990F29  
 SDG #: 235782

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover )

- N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference -RPD-
	7	8	
Ra-228	1.16	1.16	0.00 ( ≤0.50 )
Ra-226	1.23	1.13	0.10 ( ↓ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 21 through August 26, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235860

### Sample Identification

RSAN6-10B	SA185-41B
RSAN6009-10B	SA185-10BMS
RSAN6-20B	SA185-10BDUP
RSAN6-33B	
RSAS7-0.5B	
RSAS7009-0.5B	
RSAS7-10B	
RSAS7-25B	
RSAS7-42B	
RSAS4-0.5B	
RSAS4-10B	
RSAS4-30B	
RSAS4-45B	
RSAS4009-45B	
EB082109-SO1	
SA65-10B	
SA65-20B	
SA65-32.5B	
SA185-10B	
SA185-25B	



## Introduction

This data review covers 22 soil samples and one water sample listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB082109-SO1 was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
SA185-10BDUP (RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B)	Radium-228	-	0.742 pCi/g ( $\leq 0.50$ )	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Although the LCS/LCSD relative percent difference (RPD) was not within QC limits for one isotope, the LCS/LCSD percent recoveries (%R) were within QC limits and no data were qualified.

### c. Chemical Recovery

All chemical recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
RSAN6-20B	Radium-228	0.527	0.50	None	P
RSAS7-0.5B	Radium-228	0.696	0.50	None	P
RSAS7-10B	Radium-228	0.772	0.50	None	P
RSAS7-25B	Radium-228	0.739	0.50	None	P
RSAS7-42B	Radium-228	0.607	0.50	None	P
RSAS4-0.5B	Radium-228	0.631	0.50	None	P
RSAS4-10B	Radium-228	0.809	0.50	None	P
RSAS4-30B	Radium-228	0.718	0.50	None	P

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
SA65-20B	Radium-228	0.681	0.50	None	P
SA65-32.5B	Radium-228	0.691	0.50	None	P
SA185-10B	Radium-228	0.583	0.50	None	P
SA185-25B	Radium-228	0.613	0.50	None	P
SA185-41B	Radium-228	0.659	0.50	None	P

The MDA was greater than the PQL as listed above.

## V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235860	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples RSAN6-10B and RSAN6009-10B, samples RSAS7-0.5B and RSAS7009-0.5B, and samples RSAS4-45B and RSAS4009-45B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAN6-10B	RSAN6009-10B				
Radium-228	0.550	0.629	-	0.079 ( $\leq 0.50$ )	-	-
Radium-226	0.941	1.21	-	0.269 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS7-0.5B	RSAS7009-0.5B				
Radium-228	1.18	0.649	-	0.531 ( $\leq 0.50$ )	J (all detects)	A
Radium-226	0.864	0.765	-	0.099 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS4-45B	RSAS4009-45B				
Radium-228	0.657	0.724	-	0.067 ( $\leq 0.50$ )	-	-
Radium-226	3.69	2.58	35 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 235860**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235860	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B	Radium-228	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
235860	RSAN6-20B RSAS7-0.5B RSAS7-10B RSAS7-25B RSAS7-42B RSAS4-0.5B RSAS4-10B RSAS4-30B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B	Radium-228	None	P	Minimum detectable activity (PQL)
235860	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B RSAS7-0.5B RSAS7009-0.5B RSAS7-10B RSAS7-25B RSAS7-42B RSAS4-0.5B RSAS4-10B RSAS4-30B RSAS4-45B RSAS4009-45B EB082109-SO1 SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
235860	RSAS7-0.5B RSAS7009-0.5B	Radium-228	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG  
235860**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG  
235860**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 235860**

No Sample Data Qualified in this SDG



LDC #: 21990G29  
 SDG #: 235860  
 Laboratory: GEL Laboratories LLC

**Tronox Northgate Henderson**  
**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-21-09 through 8-26-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	MS/DUP
IVb.	Laboratory control samples	SW	LCS/LCSD
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D = 1+2, D = 5+6, D = 13+14
XIV.	Field blanks	ND	EB = 15, FB = FB072909-SO (SDG: 234267)

FB = FB080309-SO (SDG: 234414)

Note: A = Acceptable      ND = No compounds detected      D = Duplicate  
 N = Not provided/applicable      R = Rinsate      TB = Trip blank  
 SW = See worksheet      FB = Field blank      EB = Equipment blank

Validated Samples:

1	RSAN6-10B	S	11	RSAS4-10B	S	21	SA185-41B	S	31
2	RSAN6009-10B		12	RSAS4-30B		22	SA185-10BMS		32
3	RSAN6-20B		13	RSAS4-45B		23	SA185-10BDUP		33
4	RSAN6-33B		14	RSAS4009-45B		24	PBS		34
5	RSAS7-0.5B		15 <sup>2</sup>	EB082109-SO1	W	25 <sup>2</sup>	PBW		35
6	RSAS7009-0.5B		16	SA65-10B	S	26			36
7	RSAS7-10B		17	SA65-20B		27			37
8	RSAS7-25B		18	SA65-32.5B		28			38
9	RSAS7-42B		19	SA185-10B		29			39
10	RSAS4-0.5B		20	SA185-25B		30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: W

LDC #: 21990629  
 SDG #: 235860

VALIDATION FINDINGS WORKSHEET  
 Duplicate Analysis

METHOD: Radiochemistry (Method: See Cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a duplicate sample analyzed the required frequency of 5% in this SDG? Act = sample activity  $\delta = 1$  sigma error

Y N N/A Were all duplicate sample duplicate error ratio (DER)  $\leq 1.42$ ?  $DER = \frac{Act_1 - Act_2}{2 \sqrt{\delta_1^2 + \delta_2^2}}^{1/2}$  Act = sample activity  $\delta = 1$  sigma error

LEVEL IV ONLY:

Y N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Duplicate ID	Matrix	Isotope	by difference -DER (Limits)	Associated Samples	Qualifications
1	23	soil	Ra-228	0.742 $\mu\text{Ci/g}$ ( $\leq 0.50$ )	1 $\rightarrow$ 4, 16 $\rightarrow$ 21	J/UJ/A Id

Comments: \_\_\_\_\_



DC #: 01990G29

DG #: 235860

### VALIDATION FINDINGS WORKSHEET Minimum Detectable Activities

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE Cover )

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	QAPP POL (pci/g)	Lab DL MBA (units)	Lab DL (pci/g)	Finding	Qualifications
1	3	Ra-228	0.50	0.50	0.507	0.507	Lab DL > QAPP POL	None / P
2	5				0.696			
3	7				0.772			
4	8				0.739			
5	9				0.607			
6	10				0.631			
7	11				0.809			
8	12				0.718			
9	17				0.681			
10	18				0.691			
11	19				0.583			
12	20				0.613			
13	21				0.659			

Comments:

LDC #: 21990G29  
 SDG #: 235860

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: ✓

METHOD: Radiochemistry (Method: see cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference <del>RPD</del>
	1	2	
Ra-228	0.550	0.629	0.079 ( ≤ 0.50 )
Ra-226	0.941	1.21	0.269 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference Qual parent only <del>RPD</del>
	5	6	
Ra-228	1.18	0.649	0.531 ( ≤ 0.50 ) Idets/A fd
Ra-226	0.864	0.765	0.099 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD difference RPD
	13	14	
Ra-228	0.657	0.724	0.067 ( ≤ 0.50 )
Ra-226	3.69	2.58	35 ( ≤ 50 )

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 25 through August 27, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 236043

### Sample Identification

RSAN7-0.5B                      RSAO5-41BDUP  
RSAN7-10B  
RSAN7-25B  
RSAN7-38B  
SA113-0.5B  
SA113-10B  
SA113-30B  
SA196-0.5B  
SA196-10B  
SA196-29B  
SA200-10B  
SA200-20B  
SA200-31B  
SA200009B-31B  
RSAT3-40B  
RSAT3-53B  
RSAO5-10B  
RSAO5-25B  
RSAO5-41B  
RSAO5-41BMS

## Introduction

This data review covers 21 soil samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UJ Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

### **b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### **c. Chemical Recovery**

All chemical recoveries were within validation criteria.

## V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
RSAN7-38B	Radium-228	0.561	0.50	None	P
SA113-10B	Radium-228	0.554	0.50	None	P
SA113-30B	Radium-228	0.560	0.50	None	P
SA196-0.5B	Radium-228	0.523	0.50	None	P
SA196-29B	Radium-228	0.669	0.50	None	P
SA200-10B	Radium-228	0.581	0.50	None	P
RSAT3-40B	Radium-228	0.555	0.50	None	P

The MDA was greater than the PQL as listed above.

## V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 236043	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA200-31B and SA200009B-31B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA200-31B	SA200009B-31B				
Radium-228	1.22	1.82	-	0.60 ( $\leq 0.50$ )	J (all detects)	A
Radium-226	1.45	1.59	-	0.14 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 236043**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
236043	RSAN7-38B SA113-10B SA113-30B SA196-0.5B SA196-29B SA200-10B RSAT3-40B	Radium-228	None	P	Minimum detectable activity (PQL)
236043	RSAN7-0.5B RSAN7-10B RSAN7-25B RSAN7-38B SA113-0.5B SA113-10B SA113-30B SA196-0.5B SA196-10B SA196-29B SA200-10B SA200-20B SA200-31B SA200009B-31B RSAT3-40B RSAT3-53B RSAO5-10B RSAO5-25B RSAO5-41B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
236043	SA200-31B SA200009B-31B	Radium-228	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 236043**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 236043**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990H29  
 SDG #: 236043  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET

Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 8-25-09 through 8-27-09
Ia.	Initial calibration	A	
Ib.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	A	LCS
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D = 13 + 14
XIV.	Field blanks	ND	FB = FB072909-50 (SDG: 234267)

FB = FB080309-50 (SDG: 234414)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet  
 ND = No compounds detected  
 R = Rinsate  
 FB = Field blank  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:  
 all soil

1	RSAN7-0.5B	11	SA200-10B	21	RSOA5-41BDUP <sup>226 228</sup>	31	
2	RSAN7-10B	12	SA200-20B	22	PBS	32	
3	RSAN7-25B	13	SA200-31B	23		33	
4	RSAN7-38B	14	SA200009B-31B	24		34	
5	SA113-0.5B	15	RSAT3-40B	25		35	
6	SA113-10B	16	RSAT3-53B	26		36	
7	SA113-30B	17	RSOA5-10B	27		37	
8	SA196-0.5B	18	RSOA5-25B	28		38	
9	SA196-10B	19	RSOA5-41B	29		39	
10	SA196-29B	20	RSOA5-41BMS <sup>226 228</sup>	30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



LDC #: 21990H29  
 SDG #: 236043

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: V

METHOD: Radiochemistry (Method: see cover)

- N/A Were field duplicate pairs identified in this SDG?
- N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference Qual parent only RPD
	13	14	
Ra-228	1.22	1.82	0.60 ( $\leq 0.50$ ) Idets/A fd
Ra-226	1.45	1.59	0.14 ( ↓ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** September 23 through October 5, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237785

### Sample Identification

SA148-10BSPLP  
SA148-35BSPLP  
RSAR3-0.5BSPLP  
RSAR3-35BSPLP  
RSAQ4-10BSPLP  
RSAQ4-32BSPLP  
SA148-10BSPLPMS  
SA148-10BSPLPDUP  
RSAQ4-10BSPLPMS  
RSAQ4-10BSPLPDUP

Samples in this SDG underwent SPLP extraction



## Introduction

This data review covers 10 soil samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

No field blanks were identified in this SDG.

## IV. Accuracy and Precision Data

### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Although the MS percent recovery (%R) was not within QC limits for one isotope due to the not being spiked by the laboratory, a second MS analysis percent recovery (%R) was within QC limits and no data were qualified.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
RSAQ4-10BSPLPDUP (RSAQ4-10BSPLP)	Radium-226	-	1.26 pCi/L ( $\leq 1.00$ )	J (all detects) UJ (all non-detects)	A

**b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

**c. Chemical Recovery**

All chemical recoveries were within validation criteria.

**V. Minimum Detectable Activity (MDA)**

All minimum detectable activities met required PQLs.

**V. Sample Result Verification and Project Quantitation Limit**

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237785	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

**VII. Overall Assessment of Data**

Data flags are summarized at the end of this report if data has been qualified.

**VIII. Field Duplicates**

No field duplicates were identified in this SDG.

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 237785**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237785	RSAQ4-10BSPLP	Radium-226	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
237785	SA148-10BSPLP SA148-35BSPLP RSAR3-0.5BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP RSAQ4-32BSPLP	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 237785**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 237785**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

**VALIDATION COMPLETENESS WORKSHEET**

LDC #: 21990129

SDG #: 237785

Laboratory: GEL Laboratories LLC

Stage 2B

Date: 12-2-09

Page: 1 of 1

Reviewer: MG

2nd Reviewer: [Signature]

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	<b>Validation Area</b>		<b>Comments</b>
I.	Technical holding times	A	Sampling dates: <u>9-23-09 through 10-5-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP (SDG: 237795)</u>
IVb.	Laboratory control samples	A	<u>LCS</u>
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	N	
XIV.	Field blanks	N	

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:  
all soil

1	SA148-10BSPLP	11	<sup>1</sup> PBS1	21		31	
2	SA148-35BSPLP	12	<sup>2</sup> PBS2 <sup>226</sup>	22		32	
3	RSAR3-0.5BSPLP	13	<sup>1</sup> PBSPLP	23		33	
4	RSAR3-35BSPLP	14		24		34	
5	RSAQ4-10BSPLP	15		25		35	
6	RSAQ4-32BSPLP	16		26		36	
7	SA148-10BSPLPMS <sup>228</sup>	17		27		37	
8	SA148-10BSPLPDUP <sup>228</sup>	18		28		38	
9	RSAQ4-10BSPLPMS <sup>226</sup>	19		29		39	
10	RSAQ4-10BSPLPDUP <sup>226</sup>	20		30		40	

Notes: Ra-226 batch was combined with SDG: 237795

Fluid 2 (west)



METHOD: Radiochemistry (Method: See cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a duplicate sample analyzed the required frequency of 5% in this SDG? Act = sample activity  $\delta = 1$  sigma error  
Y N N/A Were all duplicate sample duplicate error ratio (DER)  $\leq 1.42$ ?  $DER = \frac{Act_1 - Act_2}{2 \sqrt{\delta_1^2 + \delta_2^2}}^{1/2}$

LEVEL IV ONLY: Y N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Duplicate ID	Matrix	Isotope	DER (Limits)	Associated Samples	Qualifications
1	10	SPLP	Ra-226	1.26 PCI/L ( $\leq 1.00$ )	5	J/UJ/A Id

Comments: 2nd DUP for this batch is in limit so qual parent only



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** September 23 through October 5, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237795

### Sample Identification

SA148-10BSPLP  
SA148-35BSPLP  
RSAR3-0.5BSPLP  
RSAR3-35BSPLP  
RSAQ4-10BSPLP  
RSAQ4-32BSPLP  
SA148-10BSPLPMS  
SA148-10BSPLPDUP

Samples in this SDG underwent SPLP extraction

## Introduction

This data review covers 8 soil samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
SPLP PB (prep blank)	Radium-228	2.74 pCi/L	All samples in SDG 237795

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

No field blanks were identified in this SDG.

## IV. Accuracy and Precision Data

### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Although the DUP difference was not within QC limits for one isotope, the second DUP analysis difference was within QC limits and no data were qualified since the parent sample is not in this SDG.

**b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

**c. Chemical Recovery**

All chemical recoveries were within validation criteria.

**V. Minimum Detectable Activity (MDA)**

All minimum detectable activities met required PQLs.

**V. Sample Result Verification and Project Quantitation Limit**

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237795	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

**VII. Overall Assessment of Data**

Data flags are summarized at the end of this report if data has been qualified.

**VIII. Field Duplicates**

No field duplicates were identified in this SDG.

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 237795**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237795	SA148-10BSPLP SA148-35BSPLP RSAR3-0.5BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP RSAQ4-32BSPLP	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 237795**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 237795**

No Sample Data Qualified in this SDG

LDC #: 21990J29  
 SDG #: 237795  
 Laboratory: GEL Laboratories LLC

**Tronox Northgate Henderson**  
**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>9-23-09 through 10-5-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP (SDG: 237785)</u>
IVb.	Laboratory control samples	A	<u>LCS</u>
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	N	
XIV.	Field blanks	N	

Note: A = Acceptable      ND = No compounds detected      D = Duplicate  
 N = Not provided/applicable      R = Rinsate      TB = Trip blank  
 SW = See worksheet      FB = Field blank      EB = Equipment blank

Validated Samples: all soil

1	SA148-10BSPLP	11	<sup>1</sup> PBS1	21		31	
2	SA148-35BSPLP	12	<sup>2</sup> PBS2 <u>226</u>	22		32	
3	RSAR3-0.5BSPLP	13	<sup>1</sup> PBSPLP	23		33	
4	RSAR3-35BSPLP	14		24		34	
5	RSAQ4-10BSPLP	15		25		35	
6	RSAQ4-32BSPLP	16		26		36	
7	SA148-10BSPLPMS <u>226 228</u>	17		27		37	
8	SA148-10BSPLPDUP <u>226 228</u>	18		28		38	
9		19		29		39	
10		20		30		40	

Notes: Fluid 3 (Reagent Water)

Ra-226 batch was combined with SDG: 237785







## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** September 24 through October 7, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237885

### Sample Identification

M-89B  
FiltB092509-A2  
M-2AB  
M-2009AB  
M-76B  
M-76009B  
PB100209-A2  
MC-94B  
M-89BMS  
M-89BDUP

## Introduction

This data review covers 10 water samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UJ Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples FB060409 (from SDG 230340) and FB080409-GW (from SDG 233776) were identified as field blanks. No radium-226 or radium-228 was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Analyte	Concentration	Associated Samples
FB080409-GW	8/4/09	Radium-228 Radium-226	2.33 pCi/L 0.396 pCi/L	M-89B M-2AB M-2009AB M-76B M-76009B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified with the following exceptions:

Sample	Isotope	Reported Concentration	Modified Final Concentration
M-89B	Radium-226	0.405 pCi/L	1.00U pCi/L

Sample	Isotope	Reported Concentration	Modified Final Concentration
M-2AB	Radium-228 Radium-226	2.84 pCi/L 0.525 pCi/L	3.00U pCi/L 1.00U pCi/L
M-2009AB	Radium-228 Radium-226	2.56 pCi/L 0.640 pCi/L	3.00U pCi/L 1.00U pCi/L
M-76009B	Radium-228	1.85 pCi/L	3.00U pCi/L

Sample FiltB092509-A2 was identified as a filter blank. No radium-226 or radium-228 was found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Analyte	Concentration	Associated Samples
FiltB092509-A2	9/25/09	Radium-228	1.88 pCi/L	No associated samples in this SDG

Sample PB100209-A2 was identified as a pump blank. No radium-226 or radium-228 was found in this blank.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

##### c. Chemical Recovery

All chemical recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs.

## V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237885	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples M-2AB and M-2009AB and samples M-76B and M-76009B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-2AB	M-2009AB				
Radium-228	2.84	2.56	-	0.28 ( $\leq 3.00$ )	-	-
Radium-226	0.525	0.640	-	0.115 ( $\leq 1.00$ )	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-76B	M-76009B				
Radium-228	0.791U	1.85	-	1.059 ( $\leq 3.00$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 237885**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237885	M-89B FitB092509-A2 M-2AB M-2009AB M-76B M-76009B PB100209-A2 MC-94B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 237885**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 237885**

SDG	Sample	Isotope	Modified Final Concentration	A or P	Code
237885	M-89B	Radium-226	1.00U pCi/L	A	bf
237885	M-2AB	Radium-228 Radium-226	3.00U pCi/L 1.00U pCi/L	A	bf
237885	M-2009AB	Radium-228 Radium-226	3.00U pCi/L 1.00U pCi/L	A	bf
237885	M-76009B	Radium-228	3.00U pCi/L	A	bf

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Filter Blank Data Qualification Summary - SDG 237885**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Pump Blank Data Qualification Summary - SDG 237885**

No Sample Data Qualified in this SDG



LDC #: 21990K29  
 SDG #: 237885  
 Laboratory: GEL Laboratories LLC

**Tronox Northgate Henderson**  
**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

Validation Area			Comments
I.	Technical holding times	A	Sampling dates: <u>9-24-09 through 10-7-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVb.	Laboratory control samples	A	<u>LCS</u>
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	<u>D=3+4, D=5+6</u>
XIV.	Field blanks	SW	<u>Filter blank = 2, Pump blank = *7</u>

FB = \*FB060409 (SDG: 230340)  
FB = FB080409-GW (SDG: 233776)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet  
 \* = ND = No compounds detected  
 R = Rinstate  
 FB = Field blank  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:  
all water

1	M-89B	11	PBW	21		31	
2	FiltB092509-A2	12		22		32	
3	M-2AB	13		23		33	
4	M-2009AB	14		24		34	
5	M-76B	15		25		35	
6	M-76009B	16		26		36	
7	PB100209-A2	17		27		37	
8	MC-94B	18		28		38	
9	M-89BMS <u>226 228</u>	19		29		39	
10	M-89BDUP <u>226 228</u>	20		30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990K29  
 SDG #: 237885

**VALIDATION FINDINGS WORKSHEET**  
**Field Blanks**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
 Blank units: pci/L Associated sample units: pci/L  
 Sampling date: 8-4-09  
 Field blank type: (circle one) Field Blank Rinsate / Other:             
 Associated Samples: 1, 3 → 6

Qual: U bf

Analyte	Blank ID	Blank Action Limit	Sample Identification							
			1	3	4	6				
<b>FB000</b>	<b>409-GW</b>									
Ra-228	2.33			2.84/3.00	2.56/3.00	1.85/3.00				
Ra-226	0.396		0.405/1.00	0.525/1.00	0.640/1.00					

Blank units: pci/L Associated sample units: pci/L  
 Sampling date: 9-25-09

Field blank type: (circle one) Field Blank / Rinsate / ~~Other~~ Filter Blank Associated Samples: None

Analyte	Blank ID	Blank Action Limit	Sample Identification							
			1	3	4	6				
<b>FB000</b>	<b>2</b>									
Ra-228	1.88									

           No samples were qualified

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990 K29  
 SDG #: 237885

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A  
 Y N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/L )		by difference
	3	4	<del>RPD</del>
Ra-228	2.84	2.56	0.28 ( $\leq 3.00$ )
Ra-226	0.525	0.640	0.115 ( $\leq 1.00$ )

Isotopes	Activity ( pCi/L )		by difference
	5	6	<del>RPD</del>
Ra-228	0.791 U	1.85	1.059 ( $\leq 3.00$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** October 5 through October 6, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 238405

### Sample Identification

RSAQ4-0.5B	SA111-25BDUP
RSAQ4-10B	
RSAQ4-25B	
RSAQ4-32B	
SA214-0.5B	
SA214-15B	
SA214-30B	
SA214-43B	
SA111-1.5B	
SA111-10B	
SA111-25B	
SA111-39B	
EB100509-SO1A4	
SA103-0.5B	
SA103-10B	
SA103009-10B	
SA103-25B	
SA103-35B	
EB100609-SO1A4	
SA111-25BMS	

## Introduction

This data review covers 19 soil samples and 2 water samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBS (prep blank)	Radium-226	0.226 pCi/g	All soil samples in SDG 238405

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified with the following exceptions:

Sample	Isotope	Reported Activity	Modified Final Activity
SA111-10B	Radium-226	0.464 pCi/g	0.50U pCi/g

Samples EB100509-SO1A4 and EB100609-SO1A4 were identified as equipment blanks. No radium-226 or radium-228 was found in these blanks with the following exceptions:

Equipment Blank ID	Sampling Date	Analyte	Concentration	Associated Samples
EB100509-SO1A4	10/5/09	Radium-228	4.73 pCi/L	RSAQ4-0.5B RSAQ4-10B RSAQ4-25B RSAQ4-32B SA214-0.5B SA214-15B SA214-30B SA214-43B SA111-1.5B SA111-10B SA111-25B SA111-39B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Sample FB080309-SO (from SDG 234414) was identified as a field blank. No radium-226 or radium-228 was found in these blanks.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Chemical Recovery

All chemical recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
SA214-15B	Radium-228	0.646	0.50	None	P



Sample	Isotope	Lab DL pCi/g	QAPP PQL pCi/g	Flag	A or P
SA111-25B	Radium-228	0.581	0.50	None	P
SA111-39B	Radium-228	0.572	0.50	None	P

The MDA was greater than the PQL as listed above.

## V. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 238405	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA103-10B and SA103009-10B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA103-10B	SA103009-10B				
Radium-228	0.887	0.995	-	0.108 ( $\leq 0.50$ )	-	-
Radium-226	0.626	0.762	-	0.136 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 238405**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238405	SA214-15B SA111-25B SA111-39B	Radium-228	None	P	Minimum detectable activity (PQL)
238405	RSAQ4-0.5B RSAQ4-10B RSAQ4-25B RSAQ4-32B SA214-0.5B SA214-15B SA214-30B SA214-43B SA111-1.5B SA111-10B SA111-25B SA111-39B EB100509-SO1A4 SA103-0.5B SA103-10B SA103009-10B SA103-25B SA103-35B EB100609-SO1A4	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 238405**

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
238405	SA111-10B	Radium-226	0.50U pCi/g	A	bl

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 238405**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 238405**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

VALIDATION COMPLETENESS WORKSHEET

LDC #: 21990L29

SDG #: 238405

Laboratory: GEL Laboratories LLC

Stage 2B

Date: 12-3-09

Page: 1 of 1

Reviewer: MG

2nd Reviewer: ✓

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 10-5-09 through 10-6-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	A	LCS / LCSD
IVc.	Chemical recovery	A	
V.	Sample result verification	N	
VI.	Minimum detectable activity (MDA)	SW	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D = 15 + 16
XIV.	Field blanks	SW	EB = 13 * 19

FB = \*FB080309 - 50 (From 23414)

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

\* = ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:

1	RSAQ4-0.5B	S	11	SA111-25B	S	21	SA111-25BDUP <sup>226 228</sup>	S	31
2	RSAQ4-10B		12	SA111-39B	↓	22	PBS		32
3	RSAQ4-25B		13	EB100509-SO1A4	W	23	PBW		33
4	RSAQ4-32B		14	SA103-0.5B	S	24			34
5	SA214-0.5B		15	SA103-10B		25			35
6	SA214-15B		16	SA103009-10B		26			36
7	SA214-30B		17	SA103-25B		27			37
8	SA214-43B		18	SA103-35B	↓	28			38
9	SA111-1.5B		19	EB100609-SO1A4	W	29			39
10	SA111-10B	↓	20	SA111-25BMS <sup>226 228</sup>	S	30			40

Notes: \_\_\_\_\_

\_\_\_\_\_

LDC #: 21990L29  
 SDG #: 238405

### VALIDATION FINDINGS WORKSHEET

**Blanks**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

Qual: U b1

(X) N N/A Were blank analyses performed as required? If no, please see qualifications below.

(X) N N/A Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see qualifications below.

Units: Pci/g Associated Samples: all soil

Isotope	Blank ID	Blank Action Level	Sample Identification																	
	<u>PBS</u>																			
<u>Ra-226</u>	<u>0.226</u>																			

Units: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Isotope	Blank ID	Blank Action Level	Sample Identification																	

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT: If there is activity in the blank above the MDA, sample results within 10x the blank activity will be qualified as not detected "U".

LDC #: 21990L29  
 SDG #: 238405

**VALIDATION FINDINGS WORKSHEET**  
**Field Blanks**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

N/A Were field blanks identified in this SDG?  
 N/A Were target isotopes detected in the field blanks?  
 Blank units: Pci/L Associated sample units: Pci/g  
 Sampling date: 10-5-09

Field blank type: (circle one) Field Blank / Rinsate / Other: EB Associated Samples: 1 → 12 (> 10x)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified
Ra-228	4.73	0.0473		

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
 Sampling date: \_\_\_\_\_  
 Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".



LDC #: 21990L29  
 SDG #: 238405

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

- N N/A Were field duplicate pairs identified in this SDG?
- N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference RPD
	15	16	
Ra-228	0.887	0.995	0.108 ( ≤ 0.50 )
Ra-226	0.626	0.762	0.136 ( ↓ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** October 6 through October 7, 2009

**LDC Report Date:** December 8, 2009

**Matrix:** Soil

**Parameters:** Radium-226 & Radium-228

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 238477

### Sample Identification

SA138-0.5B                      RSAR5-40BDUP  
SA138-10B  
SA138009-10B  
SA138-30B  
SA138-45B  
RSAR5-0.5B  
RSAR5-10B  
RSAR5-25B  
RSAR5-40B  
RSAS5-0.5B  
RSAS5-10B  
RSAS5-25B  
RSAS5-36B  
RSAS5009-36B  
RSAP5-0.5B  
RSAP5-10B  
RSAP5009-10B  
RSAP5-25B  
RSAP5-39B  
RSAR5-40BMS



## **Introduction**

This data review covers 21 soil samples listed on the cover sheet. The analyses were per EPA Methods 903.1 and 904.0 for Radium-226 and Radium-228.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined and a self-absorption curve was generated for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within laboratory control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB100609-SO1A4 (from SDG 238405) was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Sample FB080309-SO (from SDG 234414) was identified as a field blank. No radium-226 or radium-228 was found in these blanks.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) analyses were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

### **b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### c. Chemical Recovery

All chemical recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs.

### V. Sample Result Verification and Project Quantitation Limit

All sample result verifications were acceptable.

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 238477	All isotopes reported below the PQL.	J (all detects)	A

### VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

### VIII. Field Duplicates

Samples SA138-10B and SA138009-10B, samples RSAS5-36B and RSAS5009-36B, and samples RSAP5-10B and RSAP5009-10B were identified as field duplicates. No radium-226 or radium-228 was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA138-10B	SA138009-10B				
Radium-228	1.36	1.55	-	0.19 ( $\leq 0.50$ )	-	-
Radium-226	0.812	1.12	-	0.308 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS5-36B	RSAS5009-36B				
Radium-228	0.571	1.42	-	0.849 ( $\leq 0.50$ )	J (all detects)	A
Radium-226	1.61	1.74	-	0.13 ( $\leq 0.50$ )	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAP5-10B	RSAP5009-10B				
Radium-228	1.13	1.03	-	0.10 ( $\leq 0.50$ )	-	-
Radium-226	0.718	1.01	-	0.292 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 238477**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238477	SA138-0.5B SA138-10B SA138009-10B SA138-30B SA138-45B RSAR5-0.5B RSAR5-10B RSAR5-25B RSAR5-40B RSAS5-0.5B RSAS5-10B RSAS5-25B RSAS5-36B RSAS5009-36B RSAP5-0.5B RSAP5-10B RSAP5009-10B RSAP5-25B RSAP5-39B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
238477	RSAS5-36B RSAS5009-36B	Radium-228	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Laboratory Blank Data Qualification Summary - SDG 238477**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Equipment Blank Data Qualification Summary - SDG 238477**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Field Blank Data Qualification Summary - SDG 238477**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990M29  
 SDG #: 238477  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET

Stage 2B 4  
 gmk

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radium 226 and Radium 228 (EPA Method 903.1 & 904)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 10-6-09 through 10-7-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVb.	Laboratory control samples	A	LCS
IVc.	Chemical recovery	A	
V.	Sample result verification	A w	
VI.	Minimum detectable activity (MDA)	A	
VII.	Overall assessment of data	A	
VIII.	Field duplicates	SW	D=2+3, D=13+14, D=16+17
XIV.	Field blanks	ND	EB= EB100609-SO1A4 (SDG: 238405) FB= FB080309-SO (SDG: 234414)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet  
 ND = No compounds detected  
 R = Rinsate  
 FB = Field blank  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:  
 all soil

1	SA138-0.5B	11	RSAS5-10B	21	RSAR5-40BDUP <sup>226 228</sup>	31	
2	SA138-10B	12	RSAS5-25B	22	PBS	32	
3	SA138009-10B	13	RSAS5-36B	23		33	
4	SA138-30B	14	RSAS5009-36B	24		34	
5	SA138-45B	15	RSAP5-0.5B	25		35	
6	RSAR5-0.5B	16	RSAP5-10B	26		36	
7	RSAR5-10B	17	RSAP5009-10B	27		37	
8	RSAR5-25B	18	RSAP5-25B	28		38	
9	RSAR5-40B	19	RSAP5-39B	29		39	
10	RSAS5-0.5B	20	RSAR5-40BMS <sup>226 228</sup>	30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990M29  
 SDG #: 238477

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer: ✓

Method: Radiochemistry (EPA Method *see cover*)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
All technical holding times were met.	✓			
<b>II. Calibration</b>				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the required frequency and within laboratory control limits?	✓			
<b>III. Blanks</b>				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
<b>IV. Matrix spikes and Duplicates</b>				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.	✓			
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.	✓			
Was a duplicate sample analyzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error ratios (DER) $\leq 1.427$ .	✓			
<b>V. Laboratory control samples</b>				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓			
<b>VI. Sample Chemical/Carrier Recovery</b>				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
<b>VII. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
<b>VIII. Sample Result Verification</b>				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) $< RL$ ?	✓			



LDC #: 21990M29  
 SDG #: 238477

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: MG  
 2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>IX. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	✓			
<b>X. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
<b>XI. Field blanks</b>				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.		✓		

LDC #: 21990M29  
 SDG #: 238477

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		by difference <del>RPD</del>
	2	3	
Ra-228	1.36	1.55	0.19 ( $\leq 0.50$ )
Ra-226	0.812	1.12	0.308 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference Qual parent only <del>RPD</del>
	13	14	
Ra-228	0.571	1.42	0.849 ( $\leq 0.50$ ) Jdets/A fd
Ra-226	1.61	1.74	0.13 ( ↓ )

Isotopes	Activity ( pCi/g )		by difference <del>RPD</del>
	16	17	
Ra-228	1.13	1.03	0.10 ( $\leq 0.50$ )
Ra-226	0.718	1.01	0.292 ( ↓ )

Isotopes	Activity ( )		RPD

LDC #: 21990M39 2/14  
 SDG #: 238477

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recalculated using the following formula:

$$\%R = \frac{\text{Found}}{\text{True}} \times 100$$
 Where, Found = activity of each analyte measured in the analysis of the sample.  
 True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$
 Where, S = Original sample activity  
 D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated		Reported %R or RPD	Acceptable (Y/N)
					%R or RPD	%R or RPD		
LCS	Laboratory control sample	Ra-226	8.815 (pci/g)	11.2 (pci/g)	78.7	78.7	78.7	Y
20	Matrix spike sample	Ra-228	70.22 (pci/g)	68.6 (pci/g)	102	102	102	
21	Duplicate RPD	Ra-226	1.922 (pci/g)	2.141 (pci/g)	10.8	10.8	10.8	
1	Chemical recovery	Ba-133 for Ra-228	284.2 (cpm)	302.0 (cpm)	94.1	94.1	94.1	

Comments: Refer to appropriate worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 21990M29  
 SDG #: 238477

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".  
 N N/A Have results been reported and calculated correctly?  
 N N/A Are results within the calibrated range of the instruments?

Analyte results for # 1, Ra-226 reported with a positive detect were recalculated and verified using the following equation:

Activity = 
$$\frac{(cpm - bckgrd\ cpm)}{(2.22)(E)(Vol)(CF)}$$
 Recalculation: 
$$\frac{(65./30.) - (8./30.)}{(2.22)(2.1810)(1.0120\ g)} \times \frac{1}{0.430} \times \frac{1}{0.978} \times 1.002 = 0.9239\ PCi/g$$

E = Efficiency  
 Vol = Volume  
 CF = %R, Self-absorbance, abundance, ect.

#	Sample ID	Analyte	Reported Concentration (pci/g)	Calculated Concentration (pci/g)	Acceptable (Y/N)
1	1	<del>Th</del> Ra-228	1.42	1.42	Y
		Ra-226	0.921	0.924	↓
2	11	Ra-228	1.40	1.40	↓
		Ra-226	0.725	0.728	↓

Note: \_\_\_\_\_

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Data Validation Reports  
LDC #21990**

Isotopic Uranium & Isotopic Thorium

**LDC**

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** July 15 through July 27, 2009

**LDC Report Date:** December 1, 2009

**Matrix:** Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 233580

### Sample Identification

M-92BDISS  
M-97B  
TR-6B  
EB-071709-GW  
M-33B  
CLD-4RB  
MW-6RB  
M-52B  
M-35B  
M-11B  
M-11BDISS  
M-11009B  
M-11009BDISS  
M-92BDISSMS  
M-92BDISSDUP

## Introduction

This data review covers 15 water samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB-071709-GW was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank.

Sample FB080409-GW (from SDG 233776) was identified as a field blank. No isotopic uranium or isotopic thorium was found in this blank.

Sample MC-3B-Filt (from SDG 230340) was identified as a filter blank. No isotopic uranium or isotopic thorium was found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
MC-3B-Filt	5/21/09	Uranium-235/236	0.0163 pCi/L	M-92BDISS M-11BDISS M-11009BDISS

Sample concentrations were compared to concentrations detected in the filter blanks as required by the QAPP. No sample data was qualified.

Sample PB100209-A2 (from SDG 237885) was identified as a pump blank. No isotopic uranium or isotopic thorium was found in this blank.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-92BDISS	Thorium-228	0.0858	0.03	None	P
	Thorium-230	0.0323	0.03	None	
	Thorium-232	0.0421	0.03	None	
TR-6B	Thorium-228	0.0334	0.03	None	P
	Uranium-233/234	0.0385	0.03	None	
EB-071709-GW	Thorium-228	0.0803	0.03	None	P
	Thorium-230	0.0747	0.03	None	
	Thorium-232	0.0499	0.03	None	
	Uranium-238	0.0391	0.03	None	
M-33B	Thorium-228	0.0497	0.03	None	P
	Uranium-233/234	0.0518	0.03	None	
	Uranium-235/236	0.034	0.03	None	
CLD-4RB	Thorium-228	0.0585	0.03	None	P
	Thorium-230	0.0353	0.03	None	
	Thorium-232	0.0353	0.03	None	
MW-6RB	Thorium-228	0.519	0.03	None	P
	Thorium-230	0.033	0.03	None	
	Uranium-233/234	0.0382	0.03	None	

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-52B	Uranium-238	0.0324	0.03	None	P
M-35B	Uranium-233/234 Uranium-238	0.0463 0.0321	0.03 0.03	None None	P
M-11B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	0.0471 0.120 0.103 0.0326	0.03 0.03 0.03 0.03	None None None None	P
M-11BDISS	Thorium-228 Thorium-230	0.042 0.0394	0.03 0.03	None None	P
M-11009B	Thorium-228 Uranium-238	0.038 0.0338	0.03 0.03	None None	P
M-11009BDISS	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.0397 0.0353 0.0651 0.0643 0.052	0.03 0.03 0.03 0.03 0.03	None None None None None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 233580	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples M-11B and M-11009B and samples M-11BDISS and M-11009BDISS were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-11B	M-11009B				
Thorium-230	0.0128	0.00U	-	0.0128 ( $\leq 0.03$ )	-	-
Uranium-233/234	8.13	7.69	6 ( $\leq 30$ )	-	-	-
Uranium-235/236	0.241	0.261	8 ( $\leq 30$ )	-	-	-
Uranium-238	4.37	4.98	13 ( $\leq 30$ )	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-11BDISS	M-11009BDISS				
Thorium-228	0.0439	0.0295U	-	0.0144 ( $\leq 0.03$ )	-	-
Uranium-233/234	7.68	7.31	5 ( $\leq 30$ )	-	-	-
Uranium-235/236	0.200	0.244	20 ( $\leq 30$ )	-	-	-
Uranium-238	4.65	4.38	6 ( $\leq 30$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 233580**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
233580	M-92BDISS CLD-4RB	Thorium-228 Thorium-230 Thorium-232	None None None	P	Minimum detectable activity (PQL)
233580	TR-6B	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity (PQL)
233580	EB-071709-GW	Thorium-228 Thorium-230 Thorium-232 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
233580	M-33B	Thorium-228 Uranium-233/234 Uranium-235/236	None None None	P	Minimum detectable activity (PQL)
233580	MW-6RB	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
233580	M-52B	Uranium-238	None	P	Minimum detectable activity (PQL)
233580	M-35B	Uranium-233/234 Uranium-238	None None	P	Minimum detectable activity (PQL)
233580	M-11B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
233580	M-11BDISS	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
233580	M-11009B	Thorium-228 Uranium-238	None None	P	Minimum detectable activity (PQL)
233580	M-11009BDISS	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
233580	M-92BDISS M-97B TR-6B EB-071709-GW M-33B CLD-4RB MW-6RB M-52B M-35B M-11B M-11BDISS M-11009B M-11009BDISS	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Filter Blank Data Qualification Summary -  
SDG 233580**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Pump Blank Data Qualification Summary -  
SDG 233580**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990A59

VALIDATION COMPLETENESS WORKSHEET

Date: 11-20-09

SDG #: 233580

Stage 2B

Page: 1 of 1

Laboratory: GEL Laboratories LLC

Reviewer: MG

2nd Reviewer: M

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>7-15-09 through 7-27-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	<u>SW</u>	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	<u>SW</u>	<u>D=10+12, D=11+13</u>
X.	Field blanks	<u>SW</u>	<u>EB=*4, FB=*FB080409-GW (SDG: 233776)</u>

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

\* = ND = No compounds detected  
R = Rinstate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:  
all water

Filter Blank = MC-3B-Filt (SDG: 230340)

1	M-92BDISS	11	M-11BDISS	21	31
2	M-97B	12	M-11009B	22	32
3	TR-6B	13	M-11009BDISS	23	33
4	EB-071709-GW	14	M-92BDISSMS <u>U Th</u>	24	34
5	M-33B	15	M-92BDISSDUP <u>U Th</u>	25	35
6	CLD-4RB	16	<u>PBW</u>	26	36
7	MW-6RB	17		27	37
8	M-52B	18		28	38
9	M-35B	19		29	39
10	M-11B	20		30	40

Notes: \_\_\_\_\_





DC #: 21990A59  
 DG #: 233580

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer: L

METHOD: Radiochemistry (Method: See Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MBA (units)	Finding	Qualifications
1		Th-228	0.03 (pci/L)	0.0858 (pci/L)	Lab DL > QAPP RDL	None / P
		Tm-230		0.0323		
		Tm-232		0.0421		
2		Th-228		0.0334		
		U-233/234		0.0385		
3		Th-228		0.0803		
		Tm-230		0.0747		
		Tm-232		0.0499		
		U-238		0.0391		
4		Th-228		0.0497		
		U-233/234		0.0518		
		U-235/236		0.034		
5		Th-228		0.0585		
		Tm-230		0.0353		
		Tm-232		0.0353		
6		Th-228		0.0519		
		Tm-230		0.033		
		U-233/234		0.0382		
7		U-238		0.0324		
8		U-233/234		0.0463		
		U-238		0.0321		

Comments:



LDC #: 21990A59  
 SDG #: 233580

VALIDATION FINDINGS WORKSHEET  
Field Duplicates

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

- N/A Were field duplicate pairs identified in this SDG?  
 N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/L )		difference / RPD
	10	12	
Tu-230	0.0128	0.00 U	difference 0.0128 ( $\leq 0.03$ )
U-233/234	8.13	7.69	6 <sup>RPD</sup> ( $\leq 30$ )
U-235/236	0.241	0.261	8 <sup>RPD</sup> ( $\leq 30$ )
U-238	4.37	4.98	13 <sup>RPD</sup> ( $\leq 30$ )

Isotopes	Activity ( pCi/L )		difference / RPD
	11	13	
Tu-228	0.0439	0.0295 U	difference 0.0144 ( $\leq 0.03$ )
U-233/234	7.68	7.31	5 <sup>RPD</sup> ( $\leq 30$ )
U-235/236	0.200	0.244	20 <sup>RPD</sup> ( $\leq 30$ )
U-238	4.65	4.38	6 <sup>RPD</sup> ( $\leq 30$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** July 20 through August 4, 2009

**LDC Report Date:** December 1, 2009

**Matrix:** Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 233776

### Sample Identification

M-77B  
M-77BDISS  
M-50B  
M-31-AB  
M-31-ABDISS  
M-21B  
FB080409-GW  
M-77BMS  
M-77BDUP

## Introduction

This data review covers 9 water samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBW (prep blank)	Uranium-238	0.0168 pCi/L	All samples in SDG 233776

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

Sample FB080409-GW was identified as a field blank. No isotopic uranium or isotopic thorium was found in this blank.

Sample MC-3B-Filt (from SDG 230340) was identified as a filter blank. No isotopic uranium or isotopic thorium was found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
MC-3B-Filt	5/21/09	Uranium-235/236	0.0163 pCi/L	M-77BDISS M-31-ABDISS

Sample concentrations were compared to concentrations detected in the filter blanks as required by the QAPP. No sample data was qualified.

Sample PB100209-A2 (from SDG 237885) was identified as a pump blank. No isotopic uranium or isotopic thorium was found in this blank.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Isotope	RPD (Limits)	Difference (Limits)	Flag	A or P
M-77BDUP (M-77B M-77BDISS M-50B M-31-AB M-31-ABDISS)	Thorium-228	57.6 ( $\leq 20$ )	-	J (all detects) UJ (all non-detects)	A

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-77B	Thorium-228	0.133	0.03	None	P
	Thorium-230	0.0869	0.03	None	
	Thorium-232	0.0869	0.03	None	
M-77BDISS	Thorium-228	0.0679	0.03	None	P
	Thorium-230	0.080	0.03	None	
	Thorium-232	0.0639	0.03	None	



Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-50B	Thorium-228	0.0912	0.03	None	P
	Thorium-230	0.0696	0.03	None	
	Thorium-232	0.0696	0.03	None	
M-31-AB	Thorium-228	0.0731	0.03	None	P
	Thorium-230	0.0558	0.03	None	
	Thorium-232	0.0558	0.03	None	
	Uranium-238	0.032	0.03	None	
M-31-ABDISS	Thorium-228	0.0612	0.03	None	P
	Thorium-230	0.0585	0.03	None	
	Thorium-232	0.0732	0.03	None	
	Uranium-233/234	0.0443	0.03	None	
	Uranium-235/236	0.0417	0.03	None	
	Uranium-238	0.0443	0.03	None	
M-21B	Thorium-228	0.0762	0.03	None	P
	Thorium-230	0.0728	0.03	None	
	Thorium-232	0.0728	0.03	None	
FB080409-GW	Thorium-228	0.074	0.03	None	P
	Thorium-230	0.0584	0.03	None	
	Thorium-232	0.0584	0.03	None	

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 233776	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

No field duplicates were identified in this SDG.

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 233776**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
233776	M-77B M-77BDISS M-50B M-31-AB M-31-ABDISS	Thorium-228	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (ld)
233776	M-77B M-77BDISS M-50B M-21B FB080409-GW	Thorium-228 Thorium-230 Thorium-232	None None None	P	Minimum detectable activity (PQL)
233776	M-31-AB	Thorium-228 Thorium-230 Thorium-232 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
233776	M-31-ABDISS	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None None	P	Minimum detectable activity (PQL)
233776	M-77B M-77BDISS M-50B M-31-AB M-31-ABDISS M-21B FB080409-GW	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 233776**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 233776**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Filter Blank Data Qualification Summary -  
SDG 233776**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Pump Blank Data Qualification Summary -  
SDG 233776**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990B59  
 SDG #: 233776  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**

Stage 2B

Date: 11-20-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>7-20-09 through 8-4-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	N	
X.	Field blanks	SW	<u>FB = *</u>

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

Pump Blank = \*PB100209-A2 (SDG: 237885)

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples: all water

Filter Blank = MC-3B-Filt (SDG: 23034)

1	M-77B	11		21		31	
2	M-77BDISS	12		22		32	
3	M-50B	13		23		33	
4	M-31-AB	14		24		34	
5	M-31-ABDISS	15		25		35	
6	M-21B	16		26		36	
7	FB080409-GW	17		27		37	
8	M-77BMS <u>u Th</u>	18		28		38	
9	M-77BDUP <u>u Th</u>	19		29		39	
10	PBW	20		30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 01990B59  
 SDG #: 033776

**VALIDATION FINDINGS WORKSHEET**  
 Blanks

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: L

METHOD: Radiochemistry (Method: See cover)

- N N/A Were blank analyses performed as required? If no, please see qualifications below.  
 N N/A Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see qualifications below.

Units: pci/L Associated Samples: all (> RL or ND)

Isotope	Blank ID	Blank Action Level	Sample Identification	
			No samples	were qualified
U-238	PBW 0.0168			

Units: Associated Samples:

Isotope	Blank ID	Blank Action Level	Sample Identification	
			No samples	were qualified

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT: If there is activity in the blank above the MDA, sample results within 10x the blank activity will be qualified as not detected "U".

LDC #: 21990859  
SDG #: 233776  
**VALIDATION FINDINGS WORKSHEET**  
**Field Blanks**

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
Blank units: pCi/L Associated sample units: pCi/L  
Sampling date: 5-21-09

Field blank type: (circle one) Field Blank / Rinseate / Other Filter Blank Associated Samples: 2, 5 (all diss) (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification			
	<u>38-Filt</u>		<u>No</u>	<u>samples</u>	<u>were</u>	<u>qualified</u>
<u>U-235/236</u>	<u>0.0163</u>					

< RL

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
Sampling date: \_\_\_\_\_  
Field blank type: (circle one) Field Blank / Rinseate / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification			

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990 B59

SDG #: 233776

**VALIDATION FINDINGS WORKSHEET**

Duplicate Analysis

Page: 1 of 1

Reviewer: MG

2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a duplicate sample analyzed the required frequency of 5% in this SDG?

Y N N/A Were all duplicate sample duplicate error ratio (DER) ≤ 1.42?  $DER = \frac{|Act_1 - Act_2|}{2 \sqrt{\delta_1^2 + \delta_2^2}}^{1/2}$  Act = sample activity δ = 1 sigma error

LEVEL IV ONLY:

Y N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Duplicate ID	Matrix	Isotope	RPD DER (Limits)	Associated Samples	Qualifications
1	9	Water	Tu-238	57.6 (± 20)	1 → 5	J / UJ/A 1d

Comments: \_\_\_\_\_

DC #: 21990859  
 DG #: 233776

**VALIDATION FINDINGS WORKSHEET**  
 Minimum Detectable Activities

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer:

ETHOD: Radiochemistry (Method: SEE cover )

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Tu-228 Tu-230 Tu-232	0.03 (pci/L)	0.133 (pci/L) 0.0869	Lab DL > QAPP RDL	None / P
2	↓	Tu-228 Tu-230 Tu-232		0.0679 0.080 0.0639		
3	↓	Tu-228 Tu-230 Tu-232		0.0912 0.0696 0.0696		
4	↓	Tu-228 Tu-230 Tu-232 U-238		0.0731 0.0558 0.0558 0.032		
5	↓	Tu-228 Tu-230 Tu-232 U-233/234 U-235/236 U-238		0.0612 0.0585 0.0732 0.0443 0.0417 0.0443		
6	↓	Tu-228 Tu-230 Tu-232		0.0762 0.0728 0.0728		

Comments:





## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 7 through August 10, 2009

**LDC Report Date:** December 1, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 234964

### Sample Identification

RSAM8-10B	SA92-10BMS
RSAM8-20B	SA92-10BDUP
RSAM8009-20B	
RSAM8-31B	
SA62-10B	
SA62-24B	
SA144-10B	
SA144009-10B	
SA144-28B	
SA92-10B	
SA92-20B	
SA92-31B	
SA119-0.5B	
SA119-10B	
SA119-30B	
SA119-48B	
SA158-10B	
SA158-20B	
SA158-31B	
EB081009-SO2	

## Introduction

This data review covers 21 soil samples and one water sample listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBW (prep blank)	Thorium-228	0.024 pCi/L	All water samples in SDG 234964
PBS (prep blank)	Uranium-233/234 Uranium-238	0.0331 pCi/g 0.020 pCi/g	All soil samples in SDG 234964

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

Sample EB081009-SO2 was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB081009-SO2	8/10/09	Thorium-228	0.0416 pCi/L	SA119-05B SA119-10B SA119-30B SA119-48B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	SA119-0.5B SA119-10B SA119-30B SA119-48B
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA158-10B SA158-20B SA158-31B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Isotope	RPD (Limits)	Difference (Limits)	Flag	A or P
SA92-10BDUP (RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA158-10B SA158-20B SA158-31B)	Uranium-235/236	-	0.0431 pCi/g ( $\leq 0.04$ )	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

### c. Tracer Recovery

All tracer recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAM8-10B	Thorium-228	0.0694	0.05	None	P
	Thorium-230	0.0796	0.05	None	
RSAM8-20B	Thorium-228	0.0828	0.05	None	P
	Thorium-230	0.0823	0.05	None	
	Uranium-233/234	0.045	0.04	None	
	Uranium-238	0.045	0.04	None	
RSAM8009-20B	Thorium-228	0.135	0.05	None	P
	Thorium-230	0.0975	0.05	None	
	Uranium-233/234	0.0504	0.04	None	
	Uranium-235/236	0.0501	0.04	None	
RSAM8-31B	Thorium-228	0.103	0.05	None	P
	Thorium-230	0.0844	0.05	None	
	Uranium-233/234	0.0419	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA62-10B	Thorium-228 Thorium-230	0.130 0.0973	0.05 0.05	None None	P
SA62-24B	Thorium-228 Thorium-230	0.129 0.0555	0.05 0.05	None None	P
SA144-10B	Thorium-228 Thorium-230 Thorium-232	0.196 0.110 0.110	0.05 0.05 0.10	None None None	P
SA144009-10B	Thorium-228 Thorium-230	0.143 0.103	0.05 0.05	None None	P
SA144-28B	Thorium-228 Thorium-230	0.124 0.0583	0.05 0.05	None None	P
SA92-10B	Thorium-228 Thorium-230 Thorium-232	0.184 0.0827 0.103	0.05 0.05 0.10	None None None	P
SA92-20B	Thorium-228 Thorium-230	0.134 0.0706	0.05 0.05	None None	P
SA92-31B	Thorium-228 Thorium-230 Thorium-232	0.139 0.0787 0.114	0.05 0.05 0.10	None None None	P
SA119-0.5B	Thorium-228 Thorium-230	0.109 0.0846	0.05 0.05	None None	P
SA119-10B	Thorium-228 Thorium-230	0.120 0.0863	0.05 0.05	None None	P
SA119-30B	Thorium-228 Thorium-230	0.105 0.094	0.05 0.05	None None	P
SA119-48B	Thorium-228 Thorium-230	0.135 0.0918	0.05 0.05	None None	P
SA158-10B	Thorium-228 Thorium-232	0.117 0.101	0.05 0.10	None None	P
SA158-20B	Thorium-228 Thorium-230 Thorium-232	0.182 0.166 0.149	0.05 0.05 0.10	None None None	P



Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA158-31B	Thorium-228	0.144	0.05	None	P
	Thorium-230	0.0818	0.05	None	
	Thorium-232	0.164	0.10	None	
	Uranium-233/234	0.0463	0.04	None	

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 234964	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples RSAM8-20B and RSAM8009-20B and samples SA144-10B and SA144009-10B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAM8-20B	RSAM8009-20B				
Thorium-228	2.26	2.01	12 ( $\leq 50$ )	-	-	-
Thorium-230	1.56	1.45	7 ( $\leq 50$ )	-	-	-
Thorium-232	1.86	1.61	14 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.38	1.47	6 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0509	0.0855	-	0.0346 ( $\leq 0.04$ )	-	-
Uranium-238	1.29	1.23	5 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA144-10B	SA144009-10B				
Thorium-228	1.95	1.75	11 ( $\leq 50$ )	-	-	-
Thorium-230	1.56	0.881	56 ( $\leq 50$ )	-	J (all detects)	A
Thorium-232	1.57	1.63	4 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.62	1.57	3 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0542	0.0762	-	0.0150 ( $\leq 0.04$ )	-	-
Uranium-238	1.38	1.33	4 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 234964**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
234964	RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA158-10B SA158-20B SA158-31B	Uranium-235/236	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (Id)
234964	RSAM8-20B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
234964	RSAM8009-20B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)
234964	RSAM8-31B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
234964	RSAM8-10B SA62-10B SA62-24B SA144009-10B SA144-28B SA119-0.5B SA119-10B SA119-30B SA92-20B SA119-48B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
234964	SA144-10B SA92-10B SA92-31B SA158-20B	Thorium-228 Thorium-230 Thorium-232	None None None	P	Minimum detectable activity (PQL)
234964	SA158-10B	Thorium-228 Thorium-232	None None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
234964	SA158-31B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234	None None None None	P	Minimum detectable activity (PQL)
234964	RSAM8-10B RSAM8-20B RSAM8009-20B RSAM8-31B SA62-10B SA62-24B SA144-10B SA144009-10B SA144-28B SA92-10B SA92-20B SA92-31B SA119-0.5B SA119-10B SA119-30B SA119-48B SA158-10B SA158-20B SA158-31B EB081009-SO2	All isotopes reported below the PQL	J (all detects)	A	Sample result verification (PQL) (sp)
234964	SA144-10B SA144009-10B	Thorium-230	J (all detects)	A	Field duplicates (RPD) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 234964**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 234964**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 234964**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990C59 **VALIDATION COMPLETENESS WORKSHEET**  
 SDG #: 233964 234964 Stage 2B  
 Laboratory: GEL Laboratories LLC MA

Date: 11-20-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: ✓

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 8-7-09 through 8-10-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	MS/DUP
IVa.	Laboratory control samples	A	LCS/LCSD
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	D= 2+3, D= 7+8
X.	Field blanks	SW	EB=20, FB= FB072909-SO (SDG: 234267)

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet  
 ND = No compounds detected  
 R = Rinsate  
 FB = Field blank  
 FB= FB080309-SO (SDG: 234414)  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:

1	RSAM8-10B	S	11	SA92-20B	S	21	SA92-10BMS	U Th S	31
2	RSAM8-20B		12	SA92-31B		22	SA92-10BDUP	U Th ↓	32
3	RSAM8009-20B		13	SA119-0.5B		23	PBS		33
4	RSAM8-31B		14	SA119-10B		24	PBW		34
5	SA62-10B		15	SA119-30B		25			35
6	SA62-24B		16	SA119-48B		26			36
7	SA144-10B		17	SA158-10B		27			37
8	SA144009-10B		18	SA158-20B		28			38
9	SA144-28B		19	SA158-31B		29			39
10	SA92-10B		20	EB081009-SO2	W	30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990C59  
 SDG #: 234964

**VALIDATION FINDINGS WORKSHEET**  
**Blanks**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)  
 N/A Were blank analyses performed as required? If no, please see qualifications below.  
 N/A Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see qualifications below.

Units: Pci/l Associated Samples: all water (> RL)

Isotope	Blank ID	Blank Action Level	Sample Identification	
<del> </del>	<u>PBW</u>		<u>No</u>	<u>sample was qualified</u>
<u>Tn-228</u>	<u>0.024</u>			

Units: Pci/g Associated Samples: all soil (> RL)

Isotope	Blank ID	Blank Action Level	Sample Identification	
<del> </del>	<u>PBS</u>		<u>No</u>	<u>samples were qualified</u>
<u>U-233/234</u>	<u>0.0331</u>			
<u>U-238</u>	<u>0.020</u>			

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT: if there is activity in the blank above the MDA, sample results within 10x the blank activity will be qualified as not detected "U".

**VALIDATION FINDINGS WORKSHEET**  
Field Blanks

LDC #: 21990C59  
 SDG #: 238964  
gwh 234964  
 METHOD: Radiochemistry (Method: see cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
 Blank units: Pci/L Associated sample units: Pci/g  
 Sampling date: 8-3-09  
 Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_

Associated Samples: 13 → 16 (>RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification				
	<u>FB08 0309-50</u>						
<u>U-238</u>	<u>0.0126</u>			<u>No</u>	<u>samples</u>	<u>were</u>	<u>qualified</u>

<RL

Blank units: Pci/L Associated sample units: Pci/g  
 Sampling date: 8-10-09  
 Field blank type: (circle one) Field Blank / Rinsate / Other: EB

Associated Samples: 13 → 16 (>RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification				
	<u>20</u>						
<u>Th-228</u>	<u>0.0416</u>	<u>0.00042</u>		<u>NO</u>	<u>samples</u>	<u>were</u>	<u>qualified</u>

>RL

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

VALIDATION FINDINGS WORKSHEET  
Field Blanks

LDC #: 21990C59  
SDG #: 238964  
234964

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See Cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
 Blank units: pci/L Associated sample units: pci/g  
 Sampling date: 7-29-09

Field blank type: (circle one) Field Blank / Rinsate / Other: Associated Samples: 1 → 12, 17 → 19

Analyte	Blank ID	Blank Action Limit	Sample Identification							
FB 01	2909-50		No samples were qualified							
Th-228	0.0321	0.0003								

> RL

Blank units: \_\_\_\_\_ Associated sample units: \_\_\_\_\_  
 Sampling date: \_\_\_\_\_  
 Field blank type: (circle one) Field Blank / Rinsate / Other: \_\_\_\_\_ Associated Samples: \_\_\_\_\_

Analyte	Blank ID	Blank Action Limit	Sample Identification							

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".





XC #: 21990C59  
 XG #: 234964

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 3  
 Reviewer: MG  
 2nd Reviewer: [Signature]

ETHOD: Radiochemistry (Method: SEE cover )

ie following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Th-228	0.05 (pci/g)	0.0694 (pci/g)	Lab DL > GAPP RDL	None / P
	↓	Th-230	0.05	0.0796		
2	↓	Th-228	0.05	0.0828		
	↓	Th-230	0.05	0.0823		
	↓	9mD U-233/234	0.04	0.045		
	↓	U-238	0.04	0.045		
3	↓	Th-228	0.05	0.135		
	↓	Th-230	0.05	0.0975		
	↓	U-233/234	0.04	0.0504		
	↓	U-235/236	0.04	0.0501		
4	↓	Th-228	0.05	0.103		
	↓	Th-230	0.05	0.0844		
	↓	U-233/234	0.04	0.0419		
5	↓	Th-228	0.05	0.130		
	↓	Th-230	0.05	0.0973		
6	↓	Th-228	0.05	0.129		
	↓	Th-230	0.05	0.0555		
7	↓	Th-228	0.05	0.196		
	↓	Th-230	0.05	0.110		
	↓	Th-232	0.10	0.110		

Comments:

IC #: 21990C59  
 ICG #: 234964

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 2 of 3  
 Reviewer: MG  
 2nd Reviewer:

METHOD: Radiochemistry (Method: SEE COVER)

the following sample MDAs are above the RDL:

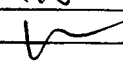
#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
8	↓	Th-228 Th-230	0.05 (pCi/g) 0.05	0.143 (pCi/g) 0.103	Lab DL > QAPP RDL	None / P
9	↓	Th-228 Th-230	0.05 0.05	0.124 0.0583		
10	↓	Th-228 Th-230 Th-232	0.05 0.05 0.10	0.184 0.0827 0.103		
11	↓	Th-228 Th-230	0.05 0.05	0.134 0.0706		
12	↓	Th-228 Th-230 Th-232	0.05 0.05 0.10	0.139 0.0787 0.114		
13	↓	Th-228 Th-230	0.05 0.05	0.109 0.0846		
14	↓	Th-228 Th-230	0.05 0.05	0.120 0.0863		
15	↓	Th-228 Th-230	0.05 0.05	0.105 0.094		
16	↓	Th-228 Th-230	0.05 0.05	0.135 0.0918		

Comments:



LDC #: 21990C59  
 SDG #: 234964

VALIDATION FINDINGS WORKSHEET  
 Field Duplicates

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: 

METHOD: Radiochemistry (Method: see cover)

Y  N  N/A  
 Y  N  N/A

Were field duplicate pairs identified in this SDG?

Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	2	3	
Th-228	2.26	2.01	12 ( $\leq 50$ )
Th-230	1.56	1.45	7 (   )
Th-232	1.86	1.61	14 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	2	3	
U-233/234	1.38	1.47	6 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0509	0.0855	difference 0.0346 ( $\leq 0.04$ )
U-238	1.29	1.23	5 <sup>RPD</sup> ( $\leq 50$ )

Isotopes	Activity ( pCi/g )		Qual parent only RPD
	7	8	
Th-228	1.95	1.75	11 ( $\leq 50$ )
Th-230	1.56	0.881	56 (   ) Jdets/A fd
Th-232	1.57	1.63	4 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	7	8	
U-233/234	1.62	1.57	3 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0542	0.0762	difference 0.0220 ( $\leq 0.04$ )
U-238	1.38	1.33	4 <sup>RPD</sup> ( $\leq 50$ )

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 11, 2009

**LDC Report Date:** December 5, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235177

### Sample Identification

SA107-0.5B	EB081109-SO
SA107-10B	RSAU6-0.5BMS
SA107009-10B	RSAU6-0.5BDUP
SA107-29B	
SA61-10B	
SA61-30B	
SA155-0.5B	
SA155009-0.5B	
SA155-10B	
SA155-30B	
SA115-0.5B	
SA115-10B	
SA115009-10B	
SA115-25B	
SA115-40B	
SA115-51B	
RSAU6-0.5B	
RSAU6-10B	
RSAU6-25B	
RSAU6-40B	

## Introduction

This data review covers 22 soil samples and one water sample listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB081109-SO was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB081109-SO	8/11/09	Thorium-228 Thorium-230	0.0703 pCi/L 0.0215 pCi/L	SA107-0.5B SA107-10B SA107009-10B SA107-29B SA61-10B SA61-30B SA155-0.5B SA155009-0.5B SA155-10B SA155-30B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Samples FB072909-SO (from SDG 234267) and FB080309-SO (from SDG 234414) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	SA107-0.5B SA107-10B SA107009-10B SA107-29B SA61-10B SA61-30B SA155-0.5B SA155009-0.5B SA155-10B SA155-30B
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	SA115-0.5B SA115-10B SA115009-10B SA115-25B SA115-40B SA115-51B RSAU6-0.5B RSAU6-10B RSAU6-25B RSAU6-40B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA107-0.5B	Thorium-228 Thorium-230 Thorium-232	0.146 0.0909 0.127	0.05 0.05 0.10	None None None	P
SA107-10B	Thorium-230 Uranium-233/234 Uranium-238	0.0782 0.0601 0.0499	0.05 0.04 0.04	None None None	P
SA107009-10B	Thorium-230 Uranium-233/234 Uranium-238	0.0955 0.0444 0.0444	0.05 0.04 0.04	None None None	P
SA107-29B	Thorium-230 Uranium-233/234	0.0671 0.0443	0.05 0.04	None None	P
SA61-10B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236	0.119 0.0976 0.127 0.0455 0.0452	0.05 0.05 0.10 0.04 0.04	None None None None None	P
SA61-30B	Thorium-228 Uranium-233/234	0.0662 0.0427	0.05 0.04	None None	P
SA155-0.5B	Thorium-228 Thorium-230	0.0665 0.0663	0.05 0.05	None None	P
SA155009-0.5B	Thorium-228 Thorium-230 Thorium-232	0.122 0.0839 0.105	0.05 0.05 0.10	None None None	P
SA155-10B	Thorium-228 Thorium-230 Uranium-233/234	0.143 0.109 0.0456	0.05 0.05 0.04	None None None	P
SA155-30B	Thorium-228 Thorium-230 Uranium-238	0.113 0.0596 0.0419	0.05 0.05 0.04	None None None	P
SA115-0.5B	Thorium-228 Thorium-230 Thorium-232	0.129 0.0802 0.112	0.05 0.05 0.10	None None None	P
SA115-10B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234	0.114 0.0935 0.122 0.0428	0.05 0.05 0.10 0.04	None None None None	P
SA115009-10B	Thorium-228	0.0715	0.05	None	P

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA115-25B	Thorium-228	0.0749	0.05	None	P
	Thorium-230	0.0746	0.05	None	
	Uranium-233/234	0.0416	0.04	None	
SA115-40B	Thorium-228	0.106	0.05	None	P
	Thorium-230	0.0731	0.05	None	
SA115-51B	Thorium-228	0.0848	0.05	None	P
	Thorium-230	0.0759	0.05	None	
	Uranium-233/234	0.0464	0.04	None	
	Uranium-238	0.0402	0.04	None	
RSAU6-0.5B	Thorium-228	0.0811	0.05	None	P
	Thorium-230	0.105	0.05	None	
RSAU6-10B	Thorium-228	0.0731	0.05	None	P
	Thorium-230	0.0631	0.05	None	
	Uranium-233/234	0.0468	0.04	None	
	Uranium-235/236	0.0401	0.04	None	
	Uranium-238	0.0406	0.04	None	
RSAU6-25B	Thorium-228	0.0956	0.05	None	P
RSAU6-40B	Thorium-228	0.126	0.05	None	P
	Thorium-230	0.110	0.05	None	
	Uranium-233/234	0.0422	0.04	None	

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
EB081109-SO	Uranium-238	0.0302	0.03	None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235177	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA107-10B and SA107009-10B, samples SA155-0.5B and SA155009-0.5B, and samples SA115-10B and SA115009-10B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA107-10B	SA107009-10B				
Thorium-228	2.01	2.07	3 ( $\leq 50$ )	-	-	-
Thorium-230	1.55	1.16	29 ( $\leq 50$ )	-	-	-
Thorium-232	2.08	1.57	28 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.36	1.87	32 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0874	0.0877	-	0.0003 ( $\leq 0.04$ )	-	-
Uranium-238	1.18	1.36	14 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA155-0.5B	SA155009-0.5B				
Thorium-228	2.06	1.83	12 ( $\leq 50$ )	-	-	-
Thorium-230	0.979	0.745	27 ( $\leq 50$ )	-	-	-
Thorium-232	1.77	1.97	11 ( $\leq 50$ )	-	-	-
Uranium-233/234	0.905	0.938	4 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0552	0.0702	-	0.0150 ( $\leq 0.04$ )	-	-
Uranium-238	0.839	0.878	5 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA115-10B	SA115009-10B				
Thorium-228	1.93	1.91	1 ( $\leq 50$ )	-	-	-
Thorium-230	1.22	1.71	33 ( $\leq 50$ )	-	-	-
Thorium-232	1.49	2.07	33 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.06	1.11	5 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0623	0.0547	-	0.0076 ( $\leq 0.04$ )	-	-
Uranium-238	1.15	1.06	8 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 235177**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235177	SA107-0.5B SA155009-0.5B SA115-0.5B	Thorium-228 Thorium-230 Thorium-232	None None None	P	Minimum detectable activity (PQL)
235177	SA107-10B SA107009-10B	Thorium-230 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity (PQL)
235177	SA107-29B	Thorium-230 Uranium-233/234	None None	P	Minimum detectable activity (PQL)
235177	SA61-10B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236	None None None None None	P	Minimum detectable activity (PQL)
235177	SA61-30B	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity (PQL)
235177	SA155-0.5B SA115-40B RSAU6-0.5B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
235177	SA155-10B SA115-25B RSAU6-40B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
235177	SA155-30B	Thorium-228 Thorium-230 Uranium-238	None None None	P	Minimum detectable activity (PQL)
235177	SA115-10B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234	None None None None	P	Minimum detectable activity (PQL)
235177	SA115009-10B RSAU6-25B	Thorium-228	None	P	Minimum detectable activity (PQL)
235177	SA115-51B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235177	RSAU6-10B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
235177	EB081109-SO	Uranium-238	None	P	Minimum detectable activity (PQL)
235177	SA107-0.5B SA107-10B SA107009-10B SA107-29B SA61-10B SA61-30B SA155-0.5B SA155009-0.5B SA155-10B SA155-30B SA115-0.5B SA115-10B SA115009-10B SA115-25B SA115-40B SA115-51B RSAU6-0.5B RSAU6-10B RSAU6-25B RSAU6-40B EB081109-SO	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 235177**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 235177**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 235177**

No Sample Data Qualified in this SDG



## Tronox Northgate Henderson

LDC #: 21990D59      **VALIDATION COMPLETENESS WORKSHEET**  
 SDG #: 235177      **Stage 2B**  
 Laboratory: GEL Laboratories LLC

Date: 12-1-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: ✓

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-11-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS/LCSD</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D=2+3, D=7+8, D=12+13</u>
X.	Field blanks	SW	<u>EB=21, FB=FB072909-SO (SDG: 234267)</u>

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

FB = FB080309-SO (SDG: 234414)

Validated Samples:

1	SA107-0.5B	S	11	SA115-0.5B	S	21 <sup>2</sup>	EB081109-SO	W	31
2	SA107-10B	↓	12	SA115-10B	↓	22	RSAU6-0.5BMS <sup>U Th</sup>	S	32
3	SA107009-10B	↓	13	SA115009-10B	↓	23	RSAU6-0.5BDUP <sup>U Th</sup>	↓	33
4	SA107-29B	↓	14	SA115-25B	↓	24 <sup>1</sup>	PBS		34
5	SA61-10B	↓	15	SA115-40B	↓	25 <sup>2</sup>	PBW		35
6	SA61-30B	↓	16	SA115-51B	↓	26			36
7	SA155-0.5B	↓	17	RSAU6-0.5B	↓	27			37
8	SA155009-0.5B	↓	18	RSAU6-10B	↓	28			38
9	SA155-10B	↓	19	RSAU6-25B	↓	29			39
10	SA155-30B	↓	20	RSAU6-40B	↓	30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990D59  
SDG #: 235177

VALIDATION FINDINGS WORKSHEET  
Field Blanks

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer:         

METHOD: Radiochemistry (Method: See Cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
Blank units: pci/L Associated sample units: pci/g  
Sampling date: 7-29-09  
Field blank type: (circle one) Field Blank / Rinsate / Other:         

Associated Samples: 1-10 (> 10x)

Analyte	Blank ID	Blank Action Limit	Sample Identification			
				No samples were qualified		
Th-228	0.0321	0.0003				

> RL

Blank units: pci/L Associated sample units: pci/g  
Sampling date: 8-11-09  
Field blank type: (circle one) Field Blank / Rinsate / Other: EB

Associated Samples: 1-10 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification			
				No samples were qualified		
Th-228	0.0703	0.00070				
Th-230	0.0215					

> RL  
> RL

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990D59  
SDG #: 235177

**VALIDATION FINDINGS WORKSHEET  
Field Blanks**

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer:    

METHOD: Radiochemistry (Method: see cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
Blank units: PCi/L Associated sample units: PCi/g  
Sampling date: 8-3-09  
Field blank type: (circle one) Field Blank / Rinsate / Other:    

Associated Samples: 11 -> 20 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification																	
FB08	0309-50		No samples were qualified																	
U-238	0.0126																			

Blank units:     Associated sample units:      
Sampling date:      
Field blank type: (circle one) Field Blank / Rinsate / Other:     Associated Samples:    

Analyte	Blank ID	Blank Action Limit	Sample Identification																	

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC #: 21990D59  
SDG #: 235177

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 of 3  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE COVER)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Th-228 Th-230 Th-232	0.05 0.05 0.10	0.146 (pci/g) 0.0909 0.127	Lab DL > QAPP RDL	None/P
2	↓	Th-230 U-233/234 U-238	0.05 0.04 0.04	0.0782 0.0601 0.0499		
3	↓	Th-228 U-233/234 U-238	0.05 0.04 0.04	0.0955 0.0444 0.0444		
4	↓	Th-230 U-233/234	0.05 0.04	0.0671 0.0443		
5	↓	Th-228 Th-230 Th-232 U-233/234 U-235/236	0.05 0.05 0.10 0.04 0.04	0.119 0.0976 0.127 0.0455 0.0452		
6	↓	Th-228 U-233/234	0.05 0.04	0.0662 0.0427		
7	↓	Th-228 Th-230	0.05 0.05	0.0665 0.0663		

Comments:

LDC #: 21990D59  
SDG #: 235177

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 2 of 3  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab MDA (units)	Lab DL (pci/g)	Finding	Qualifications
8	↓	Th-228	0.05	0.122	0.122 (pci/g)	Lab DL > GAPP RDL	None / P
		Th-230	0.05	0.0839	0.0839		
		Th-232	0.10	0.105	0.105		
9	↓	Th-228	0.05	0.143	0.143		
		Th-230	0.05	0.109	0.109		
		U-233/234	0.04	0.0456	0.0456		
10	↓	Th-228	0.05	0.113	0.113		
		Th-230	0.05	0.0596	0.0596		
		U-238	0.04	0.0419	0.0419		
11	↓	Th-228	0.05	0.129	0.129		
		Th-230	0.05	0.0802	0.0802		
		Th-232	0.10	0.112	0.112		
12	↓	Th-228	0.05	0.114	0.114		
		Th-230	0.05	0.0935	0.0935		
		Th-232	0.10	0.122	0.122		
		U-233/234	0.04	0.0428	0.0428		
13		Th-228	0.05	0.0715	0.0715		
14	↓	Th-228	0.05	0.0749	0.0749		
		Th-230	0.05	0.0746	0.0746		
		U-233/234	0.04	0.0416	0.0416		

Comments:

LDC #: 21990D59  
SDG #: 235177

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 3 of 3  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE COVER)

The following sample MDAs are above the RIDL:

#	Sample ID	Isotope	QAPP POL RIDL (units)	Lab DL MDA (units)	Finding	Qualifications
15	15 ↓	Th-228 Th-230	0.05 0.05	0.106 (pci/g) 0.0731	Lab DL > QAPP POL	None / P
16	16 ↓	Th-228 Th-230 U-233/234 U-238	0.05 0.05 0.04 0.04	0.0848 0.0759 0.0464 0.0402		
17	17 ↓	Th-228 Th-230	0.05 0.05	0.0811 0.105		
18	18 ↓	Th-228 Th-230 U-233/234 U-235/236 U-238	0.05 0.05 0.04 0.04 0.04	0.0731 0.0631 0.0468 0.0401 0.0406		
19	19	Th-228	0.05	0.0956		
20	20 ↓	Th-228 Th-230 U-233/234	0.05 0.05 0.04	0.126 0.110 0.0422 ↓		
21	21	U-238	0.03	0.0302 (pci/L)		

Comments:

LDC #: 21990D59  
 SDG #: 235177

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 2  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: See cover)

- N/A Were field duplicate pairs identified in this SDG?  
 N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	2	3	
Tu-228	2.01	2.07	3 ( $\leq 50$ )
Tu-230	1.55	1.16	29 (   )
Tu-232	2.08	1.57	28 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	2	3	
U-233/234	1.36	1.87	32 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0874	0.0877	difference 0.0003 ( $\leq 0.04$ )
U-238	1.18	1.36	14 <sup>RPD</sup> ( $\leq 50$ )

Isotopes	Activity ( pCi/g )		RPD
	7	8	
Tu-228	2.06	1.83	12 ( $\leq 50$ )
Tu-230	0.979	0.745	27 (   )
Tu-232	1.77	1.97	11 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	7	8	
U-233/234	0.905	0.938	4 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0552	0.0702	difference 0.0150 ( $\leq 0.04$ )
U-238	0.839	0.878	5 <sup>RPD</sup> ( $\leq 50$ )

LDC #: 21990D59  
 SDG #: 23517

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 2 of 2  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	12	13	
Tn-228	1.93	1.91	1 (≤50)
Tn-230	1.22	1.71	33 (   )
Tn-232	1.49	2.07	33 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	12	13	
U-233/234	1.06	1.11	5 <sup>RPD</sup> (≤50)
U-235/236	0.0623	0.0547	0.0076 (≤0.04)
U-238	1.15	1.06	8 <sup>RPD</sup> (≤50)

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 11 through August 20, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235208

### Sample Identification

RSAU6-53B	SA70-10BMS
SA86-10B	SA70-10BDUP
SA86009-10B	
SA86-28B	
RSAM6-10B	
RSAM6-28B	
RSAM6009-28B	
SA70-10B	
SA70-30B	
SA167-0.5B	
SA167-10B	
SA167009-10B	
SA167-28B	
EB081909-SO1	
SA197-10B	
SA197009-10B	
SA197-21B	
SA104-10B	
SA104009-10B	
SA104-30B	

## Introduction

This data review covers 21 soil samples and one water sample listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBS (prep blank)	Thorium-228	0.191 pCi/g	All soil samples in SDG 235208

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified with the following exceptions:

Sample	Isotope	Reported Activity	Modified Final Activity
RSAU6-53B	Thorium-228	1.41 pCi/g	1.41J+ pCi/g
SA86-10B	Thorium-228	1.60 pCi/g	1.60J+ pCi/g
SA86009-10B	Thorium-228	1.85 pCi/g	1.85J+ pCi/g
SA86-28B	Thorium-228	0.618 pCi/g	0.618J+ pCi/g
RSAM6-28B	Thorium-228	1.43 pCi/g	1.43J+ pCi/g

Sample	Isotope	Reported Activity	Modified Final Activity
RSAM6009-28B	Thorium-228	1.19 pCi/g	1.19J+ pCi/g
SA70-30B	Thorium-228	1.48 pCi/g	1.48J+ pCi/g
SA167-0.5B	Thorium-228	1.84 pCi/g	1.84J+ pCi/g
SA167-10B	Thorium-228	1.77 pCi/g	1.77J+ pCi/g
SA167009-10B	Thorium-228	1.76 pCi/g	1.76J+ pCi/g
SA167-28B	Thorium-228	1.23 pCi/g	1.23J+ pCi/g
SA197-10B	Thorium-228	1.72 pCi/g	1.72J+ pCi/g
SA197-21B	Thorium-228	1.55 pCi/g	1.55J+ pCi/g
SA104-10B	Thorium-228	1.68 pCi/g	1.68J+ pCi/g
SA104009-10B	Thorium-228	1.84 pCi/g	1.84J+ pCi/g
SA104-30B	Thorium-228	1.38 pCi/g	1.38J+ pCi/g

Sample EB081909-SO1 was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB081909-SO1	8/19/09	Thorium-228 Thorium-230	0.0548 pCi/L 0.038 pCi/L	RSAM6-10B RSAM6-28B RSAM6009-28B SA70-10B SA70-30B SA167-0.5B SA167-10B SA167009-10B SA167-28B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Samples FB072909-SO (from SDG 234267) and F080309-SO (from SDG 234414) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	SA86-10B SA86009-10B SA86-28B RSAM6-10B RSAM6-28B RSAM6009-28B SA70-10B SA70-30B SA167-0.5B SA167-10B SA167009-10B SA167-28B SA197-10B SA197009-10B SA197-21B SA104-10B SA104009-10B SA104-30B
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	RSAU6-53B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAU6-53B	Thorium-228	0.0631	0.05	None	P
	Uranium-233/234	0.0417	0.04	None	
	Uranium-238	0.0506	0.04	None	
SA86-10B	Thorium-228	0.136	0.05	None	P
	Thorium-230	0.0611	0.05	None	
	Uranium-233/234	0.0722	0.04	None	
	Uranium-235/236	0.0484	0.04	None	
	Uranium-238	0.060	0.04	None	
SA86009-10B	Thorium-228	0.150	0.05	None	P
	Thorium-230	0.0747	0.05	None	
	Uranium-233/234	0.0539	0.04	None	
	Uranium-238	0.041	0.04	None	
SA86-28B	Thorium-228	0.122	0.05	None	P
	Thorium-230	0.0931	0.05	None	
	Uranium-233/234	0.0588	0.04	None	
	Uranium-238	0.0402	0.04	None	
RSAM6-10B	Thorium-228	0.0766	0.05	None	P
	Thorium-230	0.0761	0.05	None	
	Uranium-233/234	0.0577	0.04	None	
RSAM6-28B	Thorium-228	0.192	0.05	None	P
	Thorium-230	0.146	0.05	None	
	Uranium-233/234	0.060	0.04	None	
	Uranium-235/236	0.0401	0.04	None	
	Uranium-238	0.0454	0.04	None	
RSAM6009-28B	Thorium-228	0.0923	0.05	None	P
	Thorium-230	0.0636	0.05	None	
	Uranium-233/234	0.0638	0.04	None	
	Uranium-235/236	0.0426	0.04	None	
	Uranium-238	0.0518	0.04	None	
SA70-10B	Thorium-228	0.132	0.05	None	P
	Uranium-233/234	0.0607	0.04	None	
	Uranium-235/236	0.0513	0.04	None	
	Uranium-238	0.0503	0.04	None	
SA70-30B	Thorium-228	0.138	0.05	None	P
	Thorium-230	0.0955	0.05	None	
	Uranium-233/234	0.0429	0.04	None	
SA167-0.5B	Thorium-228	0.109	0.05	None	P
	Thorium-230	0.0577	0.05	None	
	Uranium-233/234	0.053	0.04	None	
	Uranium-238	0.0407	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA167-10B	Thorium-228	0.0746	0.05	None	P
	Thorium-230	0.0593	0.05	None	
	Uranium-233/234	0.0702	0.04	None	
	Uranium-235/236	0.042	0.04	None	
SA167009-10B	Thorium-228	0.115	0.05	None	P
	Thorium-230	0.0543	0.05	None	
	Uranium-233/234	0.0472	0.04	None	
	Uranium-235/236	0.0583	0.04	None	
SA167-28B	Thorium-228	0.0596	0.05	None	P
	Thorium-230	0.0743	0.05	None	
	Uranium-233/234	0.0551	0.04	None	
	Uranium-235/236	0.0453	0.04	None	
SA197-10B	Thorium-228	0.0741	0.05	None	P
	Uranium-233/234	0.0594	0.04	None	
SA197009-10B	Thorium-230	0.105	0.05	None	P
SA197-21B	Thorium-228	0.109	0.05	None	P
	Thorium-230	0.068	0.05	None	
	Uranium-233/234	0.0446	0.04	None	
SA104-10B	Thorium-230	0.0608	0.05	None	P
	Uranium-233/234	0.0522	0.04	None	
	Uranium-238	0.0578	0.04	None	
SA104009-10B	Thorium-228	0.0815	0.05	None	P
	Uranium-233/234	0.0408	0.04	None	
	Uranium-235/236	0.0403	0.04	None	
SA104-30B	Thorium-230	0.0596	0.05	None	P

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
EB081909-SO1	Thorium-228	0.0395	0.03	None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All sample result verifications were acceptable.



All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235208	All isotopes reported below the PQL	J (all detects)	A

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA86-10B and SA86009-10B, samples RSAM6-28B and RSAM6009-28B, samples SA167-10B and SA167009-10B, samples SA197-10B and SA197009-10B, and samples SA104-10B and SA104009-10B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA86-10B	SA86009-10B				
Thorium-228	1.60	1.85	14 ( $\leq 50$ )	-	-	-
Thorium-230	1.78	1.77	1 ( $\leq 50$ )	-	-	-
Thorium-232	1.64	1.66	1 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.83	1.69	8 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0963	0.0948	-	0.0015 ( $\leq 0.04$ )	-	-
Uranium-238	1.51	1.31	14 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAM6-28B	RSAM6009-28B				
Thorium-228	1.43	1.19	18 ( $\leq 50$ )	-	-	-
Thorium-230	3.35	2.87	15 ( $\leq 50$ )	-	-	-
Thorium-232	1.32	1.30	2 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAM6-28B	RSAM6009-28B				
Uranium-233/234	2.95	2.97	1 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.159	0.147	-	0.012 ( $\leq 0.04$ )	-	-
Uranium-238	2.70	2.52	7 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA167-10B	SA167009-10B				
Thorium-228	1.77	1.76	1 ( $\leq 50$ )	-	-	-
Thorium-230	2.59	2.74	6 ( $\leq 50$ )	-	-	-
Thorium-232	1.82	1.60	13 ( $\leq 50$ )	-	-	-
Uranium-233/234	2.29	2.18	5 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0921	0.0827	-	0.0094 ( $\leq 0.04$ )	-	-
Uranium-238	2.15	2.00	7 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA197-10B	SA197009-10B				
Thorium-228	1.72	2.21	25 ( $\leq 50$ )	-	-	-
Thorium-230	2.80	2.85	2 ( $\leq 50$ )	-	-	-
Thorium-232	1.54	1.68	9 ( $\leq 50$ )	-	-	-
Uranium-233/234	2.33	2.74	16 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.139	0.145	-	0.006 ( $\leq 0.04$ )	-	-
Uranium-238	2.31	2.45	6 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA104-10B	SA104009-10B				
Thorium-228	1.68	1.84	9 ( $\leq 50$ )	-	-	-
Thorium-230	1.48	1.25	17 ( $\leq 50$ )	-	-	-
Thorium-232	1.64	1.72	5 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.15	1.03	11 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0717	0.105	-	0.0333 ( $\leq 0.04$ )	-	-
Uranium-238	1.02	1.06	4 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 235208**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235208	RSAU6-53B	Thorium-228 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity
235208	SA86-10B RSAM6-28B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity
235208	SA86009-10B SA86-28B SA167-0.5B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity
235208	RSAM6-10B SA70-30B SA197-21B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity
235208	RSAM6009-28B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity
235208	SA70-10B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity
235208	SA167-10B SA167009-10B SA167-28B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity
235208	SA197-10B	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity
235208	SA197009-10B SA104-30B	Thorium-230	None	P	Minimum detectable activity
235208	SA104-10B	Thorium-230 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity
235208	SA104009-10B	Thorium-228 Uranium-233/234 Uranium-235/236	None None None	P	Minimum detectable activity

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235208	EB081909-SO1	Thorium-228	None	P	Minimum detectable activity
235208	RSAU6-53B SA86-10B SA86009-10B SA86-28B RSAM6-10B RSAM6-28B RSAM6009-28B SA70-10B SA70-30B SA167-0.5B SA167-10B SA167009-10B SA167-28B EB081909-SO1 SA197-10B SA197009-10B SA197-21B SA104-10B SA104009-10B SA104-30B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
 Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
 - SDG 235208**

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
235208	RSAU6-53B	Thorium-228	1.41J+ pCi/g	A	bl
235208	SA86-10B	Thorium-228	1.60J+ pCi/g	A	bl
235208	SA86009-10B	Thorium-228	1.85J+ pCi/g	A	bl
235208	SA86-28B	Thorium-228	0.618J+ pCi/g	A	bl
235208	RSAM6-28B	Thorium-228	1.43J+ pCi/g	A	bl
235208	RSAM6009-28B	Thorium-228	1.19J+ pCi/g	A	bl
235208	SA70-30B	Thorium-228	1.48J+ pCi/g	A	bl
235208	SA167-0.5B	Thorium-228	1.84J+ pCi/g	A	bl
235208	SA167-10B	Thorium-228	1.77J+ pCi/g	A	bl

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
235208	SA167009-10B	Thorium-228	1.76J+ pCi/g	A	bl
235208	SA167-28B	Thorium-228	1.23J+ pCi/g	A	bl
235208	SA197-10B	Thorium-228	1.72J+ pCi/g	A	bl
235208	SA197-21B	Thorium-228	1.55J+ pCi/g	A	bl
235208	SA104-10B	Thorium-228	1.68J+ pCi/g	A	bl
235208	SA104009-10B	Thorium-228	1.84J+ pCi/g	A	bl
235208	SA104-30B	Thorium-228	1.38J+ pCi/g	A	bl

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification  
Summary - SDG 235208**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 235208**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990E59

**VALIDATION COMPLETENESS WORKSHEET**

Date: 12-1-09

SDG #: 235208

Stage 4

Page: 1 of 1

Laboratory: GEL Laboratories LLC

Reviewer: MG

2nd Reviewer: ✓

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-11-09 through 8-20-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVa.	Laboratory control samples	A	LCS/LCSD
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	A	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	D = 2+3, D = 6+7, D = 11+12, D = 15+16, D = 18+19
X.	Field blanks	SW	EB = 14, FB = FB072909-SO (SDG: 234267)

FB = FB080309-SO (SDG: 234414)

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:

1	RSAU6-53B	S	11	SA167-10B	S	21	SA70-10BMS	<sup>u</sup> <sup>Th</sup> S	31
2	SA86-10B		12	SA167009-10B		22	SA70-10BDUP	<sup>u</sup> <sup>Th</sup> ↓	32
3	SA86009-10B		13	SA167-28B	↓	23	PBS		33
4	SA86-28B		14 <sup>2</sup>	EB081909-SO1	W	24 <sup>2</sup>	PBW		34
5	RSAM6-10B		15	SA197-10B	S	25			35
6	RSAM6-28B		16	SA197009-10B		26			36
7	RSAM6009-28B		17	SA197-21B		27			37
8	SA70-10B		18	SA104-10B		28			38
9	SA70-30B		19	SA104009-10B		29			39
10	SA167-0.5B	↓	20	SA104-30B	↓	30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Method: Radiochemistry (EPA Method See cover )

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical Holding Times</b>				
All technical holding times were met.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>II. Calibration</b>				
Were all instruments and detectors calibration as required?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were NIST traceable standards used for all calibrations?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was the check source identified by activity and radionuclide?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were check sources including background counts analyzed at the required frequency and within laboratory control limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>III. Blanks</b>				
Were blank analyses performed as required?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>IV. Matrix Spikes and Duplicates</b>				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / <u>Water</u>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was a duplicate sample analyzed at the required frequency of 5% in this SDG?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all duplicate sample duplicate error ratios (DER) $\leq 1.427$ .	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>V. Laboratory Control Samples</b>				
Was an LCS analyzed per analytical batch?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>VI. Sample Chemical/Carrier Recovery</b>				
Was a tracer/carrier added to each sample?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were tracer/carrier recoveries within the QC limits?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>VII. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Were the performance evaluation (PE) samples within the acceptance limits?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>VIII. Sample Result Verification</b>				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were the Minimum Detectable Activities (MDA) $< RL$ ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



LDC #: 21990E57  
SDG #: 235208

VALIDATION FINDINGS CHECKLIST

Page: 2 of  
Reviewer: MG  
2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>IX. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>X. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Target analytes were detected in the field duplicates.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>XI. Field blanks</b>				
Field blanks were identified in this SDG.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Target analytes were detected in the field blanks.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

LDC #: 21990E59  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**

Blanks

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:   

Qual: J+ b1

METHOD: Radiochemistry (Method: See cover)

N N/A Were blank analyses performed as required? If no, please see qualifications below.

N N/A Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see qualifications below.

Units: pci/g Associated Samples: all soil

Isotope	Blank ID	Blank Action Level	Sample Identification																	
			1	2	3	4	6	7	9	10	11	12								
Th-228	PBS	0.191	1.41	1.60	1.85	0.618	1.43	1.19	1.48	1.84	1.77	1.76								

Units: pci/g Associated Samples: all soil

Isotope	Blank ID	Blank Action Level	Sample Identification																	
			13	15	17	18	19	20	1.84	1.38										
Th-228	PBS	0.191	1.23	1.72	1.55	1.68	1.84	1.38												

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT: If there is activity in the blank above the MDA, sample results within 10x the blank activity will be qualified as not detected "U".





DC #: 21990E59  
 DG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 4  
 Reviewer: MG  
 2nd Reviewer:

METHOD: Radiochemistry (Method: SEE COVER)

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Lab DL (pci/g)	Finding	Qualifications
1	↓	Th-228 U-233/234 U-238	0.05 0.04 0.04	0.0631 (pci/g) 0.0417 0.0506	0.0631 (pci/g)	Lab DL > QAPP RDL	None / P
2	↓	Th-228 Th-230 U-233/234 U-235/236 U-238	0.05 0.05 0.04 0.04 0.04	0.136 0.0611 0.0722 0.0484 0.060			
3	↓	Th-228 Th-230 U-233/234 U-238	0.05 0.05 0.04 0.04	0.150 0.0747 0.0539 0.041			
4	↓	Th-228 Th-230 U-233/234 U-238	0.05 0.05 0.04 0.04	0.122 0.0931 0.0588 0.0402			
5	↓	Th-228 Th-230 U-233/234	0.05 0.05 0.04	0.0766 0.0761 0.0577			

Comments:



LDC #: 21990E59  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 3 of 4  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
11	↓	Th-228	0.05 (pci/g)	0.0746 (pci/g)	Lab DL > GAPP RDL	None/P
		Th-230	0.05	0.0593		
		U-233/234	0.04	0.0702		
		U-235/236	0.04	0.042		
12	↓	Th-228	0.05	0.115		
		Th-230	0.05	0.0543		
		U-233/234	0.04	0.0472		
		U-235/236	0.04	0.0583		
13	↓	Th-228	0.05	0.0596		
		Th-230	0.05	0.0743		
		U-233/234	0.04	0.0551		
		U-235/236	0.04	0.0453		
14	↓	Th-228	0.03 (pci/L)	0.0395 (pci/L)		
		Th-230	0.05	0.105		
15	↓	Th-228	0.05 (pci/g)	0.0741 (pci/g)		
		U-233/234	0.04	0.0594		
16	↓	Th-228	0.05	0.109		
		Th-230	0.05	0.068		
17	↓	Th-228	0.04	0.0446		
		U-233/234	0.04			

Comments:





LDC #: 21990E59  
 SDG #: 235208

VALIDATION FINDINGS WORKSHEET  
 Field Duplicates

Page: 1 of 3  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	2	3	
Th-228	1.60	1.85	14 ( $\leq 50$ )
Th-230	1.78	1.77	1 (   )
Th-232	1.64	1.66	1 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	2	3	
U-233/234	1.83	1.69	8 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0963	0.0948	difference 0.0015 ( $\leq 0.04$ )
U-238	1.51	1.31	14 <sup>RPD</sup> ( $\leq 50$ )

Isotopes	Activity ( pCi/g )		RPD
	6	7	
Th-228	1.43	1.19	18 ( $\leq 50$ )
Th-230	3.35	2.87	15 (   )
Th-232	1.32	1.30	2 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	6	7	
U-233/234	2.95	2.97	1 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.159	0.147	difference 0.012 ( $\leq 0.04$ )
U-238	2.70	2.52	7 <sup>RPD</sup> ( $\leq 50$ )

LDC #: 21990E59  
 SDG #: 235208

VALIDATION FINDINGS WORKSHEET  
Field Duplicates

Page: 2 of 3  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: see cover)

- N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	11	12	
Th-228	1.77	1.76	1 (≤50)
Th-230	2.59	2.74	6 (   )
Th-232	1.82	1.60	13 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	11	12	
U-233/234	2.29	2.18	5 <sup>RPD</sup> (≤50)
U-235/236	0.0921	0.0827	difference 0.0094 (≤0.04)
U-238	2.15	2.00	7 <sup>RPD</sup> (≤50)

Isotopes	Activity ( pCi/g )		RPD
	15	16	
Th-228	1.72	2.21	25 (≤50)
Th-230	2.80	2.85	2 (   )
Th-232	1.54	1.68	9 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	15	16	
U-233/234	2.33	2.74	16 <sup>RPD</sup> (≤50)
U-235/236	0.139	0.145	difference 0.006 (≤0.04)
U-238	2.31	2.45	6 <sup>RPD</sup> (≤50)

LDC #: 21990E59  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 3 of 3  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: see cover)

N N/A  
 Y N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( $\text{pCi/g}$ )		RPD
	18	19	
Th-228	1.68	1.84	9 ( $\leq 50$ )
Th-230	1.48	1.25	17 (   )
Th-232	1.64	1.72	5 ( ↓ )

Isotopes	Activity ( $\text{pCi/g}$ )		difference / RPD
	18	19	
U-233 / 234	1.15	1.03	<sup>RPD</sup> 11 ( $\leq 50$ )
U-235 / 236	0.0717	0.105	difference 0.0333 ( $\leq 0.04$ )
U-238	1.02	1.06	<sup>RPD</sup> 4 ( $\leq 50$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

LDC #: 21990E59  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:   

METHOD: Radiochemistry (Method: See cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recalculated using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = activity of each analyte measured in the analysis of the sample.  
 True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where, S = Original sample activity  
 D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated		Reported %R or RPD	Acceptable (Y/N)
					%R or RPD	%R or RPD		
LCS	Laboratory control sample	Th-230	9.22 (pci/g)	8.30 (pci/g)	111	111	111	Y
21	Matrix spike sample	U-238	4.64 (pci/g)	4.93 (pci/g)	94.1	94.1	94.1	
22	Duplicate RPD	Th-232	1.90 (pci/g)	1.79 (pci/g)	5.96	5.89	5.89	
1	Chemical recovery	U-232	4.77337 (dpm)	5.26247 (dpm)	90.7	90.7	90.7	

Comments: Refer to appropriate worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 2190E59  
 SDG #: 235208

**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".  
 (Y) N N/A Have results been reported and calculated correctly?  
 (Y) N N/A Are results within the calibrated range of the instruments?

Analyte results for # 1, Th-232 reported with a positive detect were recalculated and verified using the following equation:

Activity = 
$$\frac{(cpm - bckgrd\ cpm)}{(2.22)(E)(Vol)(CF)} = 1.4523\ \text{pCi/g}$$

Recalculation: 
$$\frac{(177.00 / 1000.)}{(2.22)(0.258400)(0.254)(0.83643)}$$

E = Efficiency  
 Vol = Volume  
 CF = %R, Self-absorbance, abundance, ect.

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
1	1	Th-228	1.41	1.40	Y
		Th-230	2.00	2.00	
		Th-232	1.45	1.45	
		U-233/234	1.73	1.73	
		U-235/236	0.0606	0.0606	
		U-238	1.62	1.62	
2	11	Th-228	1.77	1.76	
		Th-230	2.59	2.59	
		Th-232	1.82	1.82	
		U-233/234	2.29	2.29	
		U-235/236	0.0921	0.0921	
		U-238	2.15	2.15	

Note: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 20 through August 21, 2009

**LDC Report Date:** December 5, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235782

### Sample Identification

SA198-10B  
SA198-27B  
SA175-10B  
SA175-28B  
SA139-0.5B  
SA139-10B  
SA139-25B  
SA139009-25B  
SA139-35B  
RSAT5-0.5B  
RSAT5-10B  
RSAT5-25B  
RSTA5-40B  
RSAT5-51B  
EB082009-SO2  
RSAO6-10B  
RSAO6-20B  
RSAO6-34B  
RSAO6-34BMS  
RSAO6-34BDUP

## Introduction

This data review covers 19 soil samples and one water sample listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples EB082109-SO1 (from SDG 235860) and EB082009-SO2 were identified as equipment blanks. No isotopic uranium or isotopic thorium were found in these blanks with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB082009-SO2	8/20/09	Thorium-228 Thorium-232	0.0523 pCi/L 0.0129 pCi/L	RSAT5-0.5B RSAT5-10B RSAT5-25B RSTA5-40B RSAT5-51B
EB082109-SO1	8/21/09	Uranium-235/236	0.00986 pCi/L	RSAO6-10B RSAO6-20B RSAO6-34B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Sample FB072909-SO (from SDG 234267), FB080309-SO (from SDG 234414), and FB082809-SO (from SDG 236238) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	SA198-10B SA198-27B SA175-10B SA175-28B RSAO6-10B RSAO6-20B RSAO6-34B
FB082809-SO	8/28/09	Thorium-228 Uranium-235/236	0.0263 pCi/L 0.00837 pCi/L	SA139-05B SA139-10B SA139-25B SA139009-25B SA139-35B
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	RSAT5-05B RSAT5-10B RSAT5-25B RSTA5-40B RSAT5-51B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA198-10B	Thorium-228 Uranium-233/234 Uranium-235/236	0.0599 0.048 0.0411	0.05 0.04 0.04	None None None	P
SA198-27B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236	0.184 0.124 0.124 0.0485 0.0467	0.05 0.05 0.10 0.04 0.04	None None None None None	P
SA175-10B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.195 0.154 0.182 0.0503 0.104	0.05 0.05 0.04 0.04 0.04	None None None None None	P
SA175-28B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	0.103 0.121 0.0936 0.106	0.05 0.04 0.04 0.04	None None None None	P
SA139-05B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.102 0.0906 0.0814 0.0872 0.0814	0.05 0.05 0.04 0.04 0.04	None None None None None	P
SA139-10B	Thorium-228 Thorium-230 Uranium-233/234	0.145 0.098 0.050	0.05 0.05 0.04	None None None	P
SA139-25B	Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.0982 0.0577 0.0515 0.0417	0.05 0.04 0.04 0.04	None None None None	P
SA139009-25B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	0.0818 0.0769 0.055 0.0795	0.05 0.04 0.04 0.04	None None None None	P
SA139-35B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.118 0.107 0.0656 0.0463 0.0602	0.05 0.05 0.04 0.04 0.04	None None None None None	P
RSAT5-05B	Thorium-228 Thorium-230 Thorium-232 Uranium-235/236 Uranium-238	0.127 0.0716 0.143 0.0443 0.046	0.05 0.05 0.10 0.04 0.04	None None None None None	P

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAT5-10B	Thorium-228	0.102	0.05	None	P
	Thorium-230	0.0789	0.05	None	
	Uranium-235/236	0.0433	0.04	None	
RSAT5-25B	Thorium-228	0.134	0.05	None	P
	Thorium-230	0.0957	0.05	None	
	Uranium-233/234	0.0544	0.04	None	
RSTA5-40B	Thorium-228	0.942	0.05	None	P
	Thorium-230	0.0644	0.05	None	
	Uranium-233/234	0.105	0.04	None	
	Uranium-235/236	0.0721	0.04	None	
	Uranium-238	0.0675	0.04	None	
RSAT5-51B	Thorium-228	0.0709	0.05	None	P
	Thorium-230	0.0876	0.05	None	
	Uranium-233/234	0.0622	0.04	None	
	Uranium-235/236	0.0511	0.04	None	
	Uranium-238	0.0414	0.04	None	
RSAO6-10B	Thorium-228	0.158	0.05	None	P
	Thorium-230	0.102	0.05	None	
	Uranium-233/234	0.0682	0.04	None	
	Uranium-235/236	0.0527	0.04	None	
RSAO6-20B	Thorium-228	0.080	0.05	None	P
	Thorium-230	0.0631	0.05	None	
	Uranium-233/234	0.0675	0.04	None	
	Uranium-235/236	0.0577	0.04	None	
	Uranium-238	0.0818	0.04	None	
RSAO6-34B	Thorium-228	0.0794	0.05	None	P
	Thorium-230	0.0627	0.05	None	
	Uranium-233/234	0.108	0.04	None	
	Uranium-235/236	0.0721	0.04	None	
	Uranium-238	0.0894	0.04	None	

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
EB082009-SO2	Thorium-228	0.0333	0.03	None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 235782	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA139-25B and SA139009-25B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA139-25B	SA139009-25B				
Thorium-228	1.88	1.97	5 ( $\leq 50$ )	-	-	-
Thorium-230	1.78	1.75	2 ( $\leq 50$ )	-	-	-
Thorium-232	1.78	1.48	18 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.22	1.33	9 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0559	0.0696	-	0.0137 ( $\leq 0.04$ )	-	-
Uranium-238	1.12	1.06	6 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 235782**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235782	SA198-10B	Thorium-228 Uranium-233/234 Uranium-235/236	None None None	P	Minimum detectable activity (PQL)
235782	SA198-27B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236	None None None None None	P	Minimum detectable activity (PQL)
235782	SA175-10B SA139-0.5B SA139-35B RSTA5-40B RSAT5-51B RSAO6-20B RSAO6-34B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
235782	SA175-28B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
235782	SA139-10B RSAT5-25B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
235782	SA139-25B	Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
235782	SA139009-25B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
235782	RSAT5-10B	Thorium-228 Thorium-230 Uranium-235/236	None None None	P	Minimum detectable activity (PQL)
235782	RSO6-10B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235782	RSAT5-0.5B	Thorium-228 Thorium-230 Thorium-232 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
235782	EB082009-SO2	Thorium-228	None	P	Minimum detectable activity (PQL)
235782	SA198-10B SA198-27B SA175-10B SA175-28B SA139-0.5B SA139-10B SA139-25B SA139009-25B SA139-35B RSAT5-0.5B RSAT5-10B RSAT5-25B RSTA5-40B RSAT5-51B EB082009-SO2 RSAO6-10B RSAO6-20B RSAO6-34B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 235782**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 235782**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 235782**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990F59  
 SDG #: 235782  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-20-09 through 8-21-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS/LCSD</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D = 7+8</u>
X.	Field blanks	SW	<u>EB=15, EB082109-S01 (SDG: 235860)</u>

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

FB = FB072909-S0 (SDG: 234267)

FB = FB082809-S0 (SDG: 236238)

FB = FB080309-S0 (SDG: 234414)

Validated Samples:

1	SA198-10B	S	11	RSAT5-10B	S	21	PBS	31	
2	SA198-27B		12	RSAT5-25B		22	PBW	32	
3	SA175-10B		13	RSTA5-40B		23		33	
4	SA175-28B		14	RSAT5-51B		24		34	
5	SA139-0.5B		15	EB082009-SO2	W	25		35	
6	SA139-10B		16	RSAO6-10B	S	26		36	
7	SA139-25B		17	RSAO6-20B		27		37	
8	SA139009-25B		18	RSAO6-34B		28		38	
9	SA139-35B		19	RSAO6-34BMS	U Th	29		39	
10	RSAT5-0.5B		20	RSAO6-34BDUP	U Th	30		40	

Notes: \_\_\_\_\_









DC #: 21990 F59  
 CG #: 235782

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 4  
 Reviewer: MG  
 2nd Reviewer: [Signature]

ETHOD: Radiochemistry (Method: See Cover)

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MBA (units)	Lab DL (pci/g)	Finding	Qualifications
1	↓	Th-228	0.05 (pci/g)	0.0599 (pci/g)		Lab DL > QAPP RDL	None / P
		U-233/234	0.04	0.048			
		U-235/236	0.04	0.0411			
2	↓	Th-228	0.05	0.184			
		Th-230	0.05	0.124			
		Th-232	0.10	0.124			
		U-233/234	0.04	0.0485			
		U-235/236	0.04	0.0467			
3	↓	Th-228	0.05	0.195			
		Th-230	0.05	0.154			
		U-233/234	0.04	0.182			
		U-235/236	0.04	0.0503			
		U-238	0.04	0.104			
4	↓	Th-228	0.05	0.103			
		U-233/234	0.04	0.121			
		U-235/236	0.04	0.0936			
5	↓	Th-228	0.05	0.106			
		Th-230	0.05	0.102			
		U-233/234	0.04	0.0906			
		U-235/236	0.04	0.0814			
		U-238	0.04	0.0872			
			0.04	0.0814			

Comments:

LDC #: 21990F 59  
SDG #: 235782

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 2 of 4  
Reviewer: MG  
2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	GAPP RDL (pci/g)	Lab DL MDA (units)	Lab DL (pci/g)	Finding	Qualifications
6	↓	Tu-228	0.05	0.145	0.098	0.145	Lab DL > GAPP rdl	None/P
		Tu-230	0.05		0.050			
		U-233/234	0.04					
7	↓	Tu-230	0.05		0.0982			
		U-233/234	0.04		0.0577			
		U-235/236	0.04		0.0515			
		U-238	0.04		0.0417			
8	↓	Tu-228	0.05		0.0818			
		U-233/234	0.04		0.0769			
		U-235/236	0.04		0.055			
		U-238	0.04		0.0795			
9	↓	Tu-228	0.05		0.118			
		Tu-230	0.05		0.107			
		U-233/234	0.04		0.0656			
		U-235/236	0.04		0.0463			
10	↓	U-238	0.04		0.0602			
		Tu-228	0.05		0.127			
		Tu-230	0.05		0.0716			
		Tu-232	0.10		0.143			
	↓	U-235/236	0.04		0.0443			
		U-238	0.04		0.046			

Comments:

LDC #: 21990F59  
 SDG #: 235782

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 4  
 Reviewer: MG  
 2nd Reviewer:

METHOD: Radiochemistry (Method: see cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
11	↓ ↓	Tu-228	0.05 (pci/g)	0.102 (pci/g)	Lab DL > GAPP RDL	None / P
		Tu-230	0.05	0.0789		
		U-235/236	0.04	0.0433		
12	↓ ↓	Tu-228	0.05	0.134		
		Tu-230	0.05	0.0957		
		U-233/234	0.04	0.0544		
13	↓ ↓	Tu-228	0.05	0.0942		
		Tu-230	0.05	0.0644		
		U-233/234	0.04	0.105		
14	↓ ↓	U-235/236	0.04	0.0721		
		U-238	0.04	0.0675		
		Tu-228	0.05	0.0709		
15	↓ ↓	Tu-230	0.05	0.0876		
		U-233/234	0.04	0.0622		
		U-235/236	0.04	0.0511		
16	↓ ↓	U-238	0.04	0.0414		
		Tu-228	0.03 (pci/L)	0.0333 (pci/L)		
		Tu-228	0.05 (pci/g)	0.158 (pci/g)		
	↓ ↓	Tu-230	0.05	0.102		
		U-233/234	0.04	0.0682		
		U-235/236	0.04	0.0527		

Comments:



LDC #: 21990F59  
 SDG #: 235782

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	7	8	
Th-228	1.88	1.97	5 (≤50)
Tu-230	1.78	1.75	2 (   )
Tu-232	1.78	1.48	18 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	7	8	
U-233/234	1.22	1.33	9 <sup>RPD</sup> (≤50)
U-235/236	0.0559	0.0696	difference 0.0137 (≤0.04)
U-238	1.12	1.06	6 <sup>RPD</sup> (≤50)

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD



## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 21 through August 26, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 235860

### Sample Identification

RSAN6-10B	SA185-41B
RSAN6009-10B	SA185-10BMS
RSAN6-20B	SA185-10BDUP
RSAN6-33B	
RSAS7-0.5B	
RSAS7009-0.5B	
RSAS7-10B	
RSAS7-25B	
RSAS7-42B	
RSAS4-0.5B	
RSAS4-10B	
RSAS4-30B	
RSAS4-45B	
RSAS4009-45B	
EB082109-SO1	
SA65-10B	
SA65-20B	
SA65-32.5B	
SA185-10B	
SA185-25B	

## Introduction

This data review covers 22 soil samples and one water sample listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
PBW (prep blank)	Uranium-238	0.0143 pCi/L	All water samples in SDG 235860

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

Sample EB082109-SO1 was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB082109-SO1	8/21/09	Uranium-235/236	0.00986 pCi/L	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Samples FB072909-SO (from SDG 234267) and F080309-SO (from SDG 234414) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	RSAS7-0.5B RSAS7009-0.5B RSAS7-10B RSAS7-25B RSAS7-42B RSAS4-0.5B RSAS4-10B RSAS4-30B RSAS4-45B RSAS4009-45B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
SA185-10BDUP (RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B)	Uranium-235/236	-	0.0657 pCi/g ( $\leq 0.04$ )	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

### c. Tracer Recovery

All tracer recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAN6-10B	Thorium-228 Thorium-230	0.132 0.0733	0.05 0.05	None None	P
RSAN6009-10B	Thorium-228 Thorium-230 Uranium-233/234	0.130 0.0775 0.0417	0.05 0.05 0.04	None None None	P
RSAN6-20B	Thorium-228 Thorium-230	0.190 0.0967	0.05 0.05	None None	P
RSAN6-33B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	0.116 0.0506 0.0632 0.057	0.05 0.05 0.04 0.04	None None None None	P
RSAS7-0.5B	Thorium-228 Thorium-230	0.112 0.0719	0.05 0.05	None None	P
RSAS7009-0.5B	Thorium-228 Thorium-230	0.120 0.0769	0.05 0.05	None None	P

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAS7-10B	Thorium-228 Thorium-230	0.173 0.0807	0.05 0.05	None None	P
RSAS7-25B	Thorium-228 Thorium-230	0.133 0.0879	0.05 0.05	None None	P
RSAS7-42B	Thorium-228 Thorium-230	0.170 0.119	0.05 0.05	None None	P
RSAS4-0.5B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234	0.138 0.0787 0.101 0.0553	0.05 0.05 0.10 0.04	None None None None	P
RSAS4-10B	Thorium-228 Thorium-230	0.154 0.108	0.05 0.05	None None	P
RSAS4-30B	Thorium-228 Thorium-230 Uranium-235/236	0.144 0.0576 0.0418	0.05 0.05 0.04	None None None	P
RSAS4-45B	Thorium-228 Thorium-230	0.140 0.102	0.05 0.05	None None	P
RSAS4009-45B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	0.130 0.0542 0.0454 0.0498	0.05 0.05 0.04 0.04	None None None None	P
SA65-10B	Thorium-228 Thorium-230 Uranium-233/234	0.159 0.0617 0.0462	0.05 0.05 0.04	None None None	P
SA65-20B	Thorium-228 Thorium-230 Uranium-235/236	0.149 0.0748 0.0413	0.05 0.05 0.04	None None None	P
SA65-32.5B	Thorium-228 Thorium-230 Thorium-232	0.151 0.182 0.105	0.05 0.05 0.10	None None None	P
SA185-10B	Thorium-228 Thorium-230	0.151 0.0823	0.05 0.05	None None	P
SA185-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	0.148 0.0653 0.0462 0.0439	0.05 0.05 0.04 0.04	None None None None	P





Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAN6-10B	RSAN6009-10B				
Uranium-235/236	0.0643	0.0639	-	0.004 ( $\leq 0.04$ )	-	-
Uranium-238	1.01	0.977	3 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS7-0.5B	RSAS7009-0.5B				
Thorium-228	1.84	1.97	7 ( $\leq 50$ )	-	-	-
Thorium-230	1.03	1.10	7 ( $\leq 50$ )	-	-	-
Thorium-232	1.66	1.72	4 ( $\leq 50$ )	-	-	-
Uranium-233/234	0.768	0.829	8 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0486	0.101	-	0.0524 ( $\leq 0.04$ )	J (all detects)	A
Uranium-238	0.804	0.989	21 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS4-45B	RSAS4009-45B				
Thorium-228	1.59	1.21	27 ( $\leq 50$ )	-	-	-
Thorium-230	2.78	2.78	0 ( $\leq 50$ )	-	-	-
Thorium-232	1.15	1.16	1 ( $\leq 50$ )	-	-	-
Uranium-233/234	2.87	2.75	4 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.175	0.142	-	0.033 ( $\leq 0.04$ )	-	-
Uranium-238	3.10	2.90	7 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 235860**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235860	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B	Uranium-235/236	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
235860	RSAN6-10B RSAN6-20B RSAS7-0.5B RSAS7009-0.5B RSAS7-10B RSAS7-25B RSAS7-42B RSAS4-10B RSAS4-45B SA185-10B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity
235860	RSAN6009-10B SA65-10B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity
235860	RSAN6-33B RSAS4009-45B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity
235860	RSAS4-0.5B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234	None None None None	P	Minimum detectable activity
235860	RSAS4-30B SA65-20B	Thorium-228 Thorium-230 Uranium-235/236	None None None	P	Minimum detectable activity
235860	SA65-32.5B	Thorium-228 Thorium-230 Thorium-232	None None None	P	Minimum detectable activity
235860	SA185-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
235860	SA185-41B	Thorium-228 Uranium-235/236	None None	P	Minimum detectable activity
235860	EB082109-SO1	Thorium-228	None	P	Minimum detectable activity
235860	RSAN6-10B RSAN6009-10B RSAN6-20B RSAN6-33B RSAS7-0.5B RSAS7009-0.5B RSAS7-10B RSAS7-25B RSAS7-42B RSAS4-0.5B RSAS4-10B RSAS4-30B RSAS4-45B RSAS4009-45B EB082109-SO1 SA65-10B SA65-20B SA65-32.5B SA185-10B SA185-25B SA185-41B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
235860	RSAS7-0.5B RSAS7009-0.5B	Uranium-235/236	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 235860**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification  
Summary - SDG 235860**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 235860**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990G59  
 SDG #: 235860  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-21-09 through 8-26-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS/LCSD</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D=1+2, D=5+6, D=13+14</u>
X.	Field blanks	SW	<u>EB=15, FB=FB072909-SO (SDG: 234267)</u>

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet  
 ND = No compounds detected  
 R = Rinsate  
 FB = Field blank  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

FB = FB080309-SO (SDG: 234414)

Validated Samples:

1	RSAN6-10B	S	11	RSAS4-10B	S	21	SA185-41B	S	31
2	RSAN6009-10B		12	RSAS4-30B		22	SA185-10BMS	<sup>u</sup> <sup>Th</sup> ↓	32
3	RSAN6-20B		13	RSAS4-45B		23	SA185-10BDUP	<sup>u</sup> <sup>Th</sup> ↓	33
4	RSAN6-33B		14	RSAS4009-45B	↓	24	PRB		34
5	RSAS7-0.5B		15 <sup>2</sup>	EB082109-SO1	W	25 <sup>2</sup>	PBW		35
6	RSAS7009-0.5B		16	SA65-10B	S	26			36
7	RSAS7-10B		17	SA65-20B		27			37
8	RSAS7-25B		18	SA65-32.5B		28			38
9	RSAS7-42B		19	SA185-10B		29			39
10	RSAS4-0.5B	↓	20	SA185-25B	↓	30			40

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_











DC #: 21990G-59  
 DG #: 235860

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 3  
 Reviewer: MG  
 2nd Reviewer: L

ETHOD: Radiochemistry (Method: SEE Cover)

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Th-228	0.05 (pci/g)	0.132 (pci/g)	Lab DL > GAPP RDL	None / P
	↓	Th-230	0.05	0.0733		
2	↓	Th-228	0.05	0.130		
	↓	Th-230	0.05	0.0775		
	↓	U-233/234	0.04	0.0417		
3	↓	Th-228	0.05	0.190		
	↓	Th-230	0.05	0.0967		
4	↓	Th-228	0.05	0.116		
	↓	Th-230	0.05	0.0506		
	↓	U-233/234	0.04	0.0632		
	↓	U-238	0.04	0.057		
5	↓	Th-228	0.05	0.112		
	↓	Th-230	0.05	0.0719		
6	↓	Th-228	0.05	0.120		
	↓	Th-230	0.05	0.0769		
7	↓	Th-228	0.05	0.173		
	↓	Th-230	0.05	0.0807		
8	↓	Th-228	0.05	0.133		
	↓	Th-230	0.05	0.0879		

Comments:

DC #: 21990G59  
 CG #: 235860

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 2 of 3  
 Reviewer: MG  
 2nd Reviewer: [Signature]

ETHOD: Radiochemistry (Method: SEE cover )

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
9	↓	Th-228 Th-230	0.05 (pci/g) 0.05	0.170 (pci/g) 0.119	Lab DL > QAPP RDL	None / P
10	↓	Th-228 Th-230 Th-232	0.05 0.05 0.10	0.138 0.0787 0.101		
	↓	U-233/234	0.04	0.0553		
11	↓	Th-228 Th-230	0.05 0.05	0.154 0.108		
12	↓	Th-228 Th-230 U-235/236	0.05 0.05 0.04	0.144 0.0576 0.0418		
13	↓	Th-228 Th-230	0.05 0.05	0.140 0.102		
14	↓	Th-228 Th-230 U-233/234 U-238	0.05 0.05 0.04 0.04	0.130 0.0542 0.0454 0.0498		
15		Th-228	0.03 (pci/L)	0.0515 (pci/L)		
16	↓	Th-228 Th-230 U-233/234	0.05 (pci/g) 0.05 0.04	0.159 (pci/g) 0.0617 0.0462		

Comments:

DC #: 21990G59  
 DG #: 235860

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 3  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
17	↓ 17	Th-228 Th-230 U-235/236	0.05 0.05 0.04	0.149 (pci/g) 0.0748 0.0413	Lab DL > QAPP RDL	None/P
18	↓ 18	Th-228 Th-230 Th-232	0.05 0.05 0.10	0.151 0.182 0.105		
19	↓ 19	Th-228 Th-230	0.05 0.05	0.151 0.0823		
20	↓ 20	Th-228 Th-230 U-233/234 U-235/236	0.05 0.05 0.04 0.04	0.148 0.0653 0.0462 0.0439		
21	↓ 21	Th-228 U-235/236	0.05 0.04	0.107 0.0473		

Comments:

LDC #: 21990G59  
 SDG #: 235860

VALIDATION FINDINGS WORKSHEET  
Field Duplicates

Page: 1 of 2  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	1	2	
Th-228	2.07	1.60	26 ( $\leq 50$ )
Th-230	1.31	1.09	18 (   )
Th-232	1.62	1.57	3 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	1	2	
U-233/234	0.941	1.15	<sup>RPD</sup> 20 ( $\leq 50$ )
U-235/236	0.0643	0.0639	difference 0.0004 ( $\leq 0.04$ )
U-238	1.01	0.977	<sup>RPD</sup> 3 ( $\leq 50$ )

Isotopes	Activity ( pCi/g )		RPD
	5	6	
Th-228	1.84	1.97	7 ( $\leq 50$ )
Th-230	1.03	1.10	7 (   )
Th-232	1.66	1.72	4 ( ↓ )

Isotopes	Activity ( pCi/g )		Qual parent only difference / RPD
	5	6	
U-233/234	0.768	0.829	<sup>RPD</sup> 8 ( $\leq 50$ )
U-235/236	0.0486	0.101	difference 0.0524 ( $\leq 0.04$ ) Jdats/A fd
U-238	0.804	0.989	<sup>RPD</sup> 21 ( $\leq 50$ )

LDC #: 21990G59  
 SDG #: 235860

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 2 of 2  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N/A  
 N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	13	14	
Tu-228	1.59	1.21	27 ( $\leq 50$ )
Tu-230	2.78	2.78	0 (   )
Tu-232	1.15	1.16	1 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	13	14	
U-233 / 234	2.87	2.75	4 <sup>RPD</sup> ( $\leq 50$ )
U-235 / 236	0.175	0.142	difference 0.033 ( $\leq 0.04$ )
U-238	3.10	2.90	7 <sup>RPD</sup> ( $\leq 50$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** August 25 through August 27, 2009

**LDC Report Date:** December 4, 2009

**Matrix:** Soil

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 236043

### Sample Identification

RSAN7-0.5B	RSAO5-41BDUP
RSAN7-10B	
RSAN7-25B	
RSAN7-38B	
SA113-0.5B	
SA113-10B	
SA113-30B	
SA196-0.5B	
SA196-10B	
SA196-29B	
SA200-10B	
SA200-20B	
SA200-31B	
SA200009B-31B	
RSAT3-40B	
RSAT3-53B	
RSAO5-10B	
RSAO5-25B	
RSAO5-41B	
RSAO5-41BMS	

## Introduction

This data review covers 21 soil samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.



## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples FB072909-SO (from SDG 234267) and F080309-SO (from SDG 234414) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB072909-SO	7/29/09	Thorium-228	0.0321 pCi/L	RSAN7-0.5B RSAN7-10B RSAN7-25B RSAN7-38B SA113-0.5B SA113-10B SA113-30B SA196-0.5B SA196-10B SA196-29B SA200-10B SA200-20B SA200-31B SA200009B-31B RSAO5-10B RSAO5-25B RSAO5-41B
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	RSAT3-40B RSAT3-53B

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

**IV. Accuracy and Precision Data**

**a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
RSAO5-41BDUP (RSAN7-0.5B RSAN7-10B RSAN7-25B RSAN7-38B SA113-0.5B SA113-10B SA113-30B SA196-0.5B SA196-10B SA196-29B SA200-10B SA200-20B SA200-31B SA200009B-31B RSAO5-10B RSAO5-25B RSAO5-41B)	Thorium-228	20.3 (≤20)	-	J (all detects) UJ (all non-detects)	A

**b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

**c. Tracer Recovery**

All tracer recoveries were within validation criteria.

**V. Minimum Detectable Activity (MDA)**

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAN7-0.5B	Thorium-228	0.140	0.05	None	P
	Thorium-230	0.0785	0.05	None	
RSAN7-10B	Thorium-228	0.147	0.05	None	P
	Thorium-230	0.088	0.05	None	
	Uranium-233/234	0.0427	0.04	None	
RSAN7-25B	Thorium-228	0.150	0.05	None	P
	Thorium-230	0.0769	0.05	None	
RSAN7-38B	Thorium-228	0.109	0.05	None	P
SA113-0.5B	Thorium-228	0.115	0.05	None	P
	Thorium-230	0.0744	0.05	None	
SA113-10B	Thorium-228	0.120	0.05	None	P
	Thorium-230	0.0779	0.05	None	
	Uranium-233/234	0.0601	0.04	None	
	Uranium-235/236	0.0402	0.04	None	
SA113-30B	Thorium-228	0.136	0.05	None	P
	Thorium-230	0.0603	0.05	None	
	Uranium-233/234	0.0455	0.04	None	
	Uranium-238	0.0455	0.04	None	
SA196-0.5B	Thorium-228	0.106	0.05	None	P
	Uranium-233/234	0.060	0.04	None	
SA196-10B	Thorium-228	0.090	0.05	None	P
	Thorium-230	0.0938	0.05	None	
	Uranium-233/234	0.0457	0.04	None	
SA196-29B	Thorium-228	0.103	0.05	None	P
	Thorium-230	0.0876	0.05	None	
	Uranium-233/234	0.0706	0.04	None	
	Uranium-235/236	0.0473	0.04	None	
	Uranium-238	0.0613	0.04	None	
SA200-10B	Thorium-228	0.176	0.05	None	P
	Thorium-230	0.0971	0.05	None	
SA200-20B	Thorium-228	0.171	0.05	None	P
	Thorium-230	0.0807	0.05	None	
	Uranium-233/234	0.066	0.04	None	
	Uranium-235/236	0.0508	0.04	None	
	Uranium-238	0.0411	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA200-31B	Thorium-228	0.191	0.05	None	P
	Thorium-230	0.0655	0.05	None	
	Uranium-233/234	0.0506	0.04	None	
	Uranium-235/236	0.0416	0.04	None	
SA200009B-31B	Thorium-228	0.102	0.05	None	P
	Thorium-230	0.0586	0.05	None	
	Uranium-233/234	0.0429	0.04	None	
RSAT3-40B	Thorium-228	0.106	0.05	None	P
	Thorium-230	0.0899	0.05	None	
	Uranium-233/234	0.0466	0.04	None	
RSAT3-53B	Thorium-228	0.107	0.05	None	P
	Thorium-230	0.0694	0.05	None	
	Uranium-233/234	0.0491	0.04	None	
	Uranium-235/236	0.0439	0.04	None	
RSAO5-10B	Thorium-228	0.154	0.05	None	P
	Thorium-230	0.0724	0.05	None	
	Uranium-233/234	0.066	0.04	None	
	Uranium-235/236	0.0409	0.04	None	
	Uranium-238	0.0497	0.04	None	
RSAO5-25B	Thorium-228	0.119	0.05	None	P
	Thorium-230	0.0794	0.05	None	
	Uranium-233/234	0.0479	0.04	None	
RSAO5-41B	Thorium-228	0.131	0.05	None	P
	Thorium-230	0.0922	0.05	None	
	Uranium-235/236	0.0409	0.04	None	

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 236043	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA200-31B and SA200009B-31B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA200-31B	SA200009B-31B				
Thorium-228	2.32	2.34	1 ( $\leq 50$ )	-	-	-
Thorium-230	4.41	4.60	4 ( $\leq 50$ )	-	-	-
Thorium-232	1.99	1.83	8 ( $\leq 50$ )	-	-	-
Uranium-233/234	3.72	4.25	13 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.195	0.203	-	0.008 ( $\leq 0.04$ )	-	-
Uranium-238	3.94	4.03	2 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 236043**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
236043	RSAN7-0.5B RSAN7-10B RSAN7-25B RSAN7-38B SA113-0.5B SA113-10B SA113-30B SA196-0.5B SA196-10B SA196-29B SA200-10B SA200-20B SA200-31B SA200009B-31B RSAO5-10B RSAO5-25B RSAO5-41B	Thorium-228	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (ld)
236043	SA113-0.5B RSAN7-25B RSAN7-0.5B SA200-10B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity
236043	RSAN7-10B SA196-10B SA200009B-31B RSAT3-40B RSAO5-25B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity
236043	RSAN7-38B	Thorium-228	None	P	Minimum detectable activity
236043	SA113-10B SA200-31B RSAT3-53B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity
236043	SA113-30B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity
236043	SA196-0.5B	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity
236043	SA196-29B SA200-20B RSAO5-10B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
236043	RSAO5-41B	Thorium-228 Thorium-230 Uranium-235/236	None None None	P	Minimum detectable activity
236043	RSAN7-0.5B RSAN7-10B RSAN7-25B RSAN7-38B SA113-0.5B SA113-10B SA113-30B SA196-0.5B SA196-10B SA196-29B SA200-10B SA200-20B SA200-31B SA200009B-31B RSAT3-40B RSAT3-53B RSAO5-10B RSAO5-25B RSAO5-41B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 236043**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 236043**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990H59  
 SDG #: 236043  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>8-25-09 through 8-27-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	<u>9mH</u>
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS / MSD DUP</u>
IVa.	Laboratory control samples	A	<u>LCS</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D = 13 + 14</u>
X.	Field blanks	SW	<u>FB = FB070909-50 (SDG: 234267)</u>

FB = FB080309-50 (SDG: 234414)

Note: A = Acceptable      ND = No compounds detected      D = Duplicate  
 N = Not provided/applicable      R = Rinsate      TB = Trip blank  
 SW = See worksheet      FB = Field blank      EB = Equipment blank

Validated Samples:  
all soil

1	RSAN7-0.5B	11	SA200-10B	21	RSOA5-41BDUP <u>U Th</u>	31	
2	RSAN7-10B	12	SA200-20B	22	<u>PBS</u>	32	
3	RSAN7-25B	13	SA200-31B	23		33	
4	RSAN7-38B	14	SA200009B-31B	24		34	
5	SA113-0.5B	15	RSAT3-40B	25		35	
6	SA113-10B	16	RSAT3-53B	26		36	
7	SA113-30B	17	RSOA5-10B	27		37	
8	SA196-0.5B	18	RSOA5-25B	28		38	
9	SA196-10B	19	RSOA5-41B	29		39	
10	SA196-29B	20	RSOA5-41BMS <u>U Th</u>	30		40	

Notes: #1 (Isotopic Uranium) FWHM > 100 keV and tracer peak centroid > 50 keV from expected value. Manual integration was performed for this sample and the resulting tracer yield was within limit for Uranium isotopes. No Qual.



LDC #: 21990H59  
SDG #: 236043

VALIDATION FINDINGS WORKSHEET  
Field Blanks

Page: 1 of 1  
Reviewer: MG  
2nd Reviewer:

METHOD: Radiochemistry (Method: See Cover)

N N/A Were field blanks identified in this SDG?  
 N N/A Were target isotopes detected in the field blanks?  
Blank units: pCi/L Associated sample units: pCi/g  
Sampling date: 7-29-09

Field blank type: (circle one) Field Blank / Rinsate / Other: Associated Samples: 1 → 14, 17 → 19 (> 10\*)

Analyte	Blank ID	Blank Action Limit	Sample Identification																	
FB-032909-50																				
Th-228	0.0321	0.0003																		

2L

Blank units: pCi/L Associated sample units: pCi/g  
Sampling date: 8-3-09  
Field blank type: (circle one) Field Blank / Rinsate / Other:

Associated Samples: 15, 16 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification																	
FB-080309-50																				
U-238	0.0126																			

2L

Samples with isotope concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".



LOG #: 21990459  
 LOG #: 236043

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 of 3  
 Reviewer: MG  
 2nd Reviewer:         

ETHOD: Radiochemistry (Method: SEE COVER)

ie following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Tu-228 Tu-230	0.05 (pci/g) 0.05	0.140 (pci/g) 0.0785	Lab DL > QAPP RDL	None / P
2	↓	Tu-228 Tu-230 U-233/234	0.05 0.05 0.04	0.147 0.0888 0.0427		
3	↓	Tu-228 Tu-230	0.05 0.05	0.150 0.0769		
4		Tu-228	0.05	0.109		
5	↓	Tu-228 Tu-230	0.05 0.05	0.115 0.0744		
6	↓	Tu-228 Tu-230 U-233/234 U-235/236	0.05 0.05 0.04 0.04	0.120 0.0779 0.0601 0.0402		
7	↓	Tu-228 Tu-230 U-233/234 U-238	0.05 0.05 0.04 0.04	0.136 0.0603 0.0455 0.0455		
8	↓	Tu-228 U-233/234	0.05 0.04	0.106 0.060		

Comments:

DC #: 21990H59  
 IDG #: 236043

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 2 of 3  
 Reviewer: MG  
 2nd Reviewer: KA

METHOD: Radiochemistry (Method: SEE COVER)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MBA (units)	Finding	Qualifications
9	↓	Th-228	0.05 (pci/g)	0.090 (pci/g)	Lab DL > QAPP RDL	None / P
		Th-230	0.05	0.0938		
		U-233/234	0.04	0.0457		
10	↓	Th-228	0.05	0.103		
		Th-230	0.05	0.0876		
		U-233/234	0.04	0.0706		
		U-235/236	0.04	0.0473		
		U-238	0.04	0.0613		
11	↓	Th-228	0.05	0.176		
		Th-230	0.05	0.0971		
12	↓	Th-228	0.05	0.171		
		Th-230	0.05	0.0807		
		U-233/234	0.04	0.066		
		U-235/236	0.04	0.0508		
13	↓	U-238	0.04	0.0411		
		Th-228	0.05	0.191		
		Th-230	0.05	0.0655		
		U-233/234	0.04	0.0506		
		U-235/236	0.04	0.0416		
14	↓	Th-228	0.05	0.102		
		Th-230	0.05	0.0586		
		U-233/234	0.04	0.0429		

Comments:

DC #: 21990H59  
 DG #: 236043

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 3  
 Reviewer: MG  
 2nd Reviewer:

METHOD: Radiochemistry (Method: SEE cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
15	↓	Th-228	0.05 (pci/g)	0.106 (pci/g)	Lab DL > QAPP RDL	None / P
		Th-230	0.05	0.0899		
		U-233/234	0.04	0.0466		
16	↓	Th-228	0.05	0.107		
		Th-230	0.05	0.0694		
		U-233/234	0.04	0.0491		
		U-235/236	0.04	0.0439		
17	↓	Th-228	0.05	0.154		
		Th-230	0.05	0.0724		
		U-233/234	0.04	0.066		
		U-235/236	0.04	0.0409		
		U-238	0.04	0.0497		
18	↓	Th-228	0.05	0.119		
		Th-230	0.05	0.0794		
		U-233/234	0.04	0.0479		
19	↓	Th-228	0.05	0.131		
		Th-230	0.05	0.0922		
		U-235/236	0.04	0.0409		

Comments:

LDC #: 21990H59  
 SDG #: 236043

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: See cover)

- N/A Were field duplicate pairs identified in this SDG?  
 N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	13	14	
Th-228	2.32	2.34	1 ( ≤ 50 )
Th-230	4.41	4.60	4 (   )
Th-232	1.99	1.83	8 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	13	14	
U-233/234	3.72	4.25	<sup>RPD</sup> 13 ( ≤ 50 )
U-235/236	0.195	0.203	difference 0.008 ( ≤ 0.04 )
U-238	3.94	4.03	<sup>RPD</sup> 2 ( ≤ 50 )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada

**Collection Date:** September 23 through October 5, 2009

**LDC Report Date:** December 16, 2009

**Matrix:** Soil

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237785

### Sample Identification

SA148-10BSPLP  
SA148-35BSPLP  
RSAR3-0.5BSPLP  
RSAR3-35BSPLP  
RSAQ4-10BSPLP  
RSAQ4-32BSPLP  
SA148-10BSPLPMS  
SA148-10BSPLPDUP  
SA148-35BSPLPMS  
SA148-35BSPLPDUP

Samples in this SDG underwent SPLP extraction

## Introduction

This data review covers 10 soil samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.



The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA) with the following exceptions:

Method Blank ID	Isotope	Activity	Associated Samples
SPLP PB (prep blank)	Thorium-228	0.0266 pCi/L	All samples in SDG 237785

Sample concentrations were compared to concentrations detected in the method blanks as required by the QAPP. No sample data was qualified.

No field blanks were identified in this SDG.

## IV. Accuracy and Precision Data

### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
SA148-10BSPLPDUP (All samples in SDG 237785)	Uranium-233/234	-	0.0339 pCi/L ( $\leq 0.03$ )	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### c. Tracer Recovery

All tracer recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
SA148-10BSPLP	Thorium-228	0.0376	0.03	None	P
	Uranium-235/236	0.0363	0.03	None	
	Uranium-238	0.0424	0.03	None	
SA148-35BSPLP	Thorium-228	0.0364	0.03	None	P
	Uranium-233/234	0.0323	0.03	None	
	Uranium-235/236	0.0346	0.03	None	
	Uranium-238	0.036	0.03	None	
RSAR3-0.5BSPLP	Thorium-228	0.042	0.03	None	P
	Uranium-233/234	0.0444	0.03	None	
RSAR3-35BSPLP	Thorium-228	0.0398	0.03	None	P
	Uranium-233/234	0.0345	0.03	None	
	Uranium-238	0.0345	0.03	None	
RSAQ4-10BSPLP	Thorium-228	0.0438	0.03	None	P
	Uranium-238	0.0319	0.03	None	
RSAQ4-32BSPLP	Thorium-228	0.0347	0.03	None	P
	Uranium-233/234	0.0318	0.03	None	

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237785	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

No field duplicates were identified in this SDG.

**\*Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 237785**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
*237785	SA148-10BSPLP SA148-35BSPLP RSAR3-0.5BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP RSAQ4-32BSPLP	Uranium-233/234	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (Difference) (ld)
237785	SA148-10BSPLP	Thorium-228 Uranium-235/236 Uranium-238	None None None	P	Minimum detectable activity (PQL)
237785	SA148-35BSPLP	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
237785	RSAR3-0.5BSPLP RSAQ4-32BSPLP	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity (PQL)
237785	RSAR3-35BSPLP	Thorium-228 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity (PQL)
237785	RSAQ4-10BSPLP	Thorium-228 Uranium-238	None None	P	Minimum detectable activity (PQL)
237785	SA148-10BSPLP SA148-35BSPLP RSAR3-0.5BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP RSAQ4-32BSPLP	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

\*Corrected code for Duplicate qualification

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 237785**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 237785**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990159 **VALIDATION COMPLETENESS WORKSHEET**  
 SDG #: 237785 Stage 2B  
 Laboratory: GEL Laboratories LLC

Date: 12-2-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 9-23-09 through 10-5-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	MS/DUP
IVa.	Laboratory control samples	A	LCS
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	N	
X.	Field blanks	N	

Note: A = Acceptable      ND = No compounds detected      D = Duplicate  
 N = Not provided/applicable      R = Rinsate      TB = Trip blank  
 SW = See worksheet      FB = Field blank      EB = Equipment blank

Validated Samples: all soil

1	SA148-10BSPLP	11	PBS	21		31	
2	SA148-35BSPLP	12	PB SPLP	22		32	
3	RSAR3-0.5BSPLP	13		23		33	
4	RSAR3-35BSPLP	14		24		34	
5	RSAQ4-10BSPLP	15		25		35	
6	RSAQ4-32BSPLP	16		26		36	
7	SA148-10BSPLPMS <sup>u</sup>	17		27		37	
8	SA148-10BSPLPDUP <sup>u</sup>	18		28		38	
9	SA148-35BSPLPMS <sup>Tu</sup>	19		29		39	
10	SA148-35BSPLPDUP <sup>Tu</sup>	20		30		40	

Notes: Fluid 2 (west)







IC #: 21990 I 59  
 CG #: 237785

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer:

ETHOD: Radiochemistry (Method: SEE COVER)

ie following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP POL RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Tu-228 U-235/236 U-238	0.03 (pci/L)	0.0376 (pci/L) 0.0363 0.0424	Lab DL > QAPP POL	None/P
2	↓	Tu-228 U-233/234 U-235/236 U-238		0.0364 0.0323 0.0346 0.036		
3	↓	Tu-228 U-233/234		0.042 0.0444		
4	↓	Tu-228 U-233/234 U-238		0.0398 0.0345 0.0345		
5	↓	Tu-228 U-238		0.0438 0.0319		
6	↓	Tu-228 U-233/234		0.0347 0.0318		

omments:

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** September 23 through October 5, 2009

**LDC Report Date:** December 5, 2009

**Matrix:** Soil

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237795

### Sample Identification

SA148-10BSPLP  
SA148-35BSPLP  
RSAR3-0.5BSPLP  
RSAR3-35BSPLP  
RSAQ4-10BSPLP  
RSAQ4-32BSPLP  
SA148-10BSPLPMS  
SA148-10BSPLPDUP  
SA148-35BSPLPMS  
SA148-35BSPLPDUP

Samples in this SDG underwent SPLP extraction

## **Introduction**

This data review covers 10 soil samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## **I. Technical Holding Times**

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## **II. Calibration**

### **a. Initial Calibration**

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### **b. Continuing Calibration**

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## **III. Blanks**

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

No field blanks were identified in this SDG.

## **IV. Accuracy and Precision Data**

### **a. Matrix Spike/(Matrix Spike) Duplicate**

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

### **b. Laboratory Control Samples**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### **c. Tracer Recovery**

All tracer recoveries were within validation criteria.

## V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
SA148-10BSPLP	Thorium-228	0.0321	0.03	None	P
	Uranium-233/234	0.0554	0.03	None	
	Uranium-235/236	0.0324	0.03	None	
	Uranium-238	0.0379	0.03	None	
SA148-35BSPLP	Thorium-228	0.038	0.03	None	P
	Uranium-238	0.0339	0.03	None	
RSAR3-0.5BSPLP	Thorium-228	0.0365	0.03	None	P
	Uranium-233/234	0.0472	0.03	None	
	Uranium-238	0.0373	0.03	None	
RSAR3-35BSPLP	Thorium-228	0.0356	0.03	None	P
	Uranium-233/234	0.0399	0.03	None	
	Uranium-235/236	0.0328	0.03	None	
	Uranium-238	0.0399	0.03	None	
RSAQ4-10BSPLP	Thorium-228	0.042	0.03	None	P
	Uranium-233/234	0.0427	0.03	None	
	Uranium-235/236	0.047	0.03	None	
	Uranium-238	0.0354	0.03	None	
RSAQ4-32BSPLP	Thorium-228	0.0341	0.03	None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237795	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## **VIII. Field Duplicates**

No field duplicates were identified in this SDG.



**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 237795**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237795	SA148-10BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
237795	SA148-35BSPLP	Thorium-228 Uranium-238	None None	P	Minimum detectable activity (PQL)
237795	RSAR3-0.5BSPLP	Thorium-228 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity (PQL)
237795	RSAQ4-32BSPLP	Thorium-228	None	P	Minimum detectable activity (PQL)
237795	SA148-10BSPLP SA148-35BSPLP RSAR3-0.5BSPLP RSAR3-35BSPLP RSAQ4-10BSPLP RSAQ4-32BSPLP	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 237795**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 237795**

No Sample Data Qualified in this SDG

## Tronox Northgate Henderson

LDC #: 21990J59      **VALIDATION COMPLETENESS WORKSHEET**  
 SDG #: 237795      Stage 2B  
 Laboratory: GEL Laboratories LLC

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>9-23-09 through 10-5-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	N	
X.	Field blanks	N	

Note:    A = Acceptable                                      ND = No compounds detected                                      D = Duplicate  
           N = Not provided/applicable                                      R = Rinsate    TB = Trip blank  
           SW = See worksheet    FB = Field blank    EB = Equipment blank

Validated Samples:  
all soil

1	SA148-10BSPLP	11	<u>PBS</u>	21		31	
2	SA148-35BSPLP	12	<u>PBSPLP</u>	22		32	
3	RSAR3-0.5BSPLP	13		23		33	
4	RSAR3-35BSPLP	14		24		34	
5	RSAQ4-10BSPLP	15		25		35	
6	RSAQ4-32BSPLP	16		26		36	
7	SA148-10BSPLPMS <sup>u</sup>	17		27		37	
8	SA148-10BSPLPDUP <sup>u</sup>	18		28		38	
9	SA148-35BSPLPMS <sup>Tn</sup>	19		29		39	
10	SA148-35BSPLPDUP <sup>Tn</sup>	20		30		40	

Notes: Fluid 3 (Reagent water)

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LDC #: 21990J59  
 SDG #: 237795

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	QAPP POL (pci/L)	Lab DL MDA (units)	Lab DL (pci/L)	Finding	Qualifications
1	↓	Th-228 U-233/234 U-235/236 U-238	0.03	0.0321	0.0554 0.0324 0.0379	0.0321 (pci/L)	Lab DL > QAPP POL	None / P
2	↓	Th-228 U-238		0.038 0.0339				
3	↓	Th-228 U-233/234 U-238		0.0365 0.0472 0.0373				
4	↓	Th-228 U-233/234 U-235/236 U-238		0.0356 0.0399 0.0328 0.0399				
5	↓	Th-228 U-233/234 U-235/236 U-238		0.042 0.0427 0.047 0.0354				
6	↓	Th-228		0.0341				

Comments:

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** September 24 through October 7, 2009

**LDC Report Date:** January 5, 2010

**Matrix:** Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 237885

### Sample Identification

M-89B  
FiltB092509-A2  
M-2AB  
M-2009AB  
M-76B  
M-76009B  
PB100209-A2  
MC-94B  
M-89BMS  
M-89BDUP

## Introduction

This data review covers 10 water samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples FB0060409 (from SDG 230340) and FB080409-SO (from SDG 233776) were identified as field blanks. No isotopic uranium or isotopic thorium was found in these blanks.

Sample FiltB092509-A2 was identified as a filter blank. No isotopic uranium or isotopic thorium were found in this blank with the following exceptions:

Filter Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FiltB092509-A2	9/25/09	Thorium-230	0.0112 pCi/L	No associated samples in this SDG

Sample PB100209-A2 was identified as a pump blank. No isotopic uranium or isotopic thorium were found in this blank.

## IV. Accuracy and Precision Data

### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### c. Tracer Recovery

All tracer recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-89B	Thorium-228	0.0402	0.03	None	P
	Thorium-230	0.0356	0.03	None	
	Uranium-233/234	0.036	0.03	None	
	Uranium-235/236	0.0318	0.03	None	
FitB092509-A2	Thorium-228	0.0355	0.03	None	P
M-2AB	Thorium-228	0.0488	0.03	None	P
	Thorium-230	0.0307	0.03	None	
	Thorium-232	0.0307	0.03	None	
	Uranium-233/234	0.231	0.03	None	
	Uranium-235/236	0.160	0.03	None	
	Uranium-238	0.129	0.03	None	
M-2009AB	Thorium-228	0.0533	0.03	None	P
	Thorium-230	0.0343	0.03	None	
	Uranium-233/234	0.0336	0.03	None	
M-76B	Thorium-228	0.0406	0.03	None	P
	Thorium-232	0.0327	0.03	None	
M-76009B	Thorium-228	0.0563	0.03	None	P
	Thorium-230	0.0331	0.03	None	
PB100209-A2	Thorium-228	0.0415	0.03	None	P
	Uranium-238	0.0326	0.03	None	
MC-94B	Thorium-228	0.0386	0.03	None	P
	Uranium-233/234	0.126	0.03	None	
	Uranium-235/236	0.156	0.03	None	
	Uranium-238	0.146	0.03	None	

\*Indicates change as the result of report review.  
SDG 237885



The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 237885	All isotopes reported below the PQL.	J (all detects)	A

Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

### \*VIII. Field Duplicates

Samples M-2AB and M-2009AB and samples M-76B and M-76009B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-2AB	M-2009AB				
Thorium-228	0.0722	0.0921	-	0.0199 ( $\leq 0.03$ )	-	-
Thorium-232	0.0055U	0.0279	-	0.02235 ( $\leq 0.03$ )	-	-
Uranium-233/234	11.2	11.4	2 ( $\leq 30$ )	-	-	-
Uranium-235/236	0.462	0.406	13 ( $\leq 30$ )	-	-	-
Uranium-238	7.39	7.46	1 ( $\leq 30$ )	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-76B	M-76009B				
Thorium-228	0.0431	-0.00434U	-	0.04744 ( $\leq 0.03$ )	J (all detects) UJ (all non-detects)	A

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-76B	M-76009B				
Thorium-230	0.0146U	0.0617	-	0.0471 ( $\leq 0.03$ )	J (all detects) UJ (all non-detects)	A
*Thorium-232	-0.00487U	0.0444	-	0.04927 ( $\leq 0.03$ )	J (all detects) UJ (all non-detects)	A
Uranium-233/234	4.52	4.97	9 ( $\leq 30$ )	-	-	-
Uranium-235/236	0.125	0.161	-	0.036 ( $\leq 0.03$ )	J (all detects)	A
Uranium-238	3.10	3.24	4 ( $\leq 30$ )	-	-	-

\*Corrected difference value for Thorium-232 in table above

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 237885**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237885	M-89B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)
237885	FiltB092509-A2	Thorium-228	None	P	Minimum detectable activity (PQL)
237885	M-2AB	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None None	P	Minimum detectable activity (PQL)
237885	M-2009AB	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
237885	M-76B	Thorium-228 Thorium-232	None None	P	Minimum detectable activity (PQL)
237885	M-76009B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
237885	PB100209-A2	Thorium-228 Uranium-238	None None	P	Minimum detectable activity (PQL)
237885	MC-94B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
237885	M-89B FiltB092509-A2 M-2AB M-2009AB M-76B M-76009B PB100209-A2 MC-94B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
237885	M-76B M-76009B	Thorium-228 Thorium-230 Thorium-232	J (all detects) UJ (all non-detects)	A	Field duplicates (Difference) (fd)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
237885	M-76B M-76009B	Uranium-235/236	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 237885**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 237885**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Filter Blank Data Qualification Summary -  
SDG 237885**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Pump Blank Data Qualification Summary -  
SDG 237885**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 21990K59  
 SDG #: 237885  
 Laboratory: GEL Laboratories LLC

VALIDATION COMPLETENESS WORKSHEET  
 Stage 2B

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: 9-24-09 through 10-7-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP
IVa.	Laboratory control samples	A	LCS
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	D = 3+4, D = 5+6
X.	Field blanks	SW	Filter blank = 2, Pump blank = * 7

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

FB = \*FB060409 (SDG: 230340)

FB = \*FB080409-GW (SDG: 233776)

Validated Samples:  
 all water

1	M-89B	11	PBW	21		31	
2	FiltB092509-A2	12		22		32	
3	M-2AB	13		23		33	
4	M-2009AB	14		24		34	
5	M-76B	15		25		35	
6	M-76009B	16		26		36	
7	PB100209-A2	17		27		37	
8	MC-94B	18		28		38	
9	M-89BMS	19	U Th	29		39	
10	M-89BDUP	20	U Th	30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



DC #: 2199OK59  
 DG #: 237885

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer: W

ETHOD: Radiochemistry (Method: see cover )

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP POL RDL (units)	Lab DL MBA (units)	Lab DL > GAPP POL	Qualifications
1	↓	Tu-228	0.03 (PC/L)	0.0402 (PC/L)	Lab DL > GAPP POL	None / P
		Tu-230		0.0356		
		U-233/234		0.036		
		U-235/236		0.0318		
2		Tu-228		0.0355		
3	↓	Tu-228		0.0488		
		Tu-230		0.0307		
		Tu-232		0.0307		
		U-233/234		0.231		
		U-235/236		0.160		
		U-238		0.129		
4	↓	Tu-228		0.0533		
		Tu-230		0.0343		
		U-233/234		0.0336		
5	↓	Tu-228		0.0406		
		Tu-232		0.0327		
6	↓	Tu-228		0.0563		
		Tu-230		0.0331		
7	↓	Tu-228		0.0415		
		U-238		0.0326		

Comments:





LDC #: 21990K59  
 SDG #: 237825

VALIDATION FINDINGS WORKSHEET  
 Field Duplicates

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

- N N/A Were field duplicate pairs identified in this SDG?
- N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/L )		difference / RPD
	3	4	
Tu-230	0.0722	0.0921	difference 0.0199 (≤0.03)
Tu-232	0.00555 U	0.0279	difference 0.02235 (≤0.03)
U-233/234	11.2	11.4	2 <sup>RPD</sup> (≤30)
U-235/236	0.462	0.406	13 <sup>RPD</sup> (≤30)
U-238	7.39	7.46	1 <sup>RPD</sup> (≤30)

Isotopes	Activity ( pCi/L )		by difference Qual parent only -RPD-
	5	6	
Tu-228	0.0431	-0.00434 U	0.04744 (≤0.03) J/UJ/A
Tu-230	0.0146 U	0.0617	0.0471 (   )
Tu-232	-0.00487 U	0.0444	0.04927 ( ↓ ) ↓

Isotopes	Activity ( pCi/L )		Qual parent only difference / RPD
	5	6	
U-233/234	4.52	4.97	9 <sup>RPD</sup> (≤30)
U-235/236	0.125	0.161	difference 0.036 (≤0.03) J/dets/A fd
U-238	3.10	3.24	4 <sup>RPD</sup> (≤30)

Isotopes	Activity ( )		RPD

## Laboratory Data Consultants, Inc. Data Validation Report

**Project/Site Name:** Tronox LLC Facility, 2009 Phase B Investigation,  
Henderson, Nevada

**Collection Date:** October 5 through October 6, 2009

**LDC Report Date:** December 5, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 238405

### Sample Identification

RSAQ4-0.5B	SA111-25BDUP
RSAQ4-10B	
RSAQ4-25B	
RSAQ4-32B	
SA214-0.5B	
SA214-15B	
SA214-30B	
SA214-43B	
SA111-1.5B	
SA111-10B	
SA111-25B	
SA111-39B	
EB100509-SO1A4	
SA103-0.5B	
SA103-10B	
SA103009-10B	
SA103-25B	
SA103-35B	
EB100609-SO1A4	
SA111-25BMS	

## Introduction

This data review covers 19 soil samples and 2 water samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

Raw data were not reviewed for this SDG. The review was based on QC data.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Samples EB100509-SO1A4 and EB100609-SO1A4 were identified as equipment blanks. No isotopic uranium or isotopic thorium were found in these blanks with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB100509-SO1A4	10/5/09	Thorium-232	0.0055 pCi/L	RSAQ4-0.5B RSAQ4-10B RSAQ4-25B RSAQ4-32B SA214-0.5B SA214-15B SA214-30B SA214-43B SA111-1.5B SA111-10B SA111-25B SA111-39B

Sample concentrations were compared to concentrations detected in the equipment blanks as required by the QAPP. No sample data was qualified.

Sample FB080309-SO (from SDG 234414) was identified as a field blank. No isotopic uranium or isotopic thorium was found in this blank with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	All soil samples in SDG 238405

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

#### IV. Accuracy and Precision Data

##### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
SA111-25BDUP (All soil samples in SDG 238405)	Uranium-235/236	68.0 (≤20)	-	J (all detects) UJ (all non-detects)	A

##### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

##### c. Tracer Recovery

All tracer recoveries were within validation criteria.

#### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAQ4-0.5B	Thorium-228	0.119	0.05	None	P
	Thorium-230	0.0756	0.05	None	
	Uranium-233/234	0.0525	0.04	None	
	Uranium-235/236	0.0649	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAQ4-10B	Thorium-228	0.114	0.05	None	P
	Thorium-230	0.0597	0.05	None	
	Uranium-233/234	0.075	0.04	None	
	Uranium-238	0.0908	0.04	None	
RSAQ4-25B	Thorium-228	0.0946	0.05	None	P
	Thorium-230	0.0611	0.05	None	
	Uranium-233/234	0.068	0.04	None	
	Uranium-238	0.068	0.04	None	
RSAQ4-32B	Thorium-228	0.140	0.05	None	P
	Thorium-230	0.0984	0.05	None	
	Uranium-233/234	0.0831	0.04	None	
SA214-05B	Thorium-228	0.117	0.05	None	P
	Thorium-230	0.0512	0.05	None	
	Uranium-233/234	0.0925	0.04	None	
	Uranium-235/236	0.089	0.04	None	
	Uranium-238	0.072	0.04	None	
SA214-15B	Thorium-228	0.162	0.05	None	P
	Thorium-230	0.0951	0.05	None	
	Uranium-233/234	0.0874	0.04	None	
	Uranium-238	0.068	0.04	None	
SA214-30B	Thorium-228	0.181	0.05	None	P
	Thorium-230	0.0977	0.05	None	
	Uranium-233/234	0.0637	0.04	None	
	Uranium-235/236	0.0629	0.04	None	
SA214-43B	Thorium-228	0.109	0.05	None	P
	Thorium-230	0.0808	0.05	None	
	Uranium-233/234	0.116	0.04	None	
	Uranium-235/236	0.0864	0.04	None	
	Uranium-238	0.0847	0.04	None	
SA111-1.5B	Thorium-228	0.0933	0.05	None	P
	Thorium-230	0.0774	0.05	None	
	Uranium-233/234	0.0791	0.04	None	
	Uranium-235/236	0.0878	0.04	None	
SA111-10B	Thorium-228	0.110	0.05	None	P
	Thorium-230	0.0533	0.05	None	
	Uranium-238	0.0507	0.04	None	
SA111-25B	Thorium-228	0.147	0.05	None	P
	Thorium-230	0.0798	0.05	None	
	Uranium-233/234	0.0903	0.04	None	
	Uranium-238	0.0703	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA111-39B	Thorium-228	0.112	0.05	None	P
	Thorium-230	0.0791	0.05	None	
	Uranium-233/234	0.127	0.04	None	
	Uranium-235/236	0.0818	0.04	None	
	Uranium-238	0.0662	0.04	None	
SA103-05B	Thorium-228	0.119	0.05	None	P
	Thorium-230	0.0599	0.05	None	
	Uranium-233/234	0.0747	0.04	None	
	Uranium-235/236	0.0639	0.04	None	
	Uranium-238	0.0747	0.04	None	
SA103-10B	Thorium-228	0.111	0.05	None	P
	Uranium-233/234	0.0967	0.04	None	
	Uranium-235/236	0.0919	0.04	None	
	Uranium-238	0.0743	0.04	None	
SA103009-10B	Thorium-228	0.114	0.05	None	P
	Thorium-230	0.0806	0.05	None	
	Uranium-233/234	0.0856	0.04	None	
	Uranium-235/236	0.0658	0.04	None	
SA103-25B	Thorium-228	0.100	0.05	None	P
	Thorium-230	0.0518	0.05	None	
	Uranium-233/234	0.0748	0.04	None	
	Uranium-235/236	0.064	0.04	None	
SA103-35B	Thorium-228	0.117	0.05	None	P
	Uranium-233/234	0.0557	0.04	None	
	Uranium-235/236	0.0689	0.04	None	
	Uranium-238	0.0698	0.04	None	

Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
EB100509-SO1A4	Thorium-228	0.0309	0.03	None	P

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 238405	All isotopes reported below the PQL.	J (all detects)	A



Raw data were not reviewed for this SDG.

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA103-10B and SA103009-10B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA103-10B	SA103009-10B				
Thorium-228	1.73	1.57	10 ( $\leq 50$ )	-	-	-
Thorium-230	1.08	1.03	5 ( $\leq 50$ )	-	-	-
Thorium-232	1.26	1.43	13 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.16	1.15	1 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0581U	0.0859	-	0.0278 ( $\leq 0.04$ )	-	-
Uranium-238	0.947	1.07	12 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 238405**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238405	RSAQ4-0.5B RSAQ4-10B RSAQ4-25B RSAQ4-32B SA214-0.5B SA214-15B SA214-30B SA214-43B SA111-1.5B SA111-10B SA111-25B SA111-39B SA103-0.5B SA103-10B SA103009-10B SA103-25B SA103-35B	Uranium-235/236	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (ld)
238405	RSAQ4-0.5B SA214-30B SA111-1.5B SA103009-10B SA103-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)
238405	RSAQ4-10B RSAQ4-25B SA214-15B SA111-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
238405	RSAQ4-32B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
238405	SA214-0.5B SA214-43B SA111-39B SA103-0.5B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
238405	SA111-10B	Thorium-228 Thorium-230 Uranium-238	None None None	P	Minimum detectable activity (PQL)
238405	SA103-10B SA103-35B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
238405	EB100509-SO1A4	Thorium-228	None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238405	RSAQ4-0.5B RSAQ4-10B RSAQ4-25B RSAQ4-32B SA214-0.5B SA214-15B SA214-30B SA214-43B SA111-1.5B SA111-10B SA111-25B SA111-39B EB100509-SO1A4 SA103-0.5B SA103-10B SA103009-10B SA103-25B SA103-35B EB100609-SO1A4	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 238405**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 238405**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 238405**

No Sample Data Qualified in this SDG

LDC #: 21990L59  
 SDG #: 238405  
 Laboratory: GEL Laboratories LLC

**Tronox Northgate Henderson**  
**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-3-09  
 Page: 1 of 1  
 Reviewer: MG  
 2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>10-5-09 through 10-6-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS/LCSD</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	N	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D = 15+16</u>
X.	Field blanks	SW	<u>EB = 13, *19</u>

Note: A = Acceptable  
 N = Not provided/applicable  
 SW = See worksheet

\* = ND = No compounds detected  
 R = Rinsate  
 FB = Field blank

FB = FB080309-S0  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

Validated Samples:

1	RSAQ4-0.5B	S	11	SA111-25B	S	21	SA111-25BDUP	U Th S	31
2	RSAQ4-10B		12	SA111-39B	↓	22	PBS		32
3	RSAQ4-25B		13	EB100509-SO1A4	W	23	PBW		33
4	RSAQ4-32B		14	SA103-0.5B	S	24			34
5	SA214-0.5B		15	SA103-10B		25			35
6	SA214-15B		16	SA103009-10B		26			36
7	SA214-30B		17	SA103-25B		27			37
8	SA214-43B		18	SA103-35B	↓	28			38
9	SA111-1.5B		19	EB100609-SO1A4	W	29			39
10	SA111-10B	↓	20	SA111-25BMS	U Th S	30			40

Notes: PB Th-232 has negative result > 3x error. PB was recounted to confirm that Th-232 is non-detect. No Qual.





LDC #: 21990L59  
SDG #: 238405

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 of 4  
Reviewer: MG  
2nd Reviewer:

METHOD: Radiochemistry (Method: SEE Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	Tm-228	0.05 (pc/g)	0.119 (pc/g)	Lab DL > QAPP RDL	None / P
		Tm-230	0.05	0.0756		
		U-233/234	0.04	0.0525		
		U-235/236	0.04	0.0649		
2	↓	Tm-228	0.05	0.114		
		Tm-230	0.05	0.0597		
		U-233/234	0.04	0.075		
		U-238	0.04	0.0908		
3	↓	Tm-228	0.05	0.0946		
		Tm-230	0.05	0.0611		
		U-233/234	0.04	0.068		
		U-238	0.04	0.068		
4	↓	Tm-228	0.05	0.140		
		Tm-230	0.05	0.0984		
		U-233/234	0.04	0.0831		
5	↓	Tm-228	0.05	0.117		
		Tm-230	0.05	0.0512		
		U-233/234	0.04	0.0925		
		U-235/236	0.04	0.089		
6	↓	U-238	0.04	0.072		
		Tm-228	0.05	0.162		
		Tm-230	0.05	0.0951		
		U-233/234	0.04	0.0874		
			0.04	0.068		

Comments:

LDC #: 01990L59  
 SDG #: 038405

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 2 of 4  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
7	↓	Tn-228	0.05 (pc/g)	0.181 (pc/g)	Lab DL > GAPP RDL	None / P
		Tn-230	0.05	0.0977		
		U-233/234	0.04	0.0637		
		U-235/236	0.04	0.0629		
8	↓	Tn-228	0.05	0.109		
		Tn-230	0.05	0.0808		
		U-233/234	0.04	0.116		
		U-235/236	0.04	0.0864		
9	↓	U-238	0.04	0.0847		
		Tn-228	0.05	0.0933		
		Tn-230	0.05	0.0774		
		U-233/234	0.04	0.0791		
10	↓	U-235/236	0.04	0.0878		
		Tn-228	0.05	0.110		
		Tn-230	0.05	0.0533		
		U-238	0.04	0.0507		
11	↓	Tn-228	0.05	0.147		
		Tn-230	0.05	0.0798		
		U-233/234	0.04	0.0903		
		U-238	0.04	0.0703		

Comments:



LDC #: 01990L59  
 SDG #: 038405

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 4  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: See Cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
12	↓	Th-228	0.05 (pci/g)	0.112 (pci/g)	Lab DL > GAPP RDL	None / P
		Th-230	0.05	0.0791		
		U-233/234	0.04	0.127		
		U-235/236	0.04	0.0818		
13	↓	U-238	0.04	0.0662		
		Th-228	0.03 (pci/L)	0.0309 (pci/L)		
		Th-228	0.05 (pci/g)	0.119 (pci/g)		
		Th-230	0.05	0.0599		
14	↓	U-233/234	0.04	0.0747		
		U-235/236	0.04	0.0639		
		U-238	0.04	0.0747		
		Th-228	0.05	0.111		
15	↓	U-233/234	0.04	0.0967		
		U-235/236	0.04	0.0919		
		U-238	0.04	0.0743		
		Th-228	0.05	0.114		
16	↓	Th-228	0.05	0.0806		
		Th-230	0.05	0.0856		
		U-233/234	0.04	0.0658		
		U-235/236	0.04			
17	↓	Th-228	0.05	0.100		
		Th-230	0.05	0.0518		
		U-233/234	0.04	0.0748		
		U-235/236	0.04	0.064		

Comments:



LDC #: 21990L59  
 SDG #: 238405

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: [Signature]

METHOD: Radiochemistry (Method: see cover)

N N/A  
 N N/A

Were field duplicate pairs identified in this SDG?  
 Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( PCi/g )		RPD
	15	16	
Tn-228	1.73	1.57	10 ( $\leq 50$ )
Tn-230	1.08	1.03	5 (   )
Tn-232	1.26	1.43	13 ( ↓ )

Isotopes	Activity ( PCi/g )		difference / RPD
	15	16	
U-233/234	1.16	1.15	1 <sup>RPD</sup> ( $\leq 50$ )
U-235/236	0.0581 U	0.0859	difference 0.0278 ( $\leq 0.04$ )
U-238	0.947	1.07	12 <sup>RPD</sup> ( $\leq 50$ )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD



## Introduction

This data review covers 21 soil samples listed on the cover sheet. The analyses were per DOE EML HASL-300 Method and U-02-RC Method modified for Isotopic Uranium and DOE EML HASL-300 Method and Th-01-RC Method modified for Isotopic Thorium.

This review follows the Standard Operating Procedures (SOP) 40, Data Review/Validation (BRC 2009), the Quality Assurance Project Plan Tronox LLC Facility, Henderson, Nevada (June 2009), NDEP guidance (May 2006), and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) as there are no current guidelines for the method stated above.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

Blank results are summarized in Section III.

Field duplicates are summarized in Section VIII.

The following are definitions of the data qualifiers:

- J+ Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J- Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
- J Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
- U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
- R Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
- UU Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.
- B The analytical result may be a false positive totally attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JB The analytical result may be biased high and partially attributable to blank contamination. This qualifier is applicable to radiochemistry analysis only.
- JK The analytical result is an estimated maximum possible concentration (EMPC).
- X The analytical result is not used for reporting because a more accurate and precise result is reported in its place.
- J-TDS The analytical result is estimated based on failure of the Total Dissolved Solids (TDS) correctness check performed in accordance with the Standard Method 1030E.
- J-CAB The analytical result is estimated based on failure of the cation-anion balance correctness check performed in accordance with Standard Method 1030E.
- J-TDS & CAB The analytical result is unreliable based on the failure of the cation-anion balance and TDS correctness check performed in accordance with standard Method 1030E.
- A Indicates the finding is based upon technical validation criteria.
- P Indicates the finding is related to a protocol/contractual deviation.
- None Indicates the data was not significantly impacted by the finding, therefore qualification was not required.

## I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

## II. Calibration

### a. Initial Calibration

All criteria for the initial calibration were met.

Detector efficiency was determined for each radionuclide of interest.

### b. Continuing Calibration

Calibration verification and background determination were performed at the required frequencies. Results were within control limits.

## III. Blanks

Method blanks were reviewed for each matrix as applicable. Blank results contained less than the minimum detectable activity (MDA).

Sample EB100609-SO1A4 (from SDG 238405) was identified as an equipment blank. No isotopic uranium or isotopic thorium were found in this blank.

Sample FB080309-SO (from SDG 234414) was identified as a field blank. No isotopic uranium or isotopic thorium was found in this blank with the following exceptions:

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	All samples in SDG 238477

Sample concentrations were compared to concentrations detected in the field blanks as required by the QAPP. No sample data was qualified.

## IV. Accuracy and Precision Data

### a. Matrix Spike/(Matrix Spike) Duplicate

Matrix spike (MS) samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits with the following exceptions:

DUP ID (Associated Samples)	Analyte	RPD (Limits)	Difference (Limits)	Flag	A or P
RSAR5-40BDUP (All samples in SDG 238477)	Thorium-232	26.5 ( $\leq 20$ )	-	J (all detects) UJ (all non-detects)	A

### b. Laboratory Control Samples

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

### c. Tracer Recovery

All tracer recoveries were within validation criteria.

### V. Minimum Detectable Activity (MDA)

All minimum detectable activities met required PQLs with the following exceptions:

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA138-0.5B	Thorium-228	0.0931	0.05	None	P
	Thorium-230	0.0521	0.05	None	
SA138-10B	Thorium-228	0.105	0.05	None	P
	Thorium-230	0.978	0.05	None	
SA138009-10B	Thorium-228	0.0843	0.05	None	P
	Thorium-230	0.0827	0.05	None	
	Uranium-233/234	0.0535	0.04	None	
SA138-30B	Thorium-228	0.115	0.05	None	P
	Thorium-230	0.0636	0.05	None	
	Uranium-235/236	0.0697	0.04	None	
	Uranium-238	0.0564	0.04	None	
SA138-45B	Thorium-228	0.128	0.05	None	P
	Thorium-230	0.0743	0.05	None	
	Uranium-233/234	0.0621	0.04	None	
	Uranium-235/236	0.0415	0.04	None	
	Uranium-238	0.0537	0.04	None	
RSAR5-0.5B	Thorium-228	0.102	0.05	None	P
	Thorium-230	0.0723	0.05	None	
	Uranium-233/234	0.0604	0.04	None	
	Uranium-238	0.0523	0.04	None	



Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAR5-10B	Thorium-228	0.139	0.05	None	P
	Thorium-230	0.143	0.05	None	
	Uranium-233/234	0.0574	0.04	None	
	Uranium-235/236	0.0507	0.04	None	
	Uranium-238	0.0574	0.04	None	
RSAR5-25B	Thorium-228	0.128	0.05	None	P
	Thorium-230	0.0708	0.05	None	
	Uranium-233/234	0.115	0.04	None	
	Uranium-238	0.0886	0.04	None	
RSAR5-40B	Thorium-228	0.0989	0.05	None	P
	Thorium-230	0.114	0.05	None	
	Uranium-233/234	0.068	0.04	None	
	Uranium-235/236	0.0526	0.04	None	
	Uranium-238	0.0546	0.04	None	
RSAS5-05B	Thorium-228	0.119	0.05	None	P
	Uranium-238	0.0416	0.04	None	
RSAS5-10B	Thorium-228	0.0641	0.05	None	P
	Uranium-235/236	0.0495	0.04	None	
RSAS5-25B	Uranium-233/234	0.0526	0.04	None	P
	Uranium-238	0.0473	0.04	None	
RSAS5-36B	Thorium-228	0.0673	0.05	None	P
	Thorium-230	0.066	0.05	None	
	Uranium-233/234	0.052	0.04	None	
RSAS5009-36B	Thorium-228	0.114	0.05	None	P
	Thorium-230	0.121	0.05	None	
	Thorium-232	0.116	0.10	None	
	Uranium-233/234	0.0486	0.04	None	
	Uranium-235/236	0.0468	0.04	None	
RSAP5-05B	Thorium-228	0.0534	0.05	None	P
	Thorium-230	0.0524	0.05	None	
	Uranium-233/234	0.0893	0.04	None	
	Uranium-235/236	0.0894	0.04	None	
	Uranium-238	0.0776	0.04	None	
RSAP5-10B	Thorium-230	0.0541	0.05	None	P
	Uranium-235/236	0.0563	0.04	None	
RSAP5009-10B	Thorium-228	0.0642	0.05	None	P
	Thorium-230	0.0504	0.05	None	
	Uranium-233/234	0.0863	0.04	None	
	Uranium-235/236	0.0686	0.04	None	
	Uranium-238	0.0799	0.04	None	

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
RSAP5-25B	Thorium-228	0.0963	0.05	None	P
	Thorium-230	0.088	0.05	None	
	Uranium-233/234	0.0516	0.04	None	
	Uranium-235/236	0.0526	0.04	None	
	Uranium-238	0.0516	0.04	None	
RSAP5-39B	Thorium-228	0.0646	0.05	None	P
	Thorium-230	0.0506	0.05	None	
	Uranium-233/234	0.0725	0.04	None	
	Uranium-235/236	0.0628	0.04	None	
	Uranium-238	0.0546	0.04	None	

The MDA was greater than the PQL as listed above.

## VI. Sample Result Verification and Project Quantitation Limit

All sample result verifications were acceptable.

All isotopes reported below the PQL were qualified as follows:

Sample	Finding	Flag	A or P
All samples in SDG 238477	All isotopes reported below the PQL.	J (all detects)	A

## VII. Overall Assessment of Data

Data flags are summarized at the end of this report if data has been qualified.

## VIII. Field Duplicates

Samples SA138-10B and SA138009-10B, samples RSAS5-36B and RSAS5009-36B, and samples RSAP5-10B and RSAP5009-10B were identified as field duplicates. No isotopic uranium or isotopic thorium was detected in any of the samples with the following exceptions:

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA138-10B	SA138009-10B				
Thorium-228	1.51	2.01	28 ( $\leq 50$ )	-	-	-
Thorium-230	1.12	1.62	36 ( $\leq 50$ )	-	-	-
Thorium-232	1.36	1.45	6 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	SA138-10B	SA138009-10B				
Uranium-233/234	1.26	1.20	5 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0802	0.0897	-	0.0095 ( $\leq 0.04$ )	-	-
Uranium-238	1.06	1.22	14 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAS5-36B	RSAS5009-36B				
Thorium-228	1.04	1.08	4 ( $\leq 50$ )	-	-	-
Thorium-230	2.25	1.78	23 ( $\leq 50$ )	-	-	-
Thorium-232	0.868	0.993	13 ( $\leq 50$ )	-	-	-
Uranium-233/234	2.13	2.05	4 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.101	0.142	-	0.041 ( $\leq 0.04$ )	J (all detects)	A
Uranium-238	1.86	2.08	11 ( $\leq 50$ )	-	-	-

Analyte	Concentration (pCi/g)		RPD (Limits)	Difference (Limits)	Flags	A or P
	RSAP5-10B	RSAP5009-10B				
Thorium-228	1.58	1.49	6 ( $\leq 50$ )	-	-	-
Thorium-230	0.898	0.928	3 ( $\leq 50$ )	-	-	-
Thorium-232	1.49	1.39	7 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.00	0.853	16 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.0882	0.0558U	-	0.0324 ( $\leq 0.04$ )	-	-
Uranium-238	0.946	0.920	3 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 238477**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238477	SA138-0.5B SA138-10B SA138009-10B SA138-30B SA138-45B RSAR5-0.5B RSAR5-10B RSAR5-25B RSAR5-40B RSAS5-0.5B RSAS5-10B RSAS5-25B RSAS5-36B RSAS5009-36B RSAP5-0.5B RSAP5-10B RSAP5009-10B RSAP5-25B RSAP5-39B	Thorium-232	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (ld)
238477	SA138-0.5B SA138-10B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
238477	SA138009-10B RSAS5-36B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
238477	SA138-30B	Thorium-228 Thorium-230 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
238477	SA138-45B RSAR5-10B RSAR5-40B RSAP5-0.5B RSAP5009-10B RSAP5-25B RSAP5-39B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
238477	RSAR5-0.5B RSAR5-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
238477	RSAS5-0.5B	Thorium-228 Uranium-238	None None	P	Minimum detectable activity (PQL)
238477	RSAS5-10B	Thorium-228 Uranium-235/236	None None	P	Minimum detectable activity (PQL)

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238477	RSAS5-25B	Uranium-233/234 Uranium-238	None None	P	Minimum detectable activity (PQL)
238477	RSAS5009-36B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236	None None None None None	P	Minimum detectable activity (PQL)
238477	RSAP5-10B	Thorium-230 Uranium-235/236	None None	P	Minimum detectable activity (PQL)
238477	SA138-0.5B SA138-10B SA138009-10B SA138-30B SA138-45B RSAR5-0.5B RSAR5-10B RSAR5-25B RSAR5-40B RSAS5-0.5B RSAS5-10B RSAS5-25B RSAS5-36B RSAS5009-36B RSAP5-0.5B RSAP5-10B RSAP5009-10B RSAP5-25B RSAP5-39B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
238477	RSAS5-36B RSAS5009-36B	Uranium-235/236	J (all detects)	A	Field duplicates (Difference) (fd)

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Laboratory Blank Data Qualification Summary  
- SDG 238477**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Equipment Blank Data Qualification Summary  
- SDG 238477**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Field Blank Data Qualification Summary -  
SDG 238477**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 21990M59

**VALIDATION COMPLETENESS WORKSHEET**

Date: 12-3-09

SDG #: 238477

Stage ~~2B~~ 4

Page: 1 of 1

Laboratory: GEL Laboratories LLC

*omg*

Reviewer: MG

2nd Reviewer: [Signature]

**METHOD:** Isotopic Uranium (DOE EML HASL-300, U-02-RC Modified), Isotopic Thorium (DOE EML HASL-300, Th-01-RC Modified)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Technical holding times	A	Sampling dates: <u>10-6-09 through 10-7-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	SW	<u>MS/DUP</u>
IVa.	Laboratory control samples	A	<u>LCS</u>
V.	Tracer Recovery	A	
VI.	Minimum Detectable Activity (MDA)	SW	
VII.	Sample result verification	<u>A*</u>	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D = 2+3, D = 13+14, D = 16+17</u>
X.	Field blanks	SW	<u>EB = *EB100609-501A4 (SDG: 238405)</u> <u>FB = FB080309-50 (SDG: 234414)</u>

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

\* = ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

Validated Samples:

all soil

1	SA138-0.5B	11	RSAS5-10B	21	RSAR5-40BDUP <sup>U Th</sup>	31	
2	SA138-10B	12	RSAS5-25B	22	<u>PBS</u>	32	
3	SA138009-10B	13	RSAS5-36B	23		33	
4	SA138-30B	14	RSAS5009-36B	24		34	
5	SA138-45B	15	RSAP5-0.5B	25		35	
6	RSAR5-0.5B	16	RSAP5-10B	26		36	
7	RSAR5-10B	17	RSAP5009-10B	27		37	
8	RSAR5-25B	18	RSAP5-25B	28		38	
9	RSAR5-40B	19	RSAP5-39B	29		39	
10	RSAS5-0.5B	20	RSAR5-40BMS <sup>U Th</sup>	30		40	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

LDC #: 21990M59  
 SDG #: 238477

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2  
 Reviewer: MG  
 2nd Reviewer: [Signature]

Method: Radiochemistry (EPA Method *See cover*)

Validation Area	Yes	No	NA	Findings/Comments
<b>I. Technical holding times</b>				
All technical holding times were met.	✓			
<b>II. Calibration</b>				
Were all instruments and detectors calibration as required?	✓			
Were NIST traceable standards used for all calibrations?	✓			
Was the check source identified by activity and radionuclide?	✓			
Were check sources including background counts analyzed at the required frequency and within laboratory control limits?	✓			
<b>III. Blanks</b>				
Were blank analyses performed as required?	✓			
Were any activities detected in the blanks greater than the minimum detectable activity (MDA)? If yes, please see the Blanks validation completeness worksheet.		✓		
<b>IV. Matrix spikes and Duplicates</b>				
Were a matrix spike (MS) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD, or MS/DUP. Soil / Water.	✓			
Were the MS percent recoveries (%R) within the QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.	✓			
Was a duplicate sample analyzed at the required frequency of 5% in this SDG?	✓			
Were all duplicate sample duplicate error ratios (DER) $\leq 1.427$ .		✓		
<b>V. Laboratory control samples</b>				
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 75-125%	✓			
<b>VI. Sample Chemical/Carrier Recovery</b>				
Was a tracer/carrier added to each sample?	✓			
Were tracer/carrier recoveries within the QC limits?	✓			
<b>VII. Regional Quality Assurance and Quality Control</b>				
Were performance evaluation (PE) samples performed?		✓		
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
<b>VIII. Sample Result Verification</b>				
Were activities adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were the Minimum Detectable Activities (MDA) $< RL$ ?			✓	



LDC #: 21990M59  
 SDG #: 238477

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: MG  
 2nd Reviewer: [Signature]

Validation Area	Yes	No	NA	Findings/Comments
<b>IX. Overall assessment of data</b>				
Overall assessment of data was found to be acceptable.	✓			
<b>X. Field duplicates</b>				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
<b>XI. Field blanks</b>				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.	✓			





**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

METHOD: Radiochemistry (Method: see cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MBA (units)	Finding	Qualifications
1	↓	Tu-228	0.05 (pci/g)	0.0931 (pci/g)	Lab DL > QAPP RDL	None / P
	↓	Tu-230	0.05	0.0521		
2	↓	Tu-228	0.05	0.105		
	↓	Tu-230	0.05	0.0978		
3		Tu-228	0.05	0.0843		
	↓	Tu-230	0.05	0.0827		
		U-233/234	0.04	0.0535		
4		Tu-228	0.05	0.115		
	↓	Tu-230	0.05	0.0636		
	↓	U-235/236	0.04	0.0697		
	↓	U-238	0.04	0.0564		
5		Tu-228	0.05	0.128		
	↓	Tu-230	0.05	0.0743		
	↓	U-233/234	0.04	0.0621		
	↓	U-235/236	0.04	0.0415		
	↓	U-238	0.04	0.0537		
6		Tu-228	0.05	0.102		
	↓	Tu-230	0.05	0.0723		
	↓	U-233/234	0.04	0.0604		
	↓	U-238	0.04	0.0523		

Comments:

LDC #: 21990 M59  
SDG #: 238477

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 2 of 4  
Reviewer: MG  
2nd Reviewer:         

METHOD: Radiochemistry (Method: SEE COVER)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP RDL (unite)	GAPP POL (pc/g)	Lab DL MBA (unite)	Lab DL (pc/g)	Finding	Qualifications
7	↓	Tu-228	0.05	0.139	0.143	Lab DL > GAPP POL	None / P	
		Tu-230	0.05	0.0574				
		U-233/234	0.04	0.0507				
		U-235/236	0.04	0.0574				
		U-238	0.04					
8	↓	Tu-228	0.05	0.128				
		Tu-230	0.05	0.0708				
		U-233/234	0.04	0.115				
		U-238	0.04	0.0886				
9	↓	Tu-228	0.05	0.0989				
		Tu-230	0.05	0.114				
		U-233/234	0.04	0.068				
		U-235/236	0.04	0.0526				
		U-238	0.04	0.0546				
10	↓	Tu-228	0.05	0.119				
		U-238	0.04	0.0416				
11	↓	Tu-228	0.05	0.0641				
		U-235/236	0.04	0.0495				
12	↓	U-233/234	0.04	0.0526				
		U-238	0.04	0.0473				

Comments:

DC #: 21990 M59  
 DG #: 238477

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 4  
 Reviewer: MG  
 2nd Reviewer: [Signature]

METHOD: Radiochemistry (Method: SEE COVER)

the following sample MDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MBA (units)	Finding	Qualifications
13	↓	Th-228	0.05 (pci/g)	0.0673 (pci/g)	Lab DL > QAPP RDL	None / P
		Th-230	0.05	0.066		
		U-233/234	0.04	0.052		
14	↓	Th-228	0.05	0.114		
		Th-230	0.05	0.121		
		Th-232	0.10	0.116		
		U-233/234	0.04	0.0486		
		U-235/236	0.04	0.0468		
15	↓	Th-228	0.05	0.0534		
		Th-230	0.05	0.0524		
		U-233/234	0.04	0.0893		
		U-235/236	0.04	0.0894		
		U-238	0.04	0.0776		
16	↓	Th-230	0.05	0.0541		
		U-235/236	0.04	0.0563		
17	↓	Th-228	0.05	0.0642		
		Th-230	0.05	0.0504		
		U-233/234	0.04	0.0863		
		U-235/236	0.04	0.0686		
		U-238	0.04	0.0799		

Comments:



LDC #: 21990M59  
 SDG #: 238477

**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 1 of 2  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: see cover)

- N N/A Were field duplicate pairs identified in this SDG?  
 N N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	2	3	
Th-228	1.51	2.01	28 ( ≤ 50 )
Th-230	1.12	1.62	36 (   )
Th-232	1.36	1.45	6 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	2	3	
U-233/234	1.26	1.20	5 <sup>RPD</sup> ( ≤ 50 )
U-235/236	0.0802	0.0897	difference 0.0095 ( ≤ 0.04 )
U-238	1.06	1.22	14 <sup>RPD</sup> ( ≤ 50 )

Isotopes	Activity ( pCi/g )		RPD
	13	14	
Th-228	1.04	1.08	4 ( ≤ 50 )
Th-230	2.25	1.78	23 (   )
Th-232	0.868	0.993	13 ( ↓ )

Isotopes	Activity ( pCi/g )		Qual parent only difference / RPD
	13	14	
U-233/234	2.13	2.05	4 <sup>RPD</sup> ( ≤ 50 )
U-235/236	0.101	0.142	difference 0.041 ( ≤ 0.04 ) Jdets/A fd
U-238	1.86	2.08	11 <sup>RPD</sup> ( ≤ 50 )



LDC #: 21990M59  
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**VALIDATION FINDINGS WORKSHEET**  
**Field Duplicates**

Page: 2 of 2  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: see cover)

N/A Were field duplicate pairs identified in this SDG?  
 N/A Were target isotopes detected in the field duplicate pairs?

Isotopes	Activity ( pCi/g )		RPD
	16	17	
Tu-228	1.58	1.49	6 ( ≤ 50 )
Tu-230	0.898	0.928	3 (   )
Tu-232	1.49	1.39	7 ( ↓ )

Isotopes	Activity ( pCi/g )		difference / RPD
	16	17	
U-233/234	1.00	0.853	<sup>RPD</sup> 16 ( ≤ 50 )
U-235/236	0.0882	0.0558 U	difference 0.0324 ( ≤ 0.04 )
U-238	0.946	0.920	<sup>RPD</sup> 3 ( ≤ 50 )

Isotopes	Activity ( )		RPD

Isotopes	Activity ( )		RPD

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**VALIDATION FINDINGS WORKSHEET**  
**Level IV Recalculation Worksheet**

Page: 1 of 1  
 Reviewer: MG  
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METHOD: Radiochemistry (Method: see cover)

Percent recoveries (%R) for a laboratory control sample, a matrix spike and a matrix spike duplicate sample were recalculated using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = activity of each analyte measured in the analysis of the sample.  
 True = activity of each analyte in the source.

A matrix spike and matrix spike duplicate relative percent difference (RPD) was recalculated using the following formula:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where, S = Original sample activity  
 D = Duplicate sample activity

Sample ID	Type of Analysis	Analyte	Found/S (units)	True/D (units)	Recalculated		Reported		Acceptable (Y/N)
					%R or RPD	%R or RPD	%R or RPD	%R or RPD	
LCS	Laboratory control sample	U-238	5.13 (pci/g)	4.94 (pci/g)	104	104	104	104	Y
20	Matrix spike sample	Th-230	8.64 (pci/g)	8.49 (pci/g)	102	102	102	102	Y
21	Duplicate RPD	U-233/234	2.75 (pci/g)	3.05 (pci/g)	10.3	10.3	10.5	10.5	Y
1	Chemical recovery	Ac-227 for Th-isotopes	4.08010 (dpm)	3.89353 (dpm)	105	105	105	105	Y

Comments: Refer to appropriate worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 21990M59  
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**VALIDATION FINDINGS WORKSHEET**  
**Sample Calculation Verification**

Page: 1 of 1  
 Reviewer: MG  
 2nd reviewer: W

METHOD: Radiochemistry (Method: see cover)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

- N N/A Have results been reported and calculated correctly?  
 N N/A Are results within the calibrated range of the instruments?

Analyte results for # 1, Th-232 reported with a positive detect were recalculated and verified using the following equation:

Activity = 
$$\frac{(\text{cpm} - \text{bckgrd cpm})}{(2.22)(E)(\text{Vol})(CF)}$$
 Recalculation: 
$$\frac{(201.00/1000.)}{(2.22)(0.250454)(0.252g)(1.04792)} = 1.3689 \text{ pCi/g}$$

E = Efficiency  
 Vol = Volume  
 CF = %R, Self-absorbance, abundance, ect.

#	Sample ID	Analyte	Reported Concentration (pCi/g)	Calculated Concentration (pCi/g)	Acceptable (Y/N)
1	1	Th-228	1.33	1.30	Y
		Th-230	1.14	1.14	
		Th-232	1.37	1.37	
		U-233/234	0.951	0.951	
		U-235/236	0.0446	0.0446	
		U-238	1.05	1.05	
2	11	Th-228	1.56	1.53	
		Th-230	1.51	1.51	
		Th-232	1.44	1.44	
		U-233/234	1.74	1.74	
		U-235/236	0.0878	0.0878	
		U-238	1.29	1.29	✓

Note: \_\_\_\_\_