



**LABORATORY DATA CONSULTANTS, INC.**

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

January 8, 2010

**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 December 3, 2009, December 7, 2009, December 9, 2009 and December 14, 2009. Attachment 1 is a summary of the samples that were reviewed for each analysis.

**LDC Project # 22233:**

<b><u>SDG #</u></b>	<b><u>Fraction</u></b>
238974, 239237	Radium-226 & Radium-228, Isotopic Uranium &
239753, 240560	Isotopic Thorium
240965	

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



EDD CHECKLIST

LDC #: 22232  
 SDG #: 238974, 233237, 239753, 240560, 240965

Page: 1 of 1  
 Reviewer: JE  
 2nd Reviewer: BC

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_LDC22232_010410.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 #22232**

**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:** October 13 through October 29, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil

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

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 238974

### Sample Identification

RSAN8-10BSPLP  
SA52-15BSPLP  
SA52-28BSPLP  
RSAQ8-10BSPLP  
RSAQ8-31BSPLP  
SA34-10BSPLP  
SA34-31BSPLP  
RSAN8-10BSPLPMS  
RSAN8-10BSPLPDUP  
SA34-10BSPLPMS  
SA34-10BSPLPDUP

Samples in this SDG underwent SPLP extraction

## Introduction

This data review covers 11 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).

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. 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/L)	PQL (pCi/L)	Flag	A or P
SA52-15BSPLP	Radium-228	3.0	3.03	None	P

The MDA was greater than the PQL as listed above.

## 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 238974	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

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 238974**

<b>SDG</b>	<b>Sample</b>	<b>Isotope</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
238974	RSAN8-10BSPLP	Radium-228	None	P	Minimum detectable activity
238974	RSAN8-10BSPLP SA52-15BSPLP SA52-28BSPLP RSAQ8-10BSPLP RSAQ8-31BSPLP SA34-10BSPLP SA34-31BSPLP	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 238974**

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 238974**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 22232A29

VALIDATION COMPLETENESS WORKSHEET

Date: 12-21-09

SDG #: 238974

Stage 2B 4

Page: 1 of 1

Laboratory: GEL Laboratories LLC

MA

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: 10-13-09 through 10-29-09
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+	
VI.	Minimum detectable activity (MDA)	SW	
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

MA

1	RSAN8-10BSPLP	11	SA34-10SPLPDUP <sup>B 226</sup>	21	31
2	SA52-15BSPLP	12	PBS	22	32
3	SA52-28BSPLP	13	PBSPLP	23	33
4	RSAQ8-10BSPLP	14		24	34
5	RSAQ8-31BSPLP	15		25	35
6	SA34-10SPLP <sup>B</sup>	16		26	36
7	SA34-31BSPLP	17		27	37
8	RSAN8-10BSPLPMS <sup>228</sup>	18		28	38
9	RSAN8-10BSPLPDUP <sup>228</sup>	19		29	39
10	SA34-10SPLPMS <sup>B 226</sup>	20		30	40

Notes: Fluid 3 (Reagent Water)

LDC #: 10050A07  
 SDG #: 238974

VALIDATION FINDINGS CHECKLIST

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

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) $\leq 1.42$ ?	✓			
<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 #: 22232A29  
 SDG #: 238974

VALIDATION FINDINGS CHECKLIST

Page: 2 of 2  
 Reviewer: MG  
 2nd Reviewer: √

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 #: 2232A29  
SDG #: 238974

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 of 1  
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	2	Ra-228	3. (pg/L)	3.03 (pg/L)	Lab DL > QAPP RDL	None/P

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

LDC #: 22232A29  
 SDG #: 230974

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

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

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		
LCS	Laboratory control sample	Ra-228	43.046 (pCi/L)	39.2 (pCi/L)	110	110		Y
10	Matrix spike sample	Ra-226	243.39 (pCi/L)	242. (pCi/L)	101	101		
11	Duplicate RPD	Ra-226	0.3796 u (pCi/L)	0.4366 u (pCi/L)	14.0	14.0		
2	Chemical recovery	Ba-133 for Ra-228	255.9 (cpm)	322.8 (cpm)	79.3	79.3		

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

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

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 # 2, Ra-226 reported with a positive detect were recalculated and verified using the following equation:

Activity = Recalculation:

$$\frac{(\text{cpm} - \text{bckgrd cpm})}{(2.22)(E)(\text{Vol})(CF)} \frac{(0.633 - 0.167)}{(2.22)(2.2590)(0.300L)} \times \frac{1}{0.661} \times \frac{1}{0.975} \times 1.002 = 0.4816 \text{ pCi/L}$$

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

#	Sample ID	Analyte	Reported Concentration (pCi/L)	Calculated Concentration (pCi/L)	Acceptable (Y/N)
1	2	Ra-228	3.35	3.34	Y
		Ra-226	0.480	0.482	↓

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

\_\_\_\_\_

\_\_\_\_\_



## Laboratory Data Consultants, Inc. Data Validation Report

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

**Collection Date:** October 16 through October 20, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil/Water

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

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 239237

### Sample Identification

SA108-20B	SA33-33B
SA108-30B	SA108-20BMS
SA108-45B	SA108-20BDUP
SA157-10B	
SA157-25B	
SA157-44B	
SA171-5B	
SA171-15B	
SA171-30B	
SA171-41B	
EB101909-SO1A3	
SA156-0.5B	
SA156-10B	
SA156-30B	
SA156-35B	
SA156-45B	
SA33-0.5B	
SA33009-0.5B	
SA33-10B	
SA33-20B	

## 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 EB101909-SO1A3 was identified as an equipment blank. No radium-226 or radium-228 was found in this blank.

Samples FB080309-SO (from SDG 234414) and FB082809-SO (from SDG 236238) 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	Isotope	Concentration	Associated Samples
FB082809-SO	8/28/09	Radium-228 Radium-226	3.83 pCi/L 1.75 pCi/L	SA108-20B SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B

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. 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:

<b>Sample</b>	<b>Finding</b>	<b>Flag</b>	<b>A or P</b>
All samples in SDG 239237	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 SA33-0.5B and SA33009-0.5B were identified as field duplicates. No isotopic 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
	SA33-0.5B	SA33009-0.5B				
Radium-228	1.32	0.660	-	0.66 ( $\leq 0.50$ )	J (all detects)	A
Radium-226	1.05	0.490	-	0.56 ( $\leq 0.50$ )	J (all detects)	A

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 239237**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
239237	SA108-20B SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B EB101909-SO1A3 SA156-0.5B SA156-10B SA156-30B SA156-35B SA156-45B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
239237	SA33-0.5B SA33009-0.5B	Radium-228 Radium-226	J (all detects) 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 239237**

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 239237**

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 239237**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 22232B29

VALIDATION COMPLETENESS WORKSHEET

Date: 12-21-09

SDG #: 239237

Stage 2B

Page: 1 of 1

Laboratory: GEL Laboratories LLC

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: 10-16-09 through 10-20-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	MS/DUP (SDG: 237885, 238830)
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	SW	D = 17+18
XIV.	Field blanks	SW	EB = *11, FB = FB082809-SO (SDG: 236238)

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	SA108-20B	S	11	EB101909-SO1A3	W	21	SA33-33B	S	31
2	SA108-30B		12	SA156-0.5B	S	22	SA108-20BMS		32
3	SA108-45B		13	SA156-10B		23	SA108-20BDUP		33
4	SA157-10B		14	SA156-30B		24	PBS		34
5	SA157-25B		15	SA156-35B		25	PBW		35
6	SA157-44B		16	SA156-45B		26			36
7	SA171-5B		17	SA33-0.5B		27			37
8	SA171-15B		18	SA33009-0.5B		28			38
9	SA171-30B		19	SA33-10B		29			39
10	SA171-41B		20	SA33-20B		30			40

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





LDC#: 22232B29  
SDG#: 239237

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

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

**METHOD:** Radio Chemistry (Method: see cover)

- N NA Were field duplicate pairs identified in this SDG?  
 N NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/g)		( $\leq 50$ )	(pCi/g)	(pCi/g)	Qualifications (Parent Only)
	17	18	RPD	Difference	Limits	
Ra-228	1.32	0.660		0.66	(<0.50)	J dets/ A fd
Ra-226	1.05	0.490		0.56	(<0.50)	J dets/ A fd

V:\FIELD DUPLICATES\FD\_inorganic\22232B29.wpd

## Laboratory Data Consultants, Inc. Data Validation Report

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

**Collection Date:** October 23 through November 2, 2009

**LDC Report Date:** December 30, 2009

**Matrix:** Water

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

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 239753

### Sample Identification

M-141B	M-137BMS
M-141009B	M-137BDUP
PB102309-A3	
M-145B	
M-139B	
M-146B	
M-144B	
M-138B	
M-138009B	
M-138BDISS	
M-138009BDISS	
M-137B	
M-137BDISS	
M-148B	
EB103009-GWA4	
M-147B	
M-147009B	
EB110209-GWA3	
M-141BMS	
M-141BDUP	

## Introduction

This data review covers 22 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.

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).

Samples EB103009-GWA4 and EB110209-GWA3 were identified as equipment blanks. No radium-226 or radium-228 was found in these blanks.

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-146B

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

Sample	Isotope	Reported Activity	Modified Final Activity
M-146B	Radium-226	0.880 pCi/L	1.00U pCi/L

Samples PB100209-A2 (from SDG 237885) and PB102309-A3 were identified as pump blanks. No radium-226 or radium-228 was found in these blanks.

Sample FilB092509-A2 (from SDG 237885) 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
FiltB092509-A2	9/25/09	Radium-228	1.88 pCi/L	M-138BDISS M-138009BDISS M-137BDISS

Sample concentrations were compared to concentrations detected in the filter 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. 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 239753	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 M-141B and M-141009B, samples M-138B and M-138009B, samples M-138BDISS and M-138009BDISS, and samples M-147B and M-147009B were identified as field duplicates. No isotopic 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-141B	M-141009B				
Radium-228	2.40U	2.39	-	0.01 ( $\leq 3.00$ )	-	-
Radium-226	0.228U	0.458	-	0.23 ( $\leq 1.00$ )	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-138B	M-138009B				
Radium-226	0.671	0.540	-	0.131 ( $\leq 1.00$ )	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-138BDISS	M-138009BDISS				
Radium-226	0.252U	0.276	-	0.024 ( $\leq 1.00$ )	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-147B	M-147009B				
Radium-226	0.784	0.303	-	0.481 ( $\leq 1.00$ )	-	-



**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 239753**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
239753	M-141B M-141009B PB102309-A3 M-145B M-139B M-146B M-144B M-138B M-138009B M-138BDISS M-138009BDISS M-137B M-137BDISS M-148B EB103009-GWA4 M-147B M-147009B EB110209-GWA3	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 239753**

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 239753**

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 239753**

SDG	Sample	Isotope	Modified Final Activity	A or P	Code
239753	M-146B	Radium-226	1.00U pCi/L	A	bf

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Pump Blank Data Qualification Summary - SDG 239753**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Filter Blank Data Qualification Summary - SDG 239753**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 22232C29  
 SDG #: 239753  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**

Stage ~~2B~~ **4**

*MG*

Date: 12-21-09  
 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>10-23-09 through 11-2-09</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	A LCS
IVc.	Chemical recovery	A
V.	Sample result verification	A <i>✓</i>
VI.	Minimum detectable activity (MDA)	A
VII.	Overall assessment of data	A
VIII.	Field duplicates	SW D=1+2, D=8+9, D=10+11, D=16+17
XIV.	Field blanks	SW Pump Blank = *3, *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

EB = \*15, \*18; Filter Blank = Fil+B092509-A2 (SDG: 237885)  
 FB = FB080409-GW (SDG: 233776)

Validated Samples:  
all water

1	M-141B	11	M-138009BDISS	21	M-137BMS <sup>226</sup>	31
2	M-141009B	12	M-137B	22	M-137BDUP <sup>226</sup>	32
3	PB102309-A3	13	M-137BDISS	23	PBW	33
4	M-145B	14	M-128B <sup>4</sup> <i>MG</i>	24		34
5	M-139B	15	EB103009-GWA4	25		35
6	M-146B	16	M-147B	26		36
7	M-144B	17	M-147009B	27		37
8	M-138B	18	EB110209-GWA3	28		38
9	M-138009B	19	M-141BMS <sup>228</sup>	29		39
10	M-138BDISS	20	M-141BDUP <sup>228</sup>	30		40

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

LDC #: 22232C29  
 SDG #: 239753

VALIDATION FINDINGS CHECKLIST

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

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) $\leq 1.42$ ?	✓			
<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 #: 22232C29  
SDG #: 239753

VALIDATION FINDINGS CHECKLIST

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

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

LDC #: 22232C29

SDG #: 239753

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

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: 9-25-09

Field blank type: (circle one) Filter Blank / Other Rinsate Associated Samples: 10, 11, 13 (all N.D.)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	Sample Identification
<u>Filter</u>	<u>2509-A2</u>		<u>qualified</u>	
<u>Ra-228</u>	<u>1.88</u>			

Blank units: pCi/L Associated sample units: pCi/L  
Sampling date: 8-4-09  
Field blank type: (circle one) Field Blank Rinsate / Other:

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	Sample Identification
<u>Filter</u>	<u>409-GW</u>		<u>6</u>	
<u>Ra-228</u>	<u>2.33</u>			
<u>Ra-226</u>	<u>0.396</u>		<u>0.880/1.00</u>	

Associated Samples: 6 Qual: Ubf

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#: 22232C29  
 SDG#: 239753

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

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

**METHOD:** Radio Chemistry (Method: see cover)

Y  N  NA Were field duplicate pairs identified in this SDG?  
 Y  N  NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/L)		(<30) RPD	(pCi/L) Difference	(pCi/L) Limits	Qualifications (Parent Only)
	1	2				
Ra-228	2.40U	2.39		0.01	(≤3.00)	
Ra-226	0.228U	0.458		0.23	(≤1.00)	

V:\FIELD DUPLICATES\FD\_inorganic\22232C29.wpd

Compound	Concentration (pCi/L)		(<30) RPD	(pCi/L) Difference	(pCi/L) Limits	Qualifications (Parent Only)
	8	9				
Ra-226	0.671	0.540		0.131	(≤1.00)	

V:\FIELD DUPLICATES\FD\_inorganic\22232C29.wpd

Compound	Concentration (pCi/L)		(<30) RPD	(pCi/L) Difference	(pCi/L) Limits	Qualifications (Parent Only)
	10	11				
Ra-226	0.252U	0.276		0.024	(≤1.00)	

V:\FIELD DUPLICATES\FD\_inorganic\22232C29.wpd

Compound	Concentration (pCi/L)		(<30) RPD	(pCi/L) Difference	(pCi/L) Limits	Qualifications (Parent Only)
	16	17				
Ra-226	0.784	0.303		0.481	(≤1.00)	

V:\FIELD DUPLICATES\FD\_inorganic\22232C29.wpd

LDC #: 22232C29  
 SDG #: 239753

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

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

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	19.434 (pci/L)	24.2 (pci/L)	80.3	80.4	Y	
19	Matrix spike sample	Ra-228	93.425 (pci/L)	79.1 (pci/L)	118	118		
22	Duplicate RPD	Ra-226	0.1767 u (pci/L)	0.1867 u (pci/L)	5.50	5.52		
2	Chemical recovery	Ba-133 for Ra-228	276.4 (cpm)	304.5 (cpm)	90.8	90.8		

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





**Laboratory Data Consultants, Inc.  
Data Validation Report**

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

**Collection Date:** November 5, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil

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

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 240560

**Sample Identification**

SA77-0.5B  
SA77-10B  
SA77009-10B  
SA77-0.5BMS  
SA77-0.5BDUP

## Introduction

This data review covers 5 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).

Sample FB082809-SO (from SDG 236238) 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
FB082809-SO	8/28/09	Radium-228 Radium-226	3.83 pCi/L 1.75 pCi/L	All samples in SDG 240560

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. 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 240560	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 SA77-10B and SA77009-10B were identified as field duplicates. No isotopic 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
	SA77-10B	SA77009-10B				
Radium-228	0.917	0.753	-	0.164 ( $\leq 0.50$ )	-	-
Radium-226	0.926	0.768	-	0.158 ( $\leq 0.50$ )	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Data Qualification Summary - SDG 240560**

<b>SDG</b>	<b>Sample</b>	<b>Isotope</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
240560	SA77-0.5B SA77-10B SA77009-10B	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 240560**

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 240560**

No Sample Data Qualified in this SDG

## Tronox Northgate Henderson

LDC #: 22232D29

### VALIDATION COMPLETENESS WORKSHEET

Date: 12-22-09

SDG #: 240560

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: <u>11-5-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
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 = 2+3</u>
XIV.	Field blanks	SW	<u>FB = FB082809-50 (SDG: 236238)</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	SA77-0.5B	11		21		31	
2	SA77-10B	12		22		32	
3	SA77009-10B	13		23		33	
4	SA77-0.5BMS <u>226 228</u>	14		24		34	
5	SA77-0.5BDUP <u>226 228</u>	15		25		35	
6	PBS	16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

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



LDC #: 22232D29

SDG #: 240560

## VALIDATION FINDINGS WORKSHEET

### Field Blanks

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: pc/L Associated sample units: PCi/g  
 Sampling date: 8-28-09  
 Field blank type: (circle one) Field Blank/ Rinsate / Other: \_\_\_\_\_

Associated Samples: all (> 10x)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
	F8082809-50		NO	samples were qualified
>RL	Ra-228	0.0383		
>RL	Ra-226	0.0175		

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#: 22232D29

SDG#: 240560

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

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

**METHOD:** Radio Chemistry (Method: see cover)

- NA Were field duplicate pairs identified in this SDG?  
 NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/g)		( $\leq 50$ )	(pCi/g)	(pCi/g)	Qualifications (Parent Only)
	2	3	RPD	Difference	Limits	
Ra-228	0.917	0.753		0.164	( $\leq 0.50$ )	
Ra-226	0.926	0.768		0.158	( $\leq 0.50$ )	

V:\FIELD DUPLICATES\FD\_inorganic\22232D29.wpd

**Laboratory Data Consultants, Inc.  
Data Validation Report**

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

**Collection Date:** November 11, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Water

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

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 240965

**Sample Identification**

M-122B  
M-122BDISS  
M-122BMS  
M-122BDUP  
M-122BDISSMS  
M-122BDISSDUP

## Introduction

This data review covers 6 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 PB102309-A3 (from SDG 239753) was identified as a pump blank. No radium-226 or radium-228 was found in this blank.

Sample FilB092509-A2 (from SDG 237885) 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
FiltB092509-A2	9/25/09	Radium-228	1.88 pCi/L	M-122BDISS

Sample concentrations were compared to concentrations detected in the filter 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. 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 240965	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 240965**

<b>SDG</b>	<b>Sample</b>	<b>Isotope</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
240965	M-122B M-122BDISS	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 240965**

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 240965**

No Sample Data Qualified in this SDG

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Radium-226 & Radium-228 - Filter Blank Data Qualification Summary - SDG 240965**

No Sample Data Qualified in this SDG



**Tronox Northgate Henderson**

LDC #: 22232E29  
 SDG #: 240965  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**  
 Stage 2B

Date: 12-22-09  
 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>11-11-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
IVa.	Matrix Spike/(Matrix Spike) Duplicates	A	<u>MS/DUP</u>
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	SW	<u>Pump Blank = * PB102309-A3 (SDG: 239753)</u>

Filter Blank = FiltB092509-A2 (SDG: 237885)

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:  
water

1	M-122B	11		21		31	
2	M-122BDISS	12		22		32	
3	M-122BMS <u>226</u>	13		23		33	
4	M-122BDUP <u>226</u>	14		24		34	
5	M-122BDISSMS <u>228</u>	15		25		35	
6	M-122BDISSDUP <u>228</u>	16		26		36	
7	<u>PBW</u>	17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

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

LDC #: 22232E29  
 SDG #: 240965

**VALIDATION FINDINGS WORKSHEET**  
Field Blanks

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: 9-25-09

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

Analyte	Blank ID	Blank Action Limit	Sample Identification							
Field Blank	2509-A2		No	Sample	was	qualified				
Ra-228	1.88									

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".

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Data Validation Reports  
LDC #22232**

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:** October 13 through October 29, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 238974

**Sample Identification**

RSAN8-10BSPLP  
SA52-15BSPLP  
SA52-28BSPLP  
RSAQ8-10BSPLP  
RSAQ8-31BSPLP  
SA34-10BSPLP  
SA34-31BSPLP  
RSAN8-10BSPLPMS  
RSAN8-10BSPLPDUP

Samples in this SDG underwent SPLP extraction

## Introduction

This data review covers 9 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).

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
RSAN8-10BSPLP	Thorium-228	0.0381	0.03	None	P
	Uranium-233/234	0.0389	0.03	None	
SA52-28BSPLP	Thorium-228	0.046	0.03	None	P
	Uranium-233/234	0.0304	0.03	None	
RSAQ8-10BSPLP	Thorium-228	0.0449	0.03	None	P
	Uranium-233/234	0.0429	0.03	None	
RSAQ8-31BSPLP	Thorium-228	0.0467	0.03	None	P
	Thorium-230	0.033	0.03	None	
SA34-10BSPLP	Thorium-228	0.0499	0.03	None	P
SA34-31BSPLP	Thorium-228	0.041	0.03	None	P
	Uranium-238	0.0348	0.03	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 238974	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

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 238974**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
238974	RSAN8-10BSPLP SA52-28BSPLP RSAQ8-10BSPLP	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity
238974	RSAQ8-31BSPLP	Thorium-228 Thorium-230	None None	P	Minimum detectable activity
238974	SA34-10BSPLP	Thorium-228	None	P	Minimum detectable activity
238974	SA34-31BSPLP	Thorium-228 Uranium-238	None None	P	Minimum detectable activity
238974	RSAN8-10BSPLP SA52-15BSPLP SA52-28BSPLP RSAQ8-10BSPLP RSAQ8-31BSPLP SA34-10BSPLP SA34-31BSPLP	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 238974**

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 238974**

No Sample Data Qualified in this SDG

Tronox Northgate Henderson

LDC #: 22232A59

VALIDATION COMPLETENESS WORKSHEET

Date: 12-21-09

SDG #: 238974

Stage 2B 4

Page: 1 of 1

Laboratory: GEL Laboratories LLC

gmA

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: 10-13-09 through 10-29-09
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	A*	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	N	
X.	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	RSAN8-10BSPLP	11	PBS	21		31	
2	SA52-15BSPLP	12	PBSPLP	22		32	
3	SA52-28BSPLP	13		23		33	
4	RSAQ8-10BSPLP	14		24		34	
5	RSAQ8-31BSPLP	15		25		35	
6	SA34-10SPLP	16		26		36	
7	SA34-31BSPLP	17		27		37	
8	RSAN8-10BSPLPMS <sup>U Th</sup>	18		28		38	
9	RSAN8-10BSPLPDUP <sup>U Th</sup>	19		29		39	
10		20		30		40	

Notes: Fluid 3 (Reagent water)

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) $\leq 1.42$ ?	✓			
<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) $< RL$ ?			✓	

VALIDATION FINDINGS CHECKLIST

SDG #: 238974

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 #: 22232A59  
 SDG #: 232974

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

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

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		
LCS	Laboratory control sample	U-238	2.78 (pci/L)	3.15 (pci/L)	88.3	88.2		Y
8	Matrix spike sample	Th-230	2.19 (pci/L)	2.68 (pci/L)	81.7	81.8		
9	Duplicate RPD	U-233/234	0.159 (pci/L)	0.179 (pci/L)	11.8	11.9		
2	Chemical recovery	Ac-227 for Th-isotopes	3.96086 (dpm)	3.88351 (dpm)	102	102		

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



## Laboratory Data Consultants, Inc. Data Validation Report

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

**Collection Date:** October 16 through October 20, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil/Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 239237

### Sample Identification

SA108-20B	SA33-33B
SA108-30B	SA108-20BMS
SA108-45B	SA108-20BDUP
SA157-10B	
SA157-25B	
SA157-44B	
SA171-5B	
SA171-15B	
SA171-30B	
SA171-41B	
EB101909-SO1A3	
SA156-0.5B	
SA156-10B	
SA156-30B	
SA156-35B	
SA156-45B	
SA33-0.5B	
SA33009-0.5B	
SA33-10B	
SA33-20B	



## 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 EB101909-SO1A3 was identified as an equipment blank. No isotopic uranium or isotopic thorium was found in this blank.

Samples 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
FB082809-SO	8/28/09	Thorium-228 Uranium-235/236	0.0263 pCi/L 0.00837 pCi/L	SA108-20B SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B

Field Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
FB080309-SO	8/3/09	Uranium-238	0.0126 pCi/L	SA156-0.5B SA156-10B SA156-30B SA156-35B SA156-45B

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
SA157-10B	Uranium-235/236	0.0352 pCi/g	0.04U pCi/g

#### 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
SA108-20BDUP (SA108-20B)	Thorium-228	20.8 (≤20)	-	J (all detects) UJ (all non-detects)	A
SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B)	Thorium-232	24.6 (≤20)	-	J (all detects) UJ (all non-detects)	

##### 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
SA108-20B	Thorium-228 Thorium-230	0.146 0.0532	0.05 0.05	None None	P
SA108-30B	Thorium-228 Thorium-230	0.135 0.0735	0.05 0.05	None None	P
SA108-45B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	0.0917 0.0696 0.0554 0.0645	0.05 0.04 0.04 0.04	None None None None	P
SA157-10B	Thorium-228 Thorium-230 Uranium-233/234	0.0912 0.0556 0.0477	0.05 0.05 0.04	None None None	P
SA157-25B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	0.0834 0.0506 0.0559 0.0409 0.0498	0.05 0.05 0.04 0.04 0.04	None None None None None	P
SA157-44B	Thorium-228 Thorium-230 Uranium-233/234	0.197 0.0798 0.0563	0.05 0.05 0.04	None None None	P
SA171-5B	Thorium-228 Thorium-230	0.127 0.160	0.05 0.05	None None	P
SA171-15B	Thorium-228 Thorium-230	0.119 0.0885	0.05 0.05	None None	P
SA171-30B	Thorium-228 Thorium-230	0.0549 0.0865	0.05 0.05	None None	P
SA171-41B	Thorium-228 Uranium-233/234 Uranium-238	0.103 0.059 0.0403	0.05 0.04 0.04	None None None	P

Sample	Isotope	Lab DL (pCi/g)	PQL (pCi/g)	Flag	A or P
SA156-0.5B	Thorium-228	0.120	0.05	None	P
	Thorium-230	0.0857	0.05	None	
	Uranium-238	0.0478	0.04	None	
SA156-10B	Thorium-228	0.168	0.05	None	P
	Thorium-230	0.0693	0.05	None	
	Uranium-233/234	0.0594	0.04	None	
	Uranium-238	0.0469	0.04	None	
SA156-30B	Thorium-228	0.117	0.05	None	P
	Thorium-230	0.0874	0.05	None	
	Uranium-233/234	0.0526	0.04	None	
	Uranium-235/236	0.0432	0.04	None	
	Uranium-238	0.0526	0.04	None	
SA156-35B	Thorium-228	0.0864	0.05	None	P
	Thorium-230	0.0615	0.05	None	
	Uranium-233/234	0.0631	0.04	None	
	Uranium-235/236	0.0695	0.04	None	
	Uranium-238	0.0523	0.04	None	
SA156-45B	Thorium-228	0.0904	0.05	None	P
	Thorium-230	0.059	0.05	None	
	Uranium-235/236	0.0445	0.04	None	
SA33-0.5B	Thorium-228	0.118	0.05	None	P
	Uranium-233/234	0.0704	0.04	None	
	Uranium-235/236	0.0487	0.04	None	
	Uranium-238	0.0477	0.04	None	
SA33009-0.5B	Thorium-228	0.140	0.05	None	P
	Thorium-230	0.0788	0.05	None	
	Uranium-233/234	0.0407	0.04	None	
	Uranium-235/236	0.0436	0.04	None	
SA33-10B	Thorium-228	0.140	0.05	None	P
	Thorium-230	0.083	0.05	None	
SA33-20B	Thorium-228	0.145	0.05	None	P
	Thorium-230	0.0885	0.05	None	
	Uranium-233/234	0.0628	0.04	None	
	Uranium-235/236	0.0484	0.04	None	
SA33-33B	Thorium-228	0.140	0.05	None	P
	Thorium-230	0.0639	0.05	None	
	Uranium-233/234	0.050	0.04	None	
	Uranium-238	0.0428	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 239237	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 SA33-0.5B and SA33009-0.5B 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
	SA33-0.5B	SA33009-0.5B				
Thorium-228	1.14	1.53	29 ( $\leq 50$ )	-	-	-
Thorium-230	1.43	0.805	56 ( $\leq 50$ )	-	J (all detects)	A
Thorium-232	0.911	1.02	11 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.78	1.08	49 ( $\leq 50$ )	-	-	-
Uranium-238	1.50	0.877	52 ( $\leq 50$ )	-	J (all detects)	A

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 239237**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
239237	SA108-20B SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B	Thorium-228  Thorium-232	J (all detects) UJ (all non-detects)  J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (Id)
239237	SA108-20B SA108-30B SA171-5B SA171-15B SA171-30B SA33-10B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
239237	SA108-45B SA33-0.5B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity (PQL)
239237	SA157-10B SA157-44B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
239237	SA157-25B SA156-30B SA156-35B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None	P	Minimum detectable activity (PQL)
239237	SA171-41B	Thorium-228 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity (PQL)
239237	SA156-0.5B	Thorium-228 Thorium-230 Uranium-238	None None None	P	Minimum detectable activity (PQL)
239237	SA156-10B SA33-33B	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)
239237	SA156-45B	Thorium-228 Thorium-230 Uranium-235/236	None None None	P	Minimum detectable activity (PQL)
239237	SA33009-0.5B SA33-20B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)
239237	SA108-20B SA108-30B SA108-45B SA157-10B SA157-25B SA157-44B SA171-5B SA171-15B SA171-30B SA171-41B EB101909-SO1A3 SA156-0.5B SA156-10B SA156-30B SA156-35B SA156-45B SA33-0.5B SA33009-0.5B SA33-10B SA33-20B SA33-33B	All isotopes reported below the PQL.	J (all detects)	A	Sample result verification (PQL) (sp)
239237	SA33-0.5B SA33009-0.5B	Thorium-230 Uranium-238	J (all detects) 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 239237**

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 239237**

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 239237**

<b>SDG</b>	<b>Sample</b>	<b>Isotope</b>	<b>Modified Final Concentration</b>	<b>A or P</b>	<b>Code</b>
239237	SA157-10B	Uranium-235/236	0.04U pCi/g	A	bf

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LDC #: 22232B59

VALIDATION COMPLETENESS WORKSHEET

Date: 12-21-09

SDG #: 239237

Stage 2B

Page: 1 of 1

Laboratory: GEL Laboratories LLC

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: 10-16-09 through 10-20-09
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	A	
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=17+18
X.	Field blanks	SW	EB=*11 FB= FB082809-SO (SDG: 236238)

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	SA108-20B	S	11	EB101909-SO1A3	W	21	SA33-33B	S	31
2	SA108-30B		12	SA156-0.5B	S	22	SA108-20BMS		32
3	SA108-45B		13	SA156-10B		23	SA108-20BDUP		33
4	SA157-10B		14	SA156-30B		24	PBS		34
5	SA157-25B		15	SA156-35B		25	PBW		35
6	SA157-44B		16	SA156-45B		26			36
7	SA171-5B		17	SA33-0.5B		27			37
8	SA171-15B		18	SA33009-0.5B		28			38
9	SA171-30B		19	SA33-10B		29			39
10	SA171-41B		20	SA33-20B		30			40

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

LDC #: 22232 B59  
 SDG #: 239237

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

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

METHOD: Radiochemistry (Method: see cover)

N N/A Were field blanks identified in this SDG?  
 Y 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: \_\_\_\_\_

Qual: U bf

Associated Samples: 1 → 10, 17 → 21 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification												
FB 08	2809-50		4												
Tu-232	0.0263														
U-235/236	0.00837		0.0352	0.04											

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: 12 → 16 (> RL)

Analyte	Blank ID	Blank Action Limit	Sample Identification												
FB 08	309-50														
U-238	0.0126														

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".

**VALIDATION FINDINGS WORKSHEET**

**Duplicate Analysis**

LDC #: 22232B59  
 SDG #: 239237

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 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)  $\leq 1.42$ ?  $DER = \frac{|Act_1 - Act_2|}{2|\delta_1^2 + \delta_2^2|^{1/2}}$

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

#	Duplicate ID	Matrix	Isotope	RPD DER (Limits)	Associated Samples	Qualifications
1	23	Soil	Tu-232	20.8 ( $\leq 20$ )	1 → 10, 17 → 21	J/US/A 1d
	↓	↓	Tu-232	24.6 ( $\downarrow$ )	↓	↓

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

LDC #: 22232B59  
 SDG #: 239237

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 1 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 MDA (units)	Finding	Qualifications
1	↓	Th-228	0.05 (pci/g)	0.146 (pci/g)	Lab DL > QAPP RDL	None / P
	↓	Th-230	0.05	0.0532		
2	↓	Th-228	0.05	0.135		
	↓	Th-230	0.05	0.0735		
3	↓	Th-228	0.05	0.0917		
	↓	U-233/234	0.04	0.0696		
	↓	U-235/236	0.04	0.0554		
	↓	U-238	0.04	0.0645		
4	↓	Th-228	0.05	0.0912		
	↓	Th-230	0.05	0.0556		
	↓	U-233/234	0.04	0.0477		
5	↓	Th-228	0.05	0.0834		
	↓	Th-230	0.05	0.0506		
	↓	U-233/234	0.04	0.0559		
	↓	U-235/236	0.04	0.0409		
	↓	U-238	0.04	0.0498		
6	↓	Th-228	0.05	0.197		
	↓	Th-230	0.05	0.0798		
	↓	U-233/234	0.04	0.0563		
7	↓	Th-228	0.05	0.127		
	↓	Th-230	0.05	0.160		

Comments:

LDC #: 22232B59  
 SDG #: 239237

**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	QAPP RDL (units)	Lab DL-MDA (units)	Lab DL (pci/g)	Finding	Qualifications
8	↓	Tn-228	0.05 (pci/g)	0.119 (pci/g)		Lab DL > QAPP RDL	None / P
		Tn-230	0.05	0.0885			
9	↓	Tn-228	0.05	0.0549			
		Tn-230	0.05	0.0865			
10	↓	Tn-228	0.05	0.103			
		U-233/234	0.04	0.059			
	↓	U-238	0.04	0.0403			
11	↓	Tn-228	0.05	0.120			
		Tn-230	0.05	0.0857			
	↓	U-238	0.04	0.0478			
12	↓	Tn-228	0.05	0.168			
		Tn-230	0.05	0.0693			
	↓	U-233/234	0.04	0.0594			
		U-238	0.04	0.0469			
13	↓	Tn-228	0.05	0.117			
		Tn-230	0.05	0.0874			
	↓	U-233/234	0.04	0.0526			
		U-235/236	0.04	0.0432			
	↓	U-238	0.04	0.0526			

Comments:

LDC #: 22232B59  
 SDG #: 239237

**VALIDATION FINDINGS WORKSHEET**  
**Minimum Detectable Activities**

Page: 3 of 4  
 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 MDA (units)	Finding	Qualifications
14	↓	Tu-228	0.05 (pc/g)	0.0864 (pc/g)	Lab DL > QAPP RDL	None / P
		Tu-230	0.05	0.0615		
		U-233/234	0.04	0.0631		
		U-235/236	0.04	0.0695		
15	↓	U-238	0.04	0.0523		
		Tu-228	0.05	0.0904		
		Tu-230	0.05	0.059		
		U-235/236	0.04	0.0445		
16	↓	Tu-228	0.05	0.118		
		U-233/234	0.04	0.0704		
		U-235/236	0.04	0.0487		
		U-238	0.04	0.0477		
17	↓	Tu-228	0.05	0.140		
		Tu-230	0.05	0.0788		
		U-233/234	0.04	0.0407		
		U-235/236	0.04	0.0436		
18	↓	Tu-228	0.05	0.140		
		Tu-230	0.05	0.083		
		Tu-228	0.05	0.145		
		Tu-230	0.05	0.0885		
19	↓	U-233/234	0.04	0.0628		
		U-235/236	0.04	0.0484		
		Tu-228	0.05			
		Tu-230	0.05			
20	↓	Tu-228	0.05			
		Tu-230	0.05			
		U-233/234	0.04			
		U-235/236	0.04			

Comments:



LDC #: 22232B59  
SDG #: 239237

### VALIDATION FINDINGS WORKSHEET Minimum Detectable Activities

Page: 4 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 MDA (units)	Finding	Qualifications
20	21	Th-228	0.05 (pci/g)	0.140 (pci/g)	Lab DL > QAPP RDL	None / P
		Th-230	0.05	0.0639	↓	↓
		U-233/234	0.04	0.050	↓	↓
		U-238	0.04	0.0428	↓	↓

Comments:

LDC#: 22232B59  
 SDG#: 239237

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

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

**METHOD:** Radio Chemistry (Method: see cover)

- N NA Were field duplicate pairs identified in this SDG?
- N NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/g)		(<50) RPD	(pCi/g) Difference	(pCi/g) Limits	Qualifications (Parent Only)
	17	18				
Th-228	1.14	1.53	29			
Th-230	1.43	0.805	56			J dets/ A fd
Th-232	0.911	1.02	11			
U-233/234	1.78	1.08	49			
U-238	1.50	0.877	52			J dets/ A fd

V:\FIELD DUPLICATES\FD\_inorganic\22232B59.wpd

## Laboratory Data Consultants, Inc. Data Validation Report

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

**Collection Date:** October 23 through November 2, 2009

**LDC Report Date:** December 30, 2009

**Matrix:** Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 4

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 239753

### Sample Identification

M-141B	M-145BMS
M-141009B	M-145BDUP
PB102309-A3	
M-145B	
M-139B	
M-146B	
M-144B	
M-138B	
M-138009B	
M-138BDISS	
M-138009BDISS	
M-137B	
M-137BDISS	
M-148B	
EB103009-GWA4	
M-147B	
M-147009B	
EB110209-GWA3	
PB102309-A3MS	
PB102309-A3DUP	

## Introduction

This data review covers 22 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.

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).

Method Blank ID	Isotope	Activity	Associated Samples
PB (prep blank)	Uranium-235/236	0.00895 pCi/L	All samples in SDG 239753

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

Samples EB103009-GWA4 and EB110209-GWA3 were identified as equipment blanks. No isotopic uranium or isotopic thorium was found in these blanks with the following exceptions:

Equipment Blank ID	Sampling Date	Isotope	Concentration	Associated Samples
EB103009-GWA4	10/30/09	Uranium-233/234	0.0272 pCi/L	No associated samples in this SDG
EB110209-GWA3	11/2/09	Uranium-233/234 Uranium-238	0.067 pCi/L 0.035 pCi/L	M-147B M-147009B

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

Sample FB080409-GW (from SDG 233776) was identified as a field blank. No isotopic uranium or isotopic thorium was found in this blank.

Samples PB100209-A2 (from SDG 237885) and PB102309-A3 were identified as pump blanks. No isotopic uranium or isotopic thorium was found in these blanks.

Sample FiltB092509-A2 (from SDG 237885) 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
FiltB092509-A2	9/25/09	Thorium-230	0.0112 pCi/L	M-138BDISS M-138009BDISS M-137BDISS

Sample concentrations were compared to concentrations detected in the filter 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) 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-141B	Thorium-228	0.0638	0.03	None	P
	Uranium-233/234	0.0887	0.03	None	
	Uranium-235/236	0.0567	0.03	None	
	Uranium-238	0.0571	0.03	None	
M-141009B	Thorium-228	0.0436	0.03	None	P
	Thorium-230	0.0322	0.03	None	
	Thorium-232	0.0322	0.03	None	
	Uranium-233/234	0.140	0.03	None	
	Uranium-235/236	0.0569	0.03	None	
	Uranium-238	0.0973	0.03	None	
PB102309-A3	Thorium-228	0.0322	0.03	None	P
	Uranium-233/234	0.0599	0.03	None	
	Uranium-235/236	0.0371	0.03	None	
	Uranium-238	0.042	0.03	None	
M-145B	Uranium-233/234	0.0384	0.03	None	P
	Uranium-235/236	0.0365	0.03	None	
	Uranium-238	0.0408	0.03	None	
M-139B	Thorium-228	0.0485	0.03	None	P
	Uranium-233/234	0.0533	0.03	None	
M-146B	Thorium-228	0.0436	0.03	None	P
	Uranium-233/234	0.0512	0.03	None	
	Uranium-235/236	0.0366	0.03	None	
	Uranium-238	0.0359	0.03	None	
M-144B	Thorium-228	0.0329	0.03	None	P
	Uranium-233/234	0.0414	0.03	None	
	Uranium-235/236	0.0481	0.03	None	
M-138B	Uranium-233/234	0.0434	0.03	None	P
M-138009B	Uranium-233/234	0.0436	0.03	None	P
	Uranium-235/236	0.0467	0.03	None	
	Uranium-238	0.0377	0.03	None	
M-138BDISS	Uranium-233/234	0.0507	0.03	None	P
	Uranium-238	0.0507	0.03	None	
M-138009BDISS	Thorium-228	0.039	0.03	None	P
	Uranium-233/234	0.0728	0.03	None	
	Uranium-235/236	0.0468	0.03	None	
	Uranium-238	0.0302	0.03	None	
M-137B	Thorium-228	0.0394	0.03	None	P
	Uranium-233/234	0.0359	0.03	None	
	Uranium-238	0.0323	0.03	None	



Sample	Isotope	Lab DL (pCi/L)	PQL (pCi/L)	Flag	A or P
M-137BDISS	Thorium-228	0.033	0.03	None	P
	Uranium-235/236	0.038	0.03	None	
	Uranium-238	0.0462	0.03	None	
M-147B	Uranium-233/234	0.0398	0.03	None	P
M-147009B	Uranium-233/234	0.044	0.03	None	P
	Uranium-235/236	0.0311	0.03	None	
EB110209-GWA3	Uranium-238	0.0307	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 239753	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 M-141B and M-141009B, samples M-138B and M-138009B, samples M-138BDISS and M-138009BDISS, and samples M-147B and M-147009B 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-141B	M-141009B				
Uranium-233/234	76.5	75.1	2 (≤30)	-	-	-
Uranium-235/236	2.85	2.95	3 (≤30)	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-141B	M-141009B				
Uranium-238	49.2	50.7	3 ( $\leq 30$ )	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-138B	M-138009B				
Thorium-230	0.0327	0.00817U	-	0.02453 ( $\leq 0.03$ )	-	-
Thorium-232	0.019	0.0131U	-	0.0059 ( $\leq 0.03$ )	-	-
Uranium-233/234	40.9	41.6	2 ( $\leq 30$ )	-	-	-
Uranium-235/236	1.20	1.53	24 ( $\leq 30$ )	-	-	-
Uranium-238	20.7	20.9	1 ( $\leq 30$ )	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-138BDISS	M-138009BDISS				
Uranium-233/234	39.1	38.5	2 ( $\leq 30$ )	-	-	-
Uranium-235/236	1.03	1.10	7 ( $\leq 30$ )	-	-	-
Uranium-238	19.5	19.2	2 ( $\leq 30$ )	-	-	-

Analyte	Concentration (pCi/L)		RPD (Limits)	Difference (Limits)	Flags	A or P
	M-147B	M-147009B				
Thorium-228	0.017	0.00564U	-	0.01136 ( $\leq 0.03$ )	-	-
Uranium-233/234	26.1	26.2	0 ( $\leq 30$ )	-	-	-
Uranium-235/236	1.09	1.07	2 ( $\leq 30$ )	-	-	-
Uranium-238	19.6	19.6	0 ( $\leq 30$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 239753**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
239753	M-141B PB102309-A3 M-146B M-138009BDISS	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity
239753	M-141009B	Thorium-228 Thorium-230 Thorium-232 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None None None	P	Minimum detectable activity
239753	M-145B M-138009B	Uranium-233/234 Uranium-235/236 Uranium-238	None None None	P	Minimum detectable activity
239753	M-139B	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity
239753	M-144B	Thorium-228 Uranium-233/234 Uranium-235/236	None None None	P	Minimum detectable activity
239753	M-138B M-147B	Uranium-233/234	None	P	Minimum detectable activity
239753	M-138BDISS	Uranium-233/234 Uranium-238	None None	P	Minimum detectable activity
239753	M-137B	Thorium-228 Uranium-233/234 Uranium-238	None None None	P	Minimum detectable activity
239753	M-137BDISS	Thorium-228 Uranium-235/236 Uranium-238	None None None	P	Minimum detectable activity
239753	M-147009B	Uranium-233/234 Uranium-235/236	None None	P	Minimum detectable activity
239753	EB110209-GWA3	Uranium-238	None	P	Minimum detectable activity

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
239753	M-141B M-141009B PB102309-A3 M-145B M-139B M-146B M-144B M-138B M-138009B M-138BDISS M-138009BDISS M-137B M-137BDISS M-148B EB103009-GWA4 M-147B M-147009B EB110209-GWA3	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 239753**

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 239753**

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 239753**

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 239753**

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 239753**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

LDC #: 22232C59  
 SDG #: 239753  
 Laboratory: GEL Laboratories LLC

**VALIDATION COMPLETENESS WORKSHEET**

Stage ~~2B~~ 4

*mg*

Date: 12-21-09  
 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>10-23-09 through 11-2-09</u>
IIa.	Initial calibration	A	
IIb.	Calibration verification	A	
III.	Blanks	SW	
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	A <del>+</del>	
VIII.	Overall assessment of data	A	
IX.	Field duplicates	SW	<u>D = 1+2, D = 8+9, D = 10+11, D = 16+17</u>
X.	Field blanks	SW	<u>Pump Blank = *3, *PB100209-A2 (SDG: 237885)</u>

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

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

EB = 15, 18. Filter Blank = Fil+B097509-A2 (SDG: 23788)  
 D = Duplicate  
 TB = Trip blank  
 EB = Equipment blank

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

Validated Samples:  
all water

1	M-141B	11	M-138009BDISS	21	M-145BMS	<u>u</u>	31	
2	M-141009B	12	M-137B	22	M-145BDUP	<u>u</u>	32	
3	PB102309-A3	13	M-137BDISS	23	<u>PBW</u>		33	
4	M-145B	14	<sup>4</sup> M- <del>138</del> B	<i>mg</i> 24			34	
5	M-139B	15	EB103009-GWA4	25			35	
6	M-146B	16	M-147B	26			36	
7	M-144B	17	M-147009B	27			37	
8	M-138B	18	EB110209-GWA3	28			38	
9	M-138009B	19	PB102309-A3MS	<u>Tu</u> 29			39	
10	M-138BDISS	20	PB102309-A3DUP	<u>Tu</u> 30			40	

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

LDC #: 22232C59  
 SDG #: 239753

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) $\leq 1.42$ ?	✓			
<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 #: 22232C59  
SDG #: 239753

VALIDATION FINDINGS CHECKLIST

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

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

LDC #: 22232C59  
SDG #: 239753

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 (> RL or ND.)

Isotope	Blank ID	Blank Action Level	Sample Identification											
U-235/236	PBW 0.00895		<u>No samples were qualified</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 #: 22232c59  
SDG #: 239753

VALIDATION FINDINGS WORKSHEET  
Field Blanks

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

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:  $\text{pCi/L}$  Associated sample units:  $\text{pCi/L}$   
Sampling date: 9-25-09

Field blank type: (circle one) Field Blank / Rinse  Filter  Blank Associated Samples: 10, 11, 13 (all ND)

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified
Th-230	2509-A2	0.0112		

Blank units:  $\text{pCi/L}$  Associated sample units:  $\text{pCi/L}$   
Sampling date: 10-30-09

Field blank type: (circle one) Field Blank / Rinse  EB  None Associated Samples:

Analyte	Blank ID	Blank Action Limit	Sample Identification	
			No samples	were qualified
U-233/234	15	0.0272		

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 #: 22232C59  
SDG #: 239753

# 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: PC/L Associated sample units: PC/L

Sampling date: 11-2-09

Field blank type: (circle one) Field Blank / Rinsate Other EB

Associated Samples: 16, 17 (> 10x)

Analyte	Blank ID	Blank Action Limit	Sample Identification													
			No samples were qualified													
>RL U-233/234	0.067	0.67														
>RL U-238	0.035	0.35														

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".

DC #: 22232C59  
 DG #: 239753

**VALIDATION FINDINGS WORKSHEET**  
Minimum Detectable Activities

Page: 1 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)	QAPP RDL (pci/L)	Lab DL MBA (units)	Lab DL (pci/L)	Finding	Qualifications
1	↓	Tn-228	0.03		0.0638		Lab DL > QAPP RDL	None / P
		U-233/234			0.0887			
		U-235/236			0.0567			
2	↓	U-238			0.0571			
		Tn-228			0.0436			
		Tn-230			0.0322			
3	↓	Tn-232			0.0322			
		U-233/234			0.140			
		U-235/236			0.0569			
4	↓	U-238			0.0973			
		Tn-228			0.0322			
		U-233/234			0.0599			
5	↓	U-235/236			0.0371			
		U-238			0.042			
		U-233/234			0.0384			
6	↓	U-238			0.0365			
		Tn-228			0.0408			
		U-233/234			0.0485			
7	↓	Tn-228			0.0533			
		U-233/234			0.0436			
		U-235/236			0.0512			
8	↓	U-238			0.0366			
		U-233/234			0.0359			
		U-235/236						

Comments:

LDC #: 22232C59  
 SDG #: 239753

**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	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
7	7	Th-228	0.03 (pci/L)	0.0329 (pci/L)	Lab DL > QAPP RDL	None / P
	↓	U-233/234		0.0414		
		U-235/236		0.0481		
8	8	U-233/234		0.0434		
9	9	U-233/234		0.0436		
	↓	U-235/236		0.0467		
		U-238		0.0377		
10	10	U-233/234		0.0507		
	↓	U-238		0.0507		
11	11	Th-228		0.039		
	↓	U-233/234		0.0728		
	↓	U-235/236		0.0468		
		U-238		0.0302		
12	12	Th-228		0.0394		
	↓	U-233/234		0.0359		
		U-238		0.0323		
13	13	Th-228		0.033		
	↓	U-235/236		0.038		
		U-238		0.0462		
14	14	U-233/234		0.0398		

Comments:



LDC#: 22232C59  
 SDG#: 239753

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

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

**METHOD:** Radio Chemistry (Method: see cover)

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

Compound	Concentration (pCi/L)		(≤30)	(pCi/L)	(pCi/L)	Qualifications (Parent Only)
	1	2	RPD	Difference	Limits	
U-233/234	76.5	75.1	2			
U-235/236	2.85	2.95	3			
U-238	49.2	50.7	3			

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Compound	Concentration (pCi/L)		(≤30)	(pCi/L)	(pCi/L)	Qualifications (Parent Only)
	8	9	RPD	Difference	Limits	
Th- <del>230</del> <b>230</b>	0.0327	0.00817U		0.02453	(<0.03)	
Th-232	0.019	0.0131U		0.0059	(≤0.03)	
U-233/234	40.9	41.6	2			
U-235/236	1.20	1.53	24			
U-238	20.7	20.9	1			

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Compound	Concentration (pCi/L)		(≤30)	(pCi/L)	(pCi/L)	Qualifications (Parent Only)
	10	11	RPD	Difference	Limits	
U-233/234	39.1	38.5	2			
U-235/236	1.03	1.10	7			
U-238	19.5	19.2	2			

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Compound	Concentration (pCi/L)		(≤30)	(pCi/L)	(pCi/L)	Qualifications (Parent Only)
	16	17	RPD	Difference	Limits	
Th-228	0.017	0.00564U		0.01136	(≤0.03)	

LDC#: 22232C59  
SDG#: 239753

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

Page: 2 of 2  
Reviewer: MG  
2nd Reviewer: IN

**METHOD:** Metals (EPA Method 6010B/6020/7000)

- Y N NA Were field duplicate pairs identified in this SDG?  
 Y N NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/L)		(≤30)	(pCi/L)	(pCi/L)	Qualifications (Parent Only)
	16	17	RPD	Difference	Limits	
U-233/234	26.1	26.2	0			
U-235/236	1.09	1.07	2			
U-238	19.6	19.6	0			

V:\FIELD DUPLICATES\FD\_inorganic\22232C59.wpd

LDC #: 22232C59  
 SDG #: 239753

**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:

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

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	Acceptable (Y/N)
					%R or RPD	%R or RPD		
LCS	Laboratory control sample	$Tu-230$	2.11 (pci/L)	2.68 (pci/L)	78.7	78.7	78.7	Y
19	Matrix spike sample	$Tu-230$	2.22 (pci/L)	2.68 (pci/L)	82.8	82.9	82.9	
22	Duplicate RPD	$U-235/236$	0.702 (pci/L)	0.635 (pci/L)	10.02	9.99	9.99	
1	Chemical recovery	$U-232$	3.12198 (dpm)	5.25236 (dpm)	59.4	59.4	59.4	

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 #: 22232059  
 SDG #: 239753

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

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

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, U-238 reported with a positive detect were recalculated and verified using the following equation:

Activity =

Recalculation:

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

$$(13212.0 / 1000.0)$$

$$\frac{(13212.0 / 1000.0)}{(2.22)(0.254206)(0.800 \text{ L})(0.59440)} = 49.224 \text{ pCi/L}$$

E = Efficiency

Vol = Volume

CF = %R, Self-absorbance, abundance, ect.

#	Sample ID	Analyte	Reported Concentration (pCi/L)	Calculated Concentration (pCi/L)	Acceptable (Y/N)
1	1	U-233/234	76.5	76.5	Y
		U-235/236	2.85	2.85	
		U-238	49.2	49.2	
2	11	U-233/234	38.5	38.5	↓
		U-235/236	1.10	1.10	
		U-238	19.2	19.2	

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

**Laboratory Data Consultants, Inc.  
Data Validation Report**

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

**Collection Date:** November 5, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Soil

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 240560

**Sample Identification**

SA77-0.5B  
SA77-10B  
SA77009-10B  
SA77-10BMS  
SA77-10BDUP

## Introduction

This data review covers 5 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
PBS (prep blank)	Thorium-232	0.0262 pCi/g	All samples in SDG 240560

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

Sample FB082809-SO (from SDG 236238) 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
FB082809-SO	8/28/09	Thorium-228 Uranium-235/236	0.0263 pCi/L 0.00837 pCi/L	All samples in SDG 240560

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
SA77-10BDUP (All samples in SDG 240560)	Thorium-230	28.9 ( $\leq 20$ )	-	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
SA77-0.5B	Thorium-228	0.161	0.05	None	P
	Thorium-230	0.0696	0.05	None	
	Uranium-233/234	0.0617	0.04	None	
	Uranium-235/236	0.0441	0.04	None	
SA77-10B	Thorium-228	0.109	0.05	None	P
	Thorium-230	0.0999	0.05	None	
SA77009-10B	Thorium-228	0.120	0.05	None	P
	Thorium-230	0.0694	0.05	None	
	Uranium-233/234	0.0467	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 240560	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 SA77-10B and SA77009-10B 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
	SA77-10B	SA77009-10B				
Thorium-228	1.60	1.68	5 ( $\leq 50$ )	-	-	-
Thorium-230	0.791	1.16	38 ( $\leq 50$ )	-	-	-
Thorium-232	1.27	1.49	16 ( $\leq 50$ )	-	-	-
Uranium-233/234	1.35	1.44	6 ( $\leq 50$ )	-	-	-
Uranium-235/236	0.059	0.0862	-	0.0272 ( $\leq 0.04$ )	-	-
Uranium-238	1.07	1.17	9 ( $\leq 50$ )	-	-	-

**Tronox LLC Facility, 2009 Phase B Investigation, Henderson, Nevada  
Isotopic Uranium & Isotopic Thorium - Data Qualification Summary - SDG 240560**

SDG	Sample	Isotope	Flag	A or P	Reason (Code)
240560	SA77-0.5B SA77-10B SA77009-10B	Thorium-230	J (all detects) UJ (all non-detects)	A	Duplicate sample analysis (RPD) (ld)
240560	SA77-0.5B	Thorium-228 Thorium-230 Uranium-233/234 Uranium-235/236	None None None None	P	Minimum detectable activity (PQL)
240560	SA77-10B	Thorium-228 Thorium-230	None None	P	Minimum detectable activity (PQL)
240560	SA77009-10B	Thorium-228 Thorium-230 Uranium-233/234	None None None	P	Minimum detectable activity (PQL)
240560	SA77-0.5B SA77-10B SA77009-10B	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 240560**

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 240560**

No Sample Data Qualified in this SDG



Tronox Northgate Henderson

LDC #: 22232D59

VALIDATION COMPLETENESS WORKSHEET

Date: 12-22-09

SDG #: 240560

Stage 2B

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: 11-5-09
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	SW	D=2+3
X.	Field blanks	SW	FB= FB087809-50 (SDG: 236238)

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	SA77-0.5B	11		21		31	
2	SA77-10B	12		22		32	
3	SA77009-10B	13		23		33	
4	SA77-10BMS U Th	14		24		34	
5	SA77-10BDUP U Th	15		25		35	
6	PBS	16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

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

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

LDC #: 22232D59  
SDG #: 240560

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

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: PCIB Associated Samples: 911 (> RL)

Isotope	Blank ID	Blank Action Level	Sample Identification			
TU-232	PBS	0.0262	No	samples	were	qualified

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 #: 22232D59  
SDG #: 240560

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?  
 Y 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: all (> RL or ND)

Analyte	Blank ID	Blank Action Limit	Sample Identification
F B 08	2809-50		No samples were qualified
Tu-232	0.0263		
U-235/236	0.00837		

< 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 #: 22232DS9  
SDG #: 240560

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)  $\leq 1.42$ ?  $DER = \frac{|Act_1 - Act_2|}{2 \sqrt{\delta_1^2 + \delta_2^2}}^{1/2}$  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	RPD DER (Limits)	Associated Samples	Qualifications
1	5	soil	Th-230	28.9 ( $\leq 20$ )	all	J/05/A 1d

Comments:

LDC #: 22232D59

### VALIDATION FINDINGS WORKSHEET

Page: 1 of 1

SDG #: 240560

Reviewer: MG

METHOD: Radiochemistry (Method: SEE COVER)

2nd Reviewer: [Signature]

#### Minimum Detectable Activities

The following sample MIDAs are above the RDL:

#	Sample ID	Isotope	QAPP RDL (units)	Lab DL MDA (units)	Finding	Qualifications
1	↓	<u>Tn-228</u>	<u>0.05 (pc/g)</u>	<u>0.161 (pc/g)</u>	<u>Lab DL &gt; QAPP RDL</u>	<u>None / P</u>
		<u>Tn-230</u>	<u>0.05</u>	<u>0.0696</u>		
		<u>U-233/234</u>	<u>0.04</u>	<u>0.0617</u>		
		<u>U-235/236</u>	<u>0.04</u>	<u>0.0441</u>		
2	↓	<u>Tn-228</u>	<u>0.05</u>	<u>0.109</u>		
		<u>Tn-230</u>	<u>0.05</u>	<u>0.0999</u>		
3	↓	<u>Tn-228</u>	<u>0.05</u>	<u>0.120</u>		
		<u>Tn-230</u>	<u>0.05</u>	<u>0.0694</u>		
		<u>U-233/234</u>	<u>0.04</u>	<u>0.0467</u>		

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

LDC#: 22232D59  
 SDG#: 240560

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

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

**METHOD:** Radio Chemistry (Method: see cover)

~~Y~~ ~~N~~ ~~NA~~ Were field duplicate pairs identified in this SDG?  
 ~~Y~~ ~~N~~ ~~NA~~ Were target analytes detected in the field duplicate pairs?

Compound	Concentration (pCi/g)		(≤50)	(pCi/g)	(pCi/g)	Qualifications (Parent Only)
	2	3	RPD	Difference	Limits	
Th-228	1.60	1.68	5			
Th-230	0.791	1.16	38			
Th-232	1.27	1.49	16			
U-233/234	1.35	1.44	6			
U-235/236	0.059	0.0862		0.0272	(<0.04)	
U-238	1.07	1.17	9			

V:\FIELD DUPLICATES\FD\_inorganic\22232D59.wpd

## Laboratory Data Consultants, Inc. Data Validation Report

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

**Collection Date:** November 11, 2009

**LDC Report Date:** December 31, 2009

**Matrix:** Water

**Parameters:** Isotopic Uranium & Isotopic Thorium

**Validation Level:** Stage 2B

**Laboratory:** GEL Laboratories, LLC.

**Sample Delivery Group (SDG):** 240965

### Sample Identification

M-122B  
M-122BDISS  
M-122BMS  
M-122BDUP  
M-122BDISSMS  
M-122BDISSDUP

## Introduction

This data review covers 6 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 PB102309-A3 (from SDG 239753) was identified as a pump blank. No isotopic uranium or isotopic thorium was found in this blank.

Sample FiltB092509-A2 (from SDG 237885) 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
FiltB092509-A2	9/25/09	Thorium-230	0.0112 pCi/L	M-122BDISS

Sample concentrations were compared to concentrations detected in the filter 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) 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-122B	Thorium-228	0.0369	0.03	None	P
	Uranium-233/234	0.091	0.03	None	
	Uranium-235/236	0.0743	0.03	None	
	Uranium-238	0.0521	0.03	None	
M-122BDISS	Thorium-228	0.0481	0.03	None	P
	Uranium-233/234	0.0394	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 240965	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 240965**

<b>SDG</b>	<b>Sample</b>	<b>Isotope</b>	<b>Flag</b>	<b>A or P</b>	<b>Reason (Code)</b>
240965	M-122B	Thorium-228 Uranium-233/234 Uranium-235/236 Uranium-238	None None None None	P	Minimum detectable activity
240965	M-122BDISS	Thorium-228 Uranium-233/234	None None	P	Minimum detectable activity
240965	M-122B M-122BDISS	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 240965**

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 240965**

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 240965**

No Sample Data Qualified in this SDG

**Tronox Northgate Henderson**

**VALIDATION COMPLETENESS WORKSHEET**

Stage 2B

LDC #: 22232E59  
 SDG #: 240965  
 Laboratory: GEL Laboratories LLC

Date: 12-22-09  
 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>11-11-09</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</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	N	
X.	Field blanks	<u>SW</u>	<u>Pump Blank = *PB102309-A3 (SDG: 239753)</u>

Filter Blank = Fil+B092509-A2 (SDG: 237885)

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:  
Water

1	M-122B	11		21		31	
2	M-122BDISS	12		22		32	
3	M-122BMS <u>U</u>	13		23		33	
4	M-122BDUP <u>U</u>	14		24		34	
5	M-122BDISSMS <u>Th</u>	15		25		35	
6	M-122BDISSDUP <u>Th</u>	16		26		36	
7	<u>PBW</u>	17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

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

LDC #: 2232E59  
SDG #: 240965

# 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/L  
Sampling date: 9-25-09

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

Analyte	Blank ID	Blank Action Limit	Sample Identification
	<u>PCi/L</u> 2509-A2		<u>1</u> No sample was qualified
Tk-230	0.0112		

< 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

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

# VALIDATION FINDINGS WORKSHEET

## Minimum Detectable Activities

METHOD: Radiochemistry (Method: see cover)

The following sample MDAs are above the RDL:

#	Sample ID	Isotope	GAPP PQL RDL (units)	Lab DL MBA (units)	Finding	Qualifications
1	↓	Tn-228	0.03 (pci/L)	0.0369 (pci/L)	Lab DL > GAPP PQL	None / P
		U-233/234		0.091		
		U-235/236 U-238		0.0743 0.0521		
2	↓	Tn-228		0.0481		
		U-233/234		0.0394		

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