

**APPENDIX B  
USACE 2001 RI  
ANALYTICAL DATA AND QA/QC EVALUATION RESULTS**

**ATTACHMENT I**

Data Validation Packages

Tonawanda Landfill Laboratory Results Database

## Data Validation Package Index

Click on Lab I.D. to open Data Validation Package<sup>(\*)</sup>

### Mudflats Soil

<b>Lab I.D.</b>	<b>Description</b>
0107025	Mudflats Reference Area
0107026	Class 3A, Class 3B Random
0107027	Class 3A, Class 3B Random
0107028	Mudflats Reference Area, Class 3A, Class 3B Random
0107029	Mudflats Reference Area
0107030	Mudflats Reference Area, Class 3A
0107095	Class 3B Random, Class 3B Biased
0107096	Class 3B Random, Class 3B Biased
0107106	Class 3B Biased, Class 2 Area C, Class 1 Area C
0107106 (C)	Chemical – Class 1 Area C
0107107	Class 3B Biased, Class 2 Area C
0107108	Class 2 Area C
0107115	Class 2 Area C
0107116	Class 2 Area C, Class 1 Area C
0108014	Class 2 Area C, Class 1 Area C

### Landfill Soil

<b>Lab I.D.</b>	<b>Description</b>
G01070024	Landfill Reference Area, Class 3 Random
G01070025	Landfill Reference Area, Class 3 Random
G01070026	Landfill Reference Area, Class 3 Random, Class 2 Area B
G01070031	Class 3 Random, Class 3 Biased, Class 2 Area B, Class 1 Area B1A, Class 1 Area B1B
G01070034	Class 3 Biased, Class 2 Area B
G01070035	Class 2 Area B – ‘Porcelain’ sample
G01070037 (C)	Chemical – Class 1 Area A
G01070038	Class 3 Random, Class 3 Biased, Class 2 Area A, Class 1 Area B1A
G01070039	Class 3 Random, Class 3 Biased, Class 2 Area A, Class 2 Area B
G01070040	Class 3 Random, Class 3 Biased, Class 2 Area A, Class 2 Area B
G01070041	Class 3 Random, Class 1 Area A
G01070042	Class 3 Random, Class 3 Biased, Class 2 Area A, Class 1 Area A
G01070043	Class 3 Biased, Class 2 Area A (includes Addendum)
G01070044	Class 3 Random, Class 3 Biased, Class 2 Area A, Class 2 Area B
G01080001	Class 1 Area A (includes Addendum)
G01080002	Class 1 Area A
G01080003	Class 1 Area A
G01080004	Class 3 Random, Class 1 Area A

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(\*) ADDENDUM: For those Data Validation Packages that discuss gross beta results, the following statement is also applicable to the discussion under Quantification: “All samples were qualified as estimated (J) since the radionuclides used for gross beta calibration do not closely match the energy of the radionuclides found by the project. The error introduced was judged to be greater than the established accuracy measurement quality objective (MQO) of +/- 25%.”

## Data Validation Package Index

Click on Lab I.D. to open Data Validation Package<sup>(\*)</sup>

### Aqueous Samples (Groundwater, Surface Water and QC)

<b>Lab I.D.</b>	<b>Description</b>
45784	QC samples
46757	Surface water and QC samples
49323	Groundwater
49379	Groundwater and QC samples
49386	Groundwater

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(\*) ADDENDUM: For those Data Validation Packages that discuss gross beta results, the following statement is also applicable to the discussion under Quantification: "All samples were qualified as estimated (J) since the radionuclides used for gross beta calibration do not closely match the energy of the radionuclides found by the project. The error introduced was judged to be greater than the established accuracy measurement quality objective (MQO) of +/- 25%."

## Radiological Analytical Data Verification Comments on Data for SDG 0107025

This sample delivery group (SDG) contained twenty individual soil samples from the Tonawanda Landfill FUSRAP Site for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] were  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry,  $^{228}\text{Ac}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ , and any radioisotopes detected above the decision level (DL) by gamma spectrometry;  $^{226}\text{Ra}$  by radon emanation; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation were requested for all samples. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics, Inc. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data; therefore, the gross alpha/beta analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0021	0107025-1
TMF-0022	0107025-2
TMF-0011	0107025-3
TMF-0012	0107025-4
TMF-0029	0107025-5
TMF-0030	0107025-6
TMF-0033	0107025-7
TMF-0034	0107025-8
TMF-0031	0107025-9
TMF-0032	0107025-10
TMF-0003	0107025-11
TMF-0004	0107025-12
TMF-0005	0107025-13
TMF-0006	0107025-14
TMF-0013	0107025-15
TMF-0014	0107025-16
TMF-0023	0107025-17
TMF-0024	0107025-18
TMF-0025	0107025-19
TMF-0026	0107025-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$DER = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the liquid samples.

### Equipment Rinsate Sample:

There was no indication of contamination in equipment rinsate blank sample for gamma spectrometry analyses.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ac}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported for in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ ,  $^{228}\text{Ra}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples.

The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is not recommended since any modeling will assume equilibrium throughout the  $^{235/238}\text{U}$  and  $^{232}\text{Th}$  decay chains.**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{231}\text{Pa}$  result for samples TMF-0031 and TMF-0013. **Therefore, it is recommended that the  $^{231}\text{Pa}$  result for samples TMF-0031 and TMF-0013 be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination in the  $^{234/235/238}\text{U}$  alpha spectrometry analyses. There was an indication of blank contamination in the method blank for  $^{230}\text{Th}$ . All associated sample results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples have results that are greater than 5 times the blank value for the  $^{230}\text{Th}$  analyses. No qualification is required.

### Equipment Rinsate Sample:

There was an indication of  $^{228}\text{Th}$  and  $^{230}\text{Th}$  contamination of equipment rinsate blank contamination for alpha spectrometry analyses. All associated sample results less than 5 times the blank value for  $^{228/230}\text{Th}$  analyses should be qualified as estimated (J). All samples had  $^{228/230}\text{Th}$  results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 17.14% for all samples for the Th and U alpha spectrometry analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty for the U alpha spectrometry analyses. However, there is greater than 10% uncertainty in the sample-specific percent recovery results for the Th alpha spectrometry analyses. There is between 15.86% - 22.11% uncertainty in the sample specific recovery result for the Th analysis for all samples. **Therefore, it is recommended that the <sup>228/230/232</sup>Th results for all samples be qualified as estimated (J).**

### Spectral Analysis:

Relatively small spectral interferences were observed in four samples of the alpha spectra for isotopic thorium. The spectral interference observed is from the tailing of a higher energy peak into a lower energy peak. In the isotopic thorium analyses, the tracer peaks for <sup>229</sup>Th tails into the <sup>230</sup>Th in samples TMF-0031, TMF-0031 (laboratory duplicate), TMF-0004, and TMF-0006, including the matrix blank sample. The measured blank activity is below the MDC (1.0 pCi/g). **Therefore, it is recommended that the <sup>230</sup>Th results for samples TMF-0031, TMF-0031 (laboratory duplicate), TMF-0004, and TMF-0006 be qualified as estimated (J).**

Several of the isotopic thorium alpha spectra show at least five extra peaks. These peaks are in the 5.8 MeV, 6.3 MeV, 6.7 MeV, 6.9 MeV, and 7.1 MeV regions. It is assumed that the peaks can be attributed to <sup>216</sup>Po, <sup>217</sup>At, <sup>225</sup>Ac and <sup>221</sup>Fr, which are progeny of <sup>228</sup>Th and the <sup>229</sup>Th tracer. There is no indication of interference with the quantitation of the isotopic thorium results. No further qualification of the isotopic thorium results is required.

## **3.0 <sup>226</sup>Ra ANALYSES**

### Method Blank:

There no indication of blank contamination in the method blank for <sup>226</sup>Ra analyses.

### Equipment Rinsate Sample:

There was an indication of <sup>226</sup>Ra contamination of equipment rinsate blank contamination for the radon emanation analyses. All associated sample results less than 5 times the blank value for <sup>226</sup>Ra analyses should be qualified as estimated (J). All samples had <sup>226</sup>Ra results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs for the <sup>226</sup>Ra analyses were within acceptable limits.

### Duplicate Analysis:

The duplicate DERs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

Matrix Spike Sample:

No MSS was included for the  $^{226}\text{Ra}$  analyses as specified in the SOW.

Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/g for  $^{226}\text{Ra}$  except for sample TMF-0024 with an MDL of 0.56 pCi/g.

#### **4.0 GROSS ALPHA AND BETA ANALYSIS**

Method Blank:

There was no indication of blank contamination in the gross alpha/beta analyses.

Equipment Rinsate Sample:

There was no indication of gross alpha or gross beta contamination of equipment rinsate blank.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs for the gross alpha/beta analyses are within acceptable limits.

Matrix Spike Sample Analysis:

The MSS result was within acceptable limits for both gross alpha and gross beta analyses.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting, which is not quantitative and does not include volatile radionuclides (e.g.,  $^3\text{H}$  and  $^{99}\text{Tc}$ ).**



Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. All of the samples results met the required MDL.

## **5.0 TOTAL ACTIVITY**

Method Blank:

There was no indication of blank contamination for the total activity analyses.

Equipment Rinsate Sample:

There was no indication of total activity contamination of equipment rinsate blank.

Laboratory Control Sample:

The percent recoveries for the reported LCSs are within acceptable limits for the total activity analysis.

Duplicate Analysis:

The total activity laboratory duplicate DER is within acceptable limits.

Matrix Spike Sample:

The MSS recovery was within acceptable limits for the total activity analysis.

Method Detection Limit:

The required method detection limit (MDL) for the total activity analysis is 10 pCi/g. All of the samples results met the required MDL.

## **6.0 DATA INTERCOMPARISON**

U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gamma agree within the uncertainties. No further qualification of the gamma spectrometry results is required.

Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to

determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs (2.39) for sample TMF-0030 indicates that the gross alpha analysis did not agree with the sum of the alpha emitters within a 99% confidence level. In addition, the RPD (89.2%) was also outside acceptable limits. The gross alpha activity was smaller than the alpha sum value. The gross alpha analysis was performed by gas proportional counting, which has uncertainties in corrections for geometry and self-absorption of the alpha particles, which may cause the negative bias observed in the gross alpha analysis. **Therefore, it is recommended that the gross alpha results for sample TMF-0030 be qualified as estimated (J).**

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (from 2.97 to 4.88) for all samples are greater than or equal to 1.29 indicating that the gross beta analyses are in agreement with the sum of the beta emitters within a 99% confidence level. The corresponding RPDs (from 112% to 139) are also outside acceptable limits. The gross beta results are a factor of approximately 5 smaller than the beta sums. This difference may be indicative of a negative bias in the gross beta sample results. **Therefore, it is recommended that the gross beta results from all samples be qualified as estimated (J).**

#### Total Activity to Sum of Alpha and Beta Emitters:

The DERs (from 2.27 to 3.86) for all samples indicate that the total activity analysis do not agree with the sum of the alpha and beta emitters within a 99% confidence level. In addition, the corresponding RPDs (84.2% to 122%) are also outside acceptable limits. The total activity results range for a factor of 2 to 4 smaller than the total activity sums. Again, this may be indicative of a negative bias in the total activity. **Therefore, it is recommended that the total activity results from all samples be qualified as estimated (J).**

#### $^{228}\text{Ra}$ Gamma to $^{232}\text{Th}$ Alpha:

When comparing the  $^{228}\text{Ra}$  activity to  $^{232}\text{Th}$  activity, it was assumed that the radium and thorium were in equilibrium. The activities are all within the uncertainties of the measurements for all samples.

#### $^{231}\text{Pa}$ Gamma to $^{235}\text{U}$ Alpha:

When comparing the  $^{231}\text{Pa}$  activity and  $^{235}\text{U}$  activity, it was assumed that the protactinium was in equilibrium. The  $^{231}\text{Pa}$  and  $^{235}\text{U}$  activities are within the measurement uncertainties for all samples except TMF-0030 and TMF-0014. These two exceptions are indicative of incomplete equilibrium.

#### Summary:

For all samples, there was agreement within the measurement uncertainties between the total activity results and the sum of the gross alpha and gross beta results. However, there appears to be a negative bias on the gross alpha/beta and total activity results. **Therefore, it is recommended that the individual analysis results be used.**

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0021		FROM GAMMA										
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q	Duplicate		Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)					
Am-241									0.00E+00	2.90E-01	2.30E-01	6.40E-01	0.33	200	U
Ra-226	3.00E-01	2.70E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.36E+00	4.50E-01						J							
Th-230	9.40E-01	3.40E-01						J							
Th-232	9.60E-01	3.50E-01						J							
U-234	8.00E-01	2.20E-01													
U-235	5.50E-02	5.40E-02							-4.00E-02	3.50E-01	1.80E-01	4.10E-01	0.41	314	U
U-238	9.40E-01	2.50E-01													
<b>Total U Alpha</b>	<b>1.80E+00</b>	<b>3.37E-01</b>													
<b>Alpha Sum</b>	<b>5.18E+00</b>	<b>1.72E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.40E-01	2.50E-01							9.00E-01	1.10E+00	4.00E-01	1.30E+00	0.29	76.9	U
Pa-234m (Assumed from U-238)	9.40E-01	2.50E-01							-4.40E+00	8.30E+00	2.10E+00	9.30E+00	0.52	565	U
K-40	2.48E+01	4.50E+00	2.22E+01	4.50E+00	0.41	11.1									
Ra-228	9.70E-01	2.40E-01	7.50E-01	2.60E-01	0.62	25.6									
Pa-231	-2.00E-01	1.70E+00	1.00E-01	2.10E+00	0.11	600	U								
<b>Beta Sum</b>	<b>2.76E+01</b>	<b>4.52E+00</b>							<b>2.22E+01</b>	<b>9.51E+00</b>	<b>2.55E+01</b>	<b>1.04E+01</b>			
<b>Total Activity Sum</b>	<b>3.28E+01</b>	<b>4.84E+00</b>							<b>2.74E+01</b>	<b>9.67E+00</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.02E+00	9.20E-01							0.08	(from gamma)		3.04			
Gross Beta	4.95E+00	8.40E-01					J		4.93	1.81		139			
Total Activity	9.50E+00	3.80E+00					J		3.79	1.73		110			

**Tonawanda Landfill Data Summary Tables**

Analyses			TMF-0022					FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-2.60E-01	4.90E-01					U
Ra-226	4.90E-01	2.30E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.70E-01	2.80E-01	1.23E+00	4.30E-01	0.90	46.0	J							
Th-230	7.90E-01	2.60E-01	8.90E-01	3.30E-01	0.24	11.9	J							
Th-232	9.20E-01	2.90E-01	9.20E-01	3.40E-01	0.00	0.00	J							
U-234	9.60E-01	2.60E-01												
U-235	7.60E-02	6.50E-02						-2.00E-02	3.10E-01					U
U-238	7.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.80E+00</b>	<b>3.53E-01</b>												
<b>Alpha Sum</b>	<b>4.32E+00</b>	<b>1.66E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.60E-01	2.30E-01						1.06E+00	9.90E-01					
Pa-234m (Assumed from U-238)	7.60E-01	2.30E-01						9.00E-01	9.20E+00					U
K-40	1.65E+01	3.40E+00												
Ra-228	6.70E-01	2.20E-01												
Pa-231	-5.00E-01	1.70E+00												U
<b>Beta Sum</b>	<b>1.86E+01</b>	<b>3.43E+00</b>						<b>1.91E+01</b>	<b>9.86E+00</b>					
<b>Total Activity Sum</b>	<b>2.29E+01</b>	<b>3.81E+00</b>						<b>2.34E+01</b>	<b>1.00E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.93E+00	9.90E-01						0.32	(from gamma)				13.3	
Gross Beta	4.25E+00	7.50E-01					J	4.10					126	
Total Activity	8.90E+00	3.70E+00					J	2.65	1.36				88.2	



**Tonawanda Landfill Data Summary Tables**

Analyses	TMF-0012					FROM GAMMA					Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241							2.10E-02	8.60E-02				U
Ra-226	4.60E-01	2.10E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.60E-01	3.70E-01										J
Th-230	7.40E-01	2.90E-01										J
Th-232	7.20E-01	2.90E-01										J
U-234	5.80E-01	1.80E-01	8.40E-01	2.30E-01	0.89	36.6						
U-235	4.90E-02	5.00E-02	3.50E-02	4.20E-02	0.21	33.3	-1.20E-01	2.70E-01				U
U-238	8.60E-01	2.30E-01	8.00E-01	2.30E-01	0.18	7.23						
<b>Total U Alpha</b>	<b>1.49E+00</b>	<b>2.96E-01</b>	<b>1.68E+00</b>	<b>3.28E-01</b>								
<b>Alpha Sum</b>	<b>4.37E+00</b>	<b>1.92E+00</b>	<b>1.68E+00</b>	<b>3.28E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01	8.00E-01	2.30E-01	0.18	7.23	9.40E-01	6.70E-01				
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01	8.00E-01	2.30E-01	0.18	7.23	-5.00E+00	1.20E+01				U
K-40	1.68E+01	3.70E+00										
Ra-228	7.70E-01	3.00E-01										
Pa-231	-4.00E-01	2.00E+00										U
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>3.73E+00</b>	<b>1.60E+00</b>	<b>3.25E-01</b>			<b>1.35E+01</b>	<b>1.26E+01</b>				
<b>Total Activity Sum</b>	<b>2.36E+01</b>	<b>4.20E+00</b>	<b>3.28E+00</b>	<b>4.62E-01</b>			<b>1.78E+01</b>	<b>1.27E+01</b>				
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>		
Gross Alpha	4.93E+00	9.30E-01					0.26	(from gamma)			12.1	
Gross Beta	4.13E+00	7.10E-01				J	3.98	0.74			129	
Total Activity	5.70E+00	3.60E+00				J	3.24	0.92			122	

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0029		DER	RPD	Val Q	FROM GAMMA				DER	RPD	Val Q
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)			
			Result (pCi/g)	Uncertainty (pCi/g)										
Am-241								5.00E-02	1.20E-01	-1.90E-01	2.90E-01	<b>0.76</b>	<b>343</b>	U
Ra-226	6.80E-01	2.30E-01	8.50E-01	2.90E-01	<b>0.46</b>	<b>22.2</b>								
Np-237														
Pu-238														
Pu-239														
Th-228	1.33E+00	4.40E-01					J							
Th-230	1.17E+00	3.90E-01					J							
Th-232	1.17E+00	3.90E-01					J							
U-234	1.07E+00	2.70E-01												
U-235	4.60E-02	4.80E-02						1.90E-01	2.90E-01	2.70E-01	3.30E-01	<b>0.18</b>	<b>34.8</b>	U
U-238	1.15E+00	2.80E-01												
<b>Total U Alpha</b>	<b>2.27E+00</b>	<b>3.92E-01</b>												
<b>Alpha Sum</b>	<b>5.81E+00</b>	<b>1.82E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	1.15E+00	2.80E-01						1.20E+00	9.80E-01	2.60E-01	7.80E-01	<b>0.75</b>	<b>129</b>	
Pa-234m (Assumed from U-238)	1.15E+00	2.80E-01						4.00E+00	1.10E+01	7.50E+00	7.00E+00	<b>0.27</b>	<b>60.9</b>	U
K-40	1.86E+01	4.00E+00	2.20E+01	4.00E+00	<b>0.60</b>	<b>16.7</b>								
Ra-228	7.90E-01	2.50E-01	9.30E-01	2.30E-01	<b>0.41</b>	<b>16.3</b>								
Pa-231	-9.00E-01	1.80E+00	-1.00E+00	1.60E+00	<b>0.04</b>	<b>10.5</b>	U							
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>4.03E+00</b>						<b>2.45E+01</b>	<b>1.18E+01</b>	<b>3.06E+01</b>	<b>8.11E+00</b>			
<b>Total Activity Sum</b>	<b>2.74E+01</b>	<b>4.43E+00</b>						<b>3.03E+01</b>	<b>1.19E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.75E+00	9.90E-01	6.60E+00	1.10E+00	<b>0.57</b>	<b>13.8</b>		<b>0.03</b>	<b>(from gamma)</b>		<b>0.97</b>			
Gross Beta	4.99E+00	8.10E-01	5.54E+00	8.90E-01	<b>0.46</b>	<b>10.4</b>	J	<b>4.03</b>	<b>1.65</b>		<b>125</b>			
Total Activity	9.70E+00	3.90E+00	1.15E+01	3.90E+00	<b>0.33</b>	<b>17.0</b>	J	<b>3.00</b>	<b>1.65</b>		<b>95.4</b>			



**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0030		DER	RPD	Val Q	FROM GAMMA				DER	RPD	Val Q	
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				
Am-241								4.00E-02	5.20E-01						U
Ra-226	-3.00E-02	1.80E-01					U								
Np-237															
Pu-238															
Pu-239															
Th-228	8.60E-01	3.10E-01					J								
Th-230	8.20E+00	2.90E+00					J								
Th-232	8.50E-01	2.90E-01					J								
U-234	7.60E-01	2.00E-01													
U-235	5.20E-02	4.90E-02						-2.70E-01	3.50E-01						U
U-238	6.90E-01	1.90E-01													
<b>Total U Alpha</b>	<b>1.50E+00</b>	<b>2.80E-01</b>													
<b>Alpha Sum</b>	<b>1.37E+01</b>	<b>3.41E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	6.90E-01	1.90E-01						6.00E-01	1.00E+00						U
Pa-234m (Assumed from U-238)	6.90E-01	1.90E-01						-7.00E+00	1.20E+01						U
K-40	1.65E+01	3.70E+00													
Ra-228	7.20E-01	3.00E-01													
Pa-231	2.60E+00	1.90E+00													
<b>Beta Sum</b>	<b>1.89E+01</b>	<b>3.73E+00</b>						<b>1.11E+01</b>	<b>1.26E+01</b>						
<b>Total Activity Sum</b>	<b>3.26E+01</b>	<b>5.05E+00</b>						<b>2.49E+01</b>	<b>1.31E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.26E+00	9.60E-01					J	<b>2.39</b>	<b>(from gamma)</b>			<b>89.2</b>			
Gross Beta	4.32E+00	7.40E-01					J	<b>3.84</b>	<b>0.54</b>			<b>126</b>			
Total Activity	9.20E+00	3.70E+00					J	<b>3.74</b>	<b>1.15</b>			<b>112</b>			

**Tonawanda Landfill Data Summary Tables**

Analyses			TMF-0033						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241									2.40E-01	3.50E-01					U
Ra-226	6.00E-01	3.20E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.12E+00	3.80E-01					J								
Th-230	9.80E-01	3.30E-01					J								
Th-232	6.50E-01	2.50E-01					J								
U-234	8.60E-01	2.10E-01													
U-235	5.90E-02	4.80E-02							-1.00E-01	3.40E-01					U
U-238	7.80E-01	2.00E-01													
<b>Total U Alpha</b>	<b>1.70E+00</b>	<b>2.94E-01</b>													
<b>Alpha Sum</b>	<b>5.41E+00</b>	<b>1.94E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.80E-01	2.00E-01							1.70E+00	1.30E+00					
Pa-234m (Assumed from U-238)	7.80E-01	2.00E-01							-6.00E+00	1.10E+01					U
K-40	2.02E+01	4.10E+00													
Ra-228	8.10E-01	2.40E-01													
Pa-231	4.00E-01	2.00E+00						U							
<b>Beta Sum</b>	<b>2.26E+01</b>	<b>4.12E+00</b>							<b>1.68E+01</b>	<b>1.18E+01</b>					
<b>Total Activity Sum</b>	<b>2.80E+01</b>	<b>4.56E+00</b>							<b>2.22E+01</b>	<b>1.20E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.74E+00	1.00E+00							<b>0.15</b>	<b>(from gamma)</b>			<b>5.94</b>		
Gross Beta	4.70E+00	7.60E-01					J		<b>4.27</b>	<b>1.02</b>			<b>131</b>		
Total Activity	9.90E+00	3.80E+00					J		<b>3.06</b>	<b>0.98</b>			<b>95.6</b>		

**Tonawanda Landfill Data Summary Tables**

Analyses			TMF-0034						FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD			
Am-241								1.12E-01	9.80E-02							
Ra-226	5.50E-01	2.20E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	9.30E-01	3.00E-01					J									
Th-230	1.00E+00	3.00E-01					J									
Th-232	8.60E-01	2.70E-01					J									
U-234	7.60E-01	2.00E-01														
U-235	6.70E-02	5.20E-02						-6.00E-02	2.80E-01							U
U-238	9.00E-01	2.20E-01														
<b>Total U Alpha</b>	<b>1.73E+00</b>	<b>3.02E-01</b>														
<b>Alpha Sum</b>	<b>4.89E+00</b>	<b>1.99E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	9.00E-01	2.20E-01						9.90E-01	6.90E-01							
Pa-234m (Assumed from U-238)	9.00E-01	2.20E-01						7.70E+00	9.20E+00							
K-40	2.00E+01	4.20E+00														
Ra-228	6.70E-01	2.40E-01														
Pa-231	-2.00E-01	2.10E+00														U
<b>Beta Sum</b>	<b>2.24E+01</b>	<b>4.23E+00</b>						<b>2.93E+01</b>	<b>1.01E+01</b>							
<b>Total Activity Sum</b>	<b>2.73E+01</b>	<b>4.67E+00</b>						<b>3.42E+01</b>	<b>1.03E+01</b>							
								<b>DER (sums to gross)</b>					<b>RPD (sums to gross)</b>			
Gross Alpha	5.11E+00	9.30E-01						<b>0.10</b>	<b>(from gamma)</b>				<b>4.46</b>			
Gross Beta	4.11E+00	7.10E-01					J	<b>4.28</b>	<b>2.48</b>				<b>138</b>			
Total Activity	8.80E+00	3.70E+00					J	<b>3.11</b>	<b>2.32</b>				<b>103</b>			

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0031		DER	RPD	Val Q	FROM GAMMA				DER	RPD	Val Q
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)			
Am-241								0.00E+00	1.00E-01					U
Ra-226	9.90E-01	2.60E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.26E+00	4.90E-01	1.20E+00	4.10E-01	0.09	4.88	J							
Th-230	9.10E-01	3.80E-01	8.20E-01	3.00E-01	0.19	10.4	J							
Th-232	1.13E+00	4.50E-01	9.30E-01	3.30E-01	0.36	19.4	J							
U-234	8.30E-01	2.20E-01												
U-235	6.40E-02	5.40E-02						4.00E-02	2.90E-01					U
U-238	8.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.75E+00</b>	<b>3.23E-01</b>												
<b>Alpha Sum</b>	<b>4.51E+00</b>	<b>1.68E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01						8.80E-01	7.10E-01					
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01						1.00E+00	1.00E+01					U
K-40	1.94E+01	4.00E+00												
Ra-228	6.70E-01	2.30E-01												
Pa-231	-1.70E+00	1.60E+00												U
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>4.02E+00</b>						<b>2.17E+01</b>	<b>1.08E+01</b>					
<b>Total Activity Sum</b>	<b>2.61E+01</b>	<b>4.36E+00</b>						<b>2.63E+01</b>	<b>1.09E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.54E+00	9.80E-01						0.53	(from gamma)			20.4		
Gross Beta	4.71E+00	7.90E-01					J	4.11				128		
Total Activity	9.10E+00	3.80E+00					J	2.94				96.6		

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0032		DER	RPD	Val Q	FROM GAMMA				DER	RPD	Val Q
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)			
Am-241								8.00E-02	5.30E-01					U
Ra-226	4.30E-01	2.30E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.80E-01	3.20E-01												
Th-230	9.30E-01	3.20E-01												
Th-232	8.40E-01	3.00E-01												
U-234	7.20E-01	2.00E-01	6.20E-01	1.80E-01	0.37	14.9	J							
U-235	3.90E-02	4.30E-02	4.70E-02	4.90E-02	0.12	18.6	J	-1.40E-01	3.30E-01					U
U-238	9.30E-01	2.30E-01	7.70E-01	2.10E-01	0.51	18.8	J							
<b>Total U Alpha</b>	<b>1.69E+00</b>	<b>3.08E-01</b>	<b>1.44E+00</b>	<b>2.81E-01</b>										
<b>Alpha Sum</b>	<b>3.41E+00</b>	<b>2.00E+00</b>	<b>1.44E+00</b>	<b>2.81E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.30E-01	2.30E-01	7.70E-01	2.10E-01	0.51	18.8		5.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	9.30E-01	2.30E-01	7.70E-01	2.10E-01	0.51	18.8		-1.00E+00	1.30E+01					U
K-40	2.04E+01	4.40E+00												
Ra-228	7.50E-01	2.70E-01												
Pa-231	-1.40E+00	2.10E+00					U							
<b>Beta Sum</b>	<b>2.28E+01</b>	<b>4.43E+00</b>	<b>1.54E+00</b>	<b>2.97E-01</b>				<b>2.05E+01</b>	<b>1.38E+01</b>					
<b>Total Activity Sum</b>	<b>2.63E+01</b>	<b>4.86E+00</b>	<b>2.98E+00</b>	<b>4.09E-01</b>				<b>2.39E+01</b>	<b>1.39E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.47E+00	9.20E-01	4.04E+00	9.00E-01	0.33	10.1		0.48	(from gamma)			26.9		
Gross Beta	4.34E+00	7.70E-01	4.21E+00	7.50E-01	0.12	3.04	J	4.12	1.17			136		
Total Activity	8.40E+00	3.70E+00	7.20E+00	3.70E+00	0.23	15.4	J	2.92	1.08			103		

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0003		DER	RPD	Val Q	FROM GAMMA				DER	RPD	Val Q
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)			
			Result (pCi/g)	Uncertainty (pCi/g)										
Am-241								6.00E-02	1.20E-01	5.00E-02	1.20E-01	<b>0.06</b>	<b>18.2</b>	U
Ra-226	4.40E-01	1.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.06E+00	4.10E-01					J							
Th-230	9.00E-01	3.50E-01					J							
Th-232	1.03E+00	3.80E-01					J							
U-234	7.80E-01	2.10E-01												
U-235	2.70E-02	3.60E-02					U	0.00E+00	4.00E-01	1.10E-01	4.20E-01	<b>0.19</b>	<b>200</b>	U
U-238	9.10E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.72E+00</b>	<b>3.14E-01</b>												
<b>Alpha Sum</b>	<b>5.60E+00</b>	<b>2.63E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.10E-01	2.30E-01						1.40E+00	1.10E+00	4.00E-01	1.20E+00	<b>0.61</b>	<b>111</b>	
Pa-234m (Assumed from U-238)	9.10E-01	2.30E-01						-1.60E+01	2.30E+01	-2.00E+00	1.80E+01	<b>0.48</b>	<b>156</b>	U
K-40	1.82E+01	5.20E+00	1.76E+01	4.70E+00	<b>0.09</b>	<b>3.35</b>								
Ra-228	6.10E-01	4.00E-01	5.60E-01	3.60E-01	<b>0.09</b>	<b>8.55</b>								
Pa-231	5.00E-01	2.80E+00	-1.10E+00	2.50E+00	<b>0.43</b>	<b>533</b>	U							
<b>Beta Sum</b>	<b>2.07E+01</b>	<b>5.24E+00</b>						<b>4.27E+00</b>	<b>2.36E+01</b>	<b>1.64E+01</b>	<b>1.86E+01</b>			
<b>Total Activity Sum</b>	<b>2.63E+01</b>	<b>5.86E+00</b>						<b>9.87E+00</b>	<b>2.38E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.19E+00	9.60E-01						<b>0.15</b>	<b>(from gamma)</b>		<b>7.55</b>			
Gross Beta	4.94E+00	8.30E-01					J	<b>2.97</b>	<b>0.03</b>		<b>123</b>			
Total Activity	1.03E+01	3.90E+00					J	<b>2.27</b>	<b>0.02</b>		<b>87.4</b>			

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0004		FROM GAMMA										Val Q		
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)			Duplicate		Duplicate								
			DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)	DER	RPD	Q					
Am-241									-2.00E-02	2.40E-01						U	
Ra-226	6.70E-01	2.70E-01															
Np-237																	
Pu-238																	
Pu-239																	
Th-228	7.50E-01	2.80E-01					J										
Th-230	1.00E+00	3.10E-01					J										
Th-232	7.70E-01	2.60E-01					J										
U-234	8.00E-01	2.30E-01															
U-235	3.90E-02	4.40E-02							1.70E-01	2.80E-01						U	
U-238	7.20E-01	2.10E-01															
<b>Total U Alpha</b>	<b>1.56E+00</b>	<b>3.15E-01</b>															
<b>Alpha Sum</b>	<b>4.21E+00</b>	<b>1.26E+00</b>															
Total U by KPA																	
Total U by KPA																	
U-235 wt% (by alpha spect)																	
U-233 wt%																	
<b>Total U Alpha (Calc)</b>																	
Total Radiological Sr																	
Tc-99																	
Th-234 (Assumed from U-238)	7.20E-01	2.10E-01							3.20E-01	8.10E-01							U
Pa-234m (Assumed from U-238)	7.20E-01	2.10E-01							6.80E+00	6.70E+00							
K-40	1.80E+01	3.30E+00															
Ra-228	7.10E-01	1.90E-01															
Pa-231	-6.00E-01	1.20E+00						U									
<b>Beta Sum</b>	<b>2.01E+01</b>	<b>3.32E+00</b>							<b>2.58E+01</b>	<b>7.52E+00</b>							
<b>Total Activity Sum</b>	<b>2.43E+01</b>	<b>3.55E+00</b>							<b>3.00E+01</b>	<b>7.62E+00</b>							
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	5.80E+00	1.10E+00							<b>0.95</b>	<b>(from gamma)</b>							<b>31.8</b>
Gross Beta	4.25E+00	8.70E-01					J		<b>4.61</b>	<b>2.84</b>							<b>130</b>
Total Activity	9.90E+00	3.70E+00					J		<b>2.81</b>	<b>2.37</b>							<b>84.2</b>

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0005		FROM GAMMA												
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)					
Am-241										5.00E-01	6.00E-01						
Ra-226	6.70E-01	2.80E-01															
Np-237																	
Pu-238																	
Pu-239																	
Th-228	1.57E+00	5.20E-01						J									
Th-230	1.35E+00	4.60E-01						J									
Th-232	1.15E+00	4.10E-01						J									
U-234	9.00E-01	2.50E-01															
U-235	7.50E-02	6.40E-02								-1.00E-01	3.90E-01						U
U-238	8.10E-01	2.30E-01															
<b>Total U Alpha</b>	<b>1.79E+00</b>	<b>3.46E-01</b>															
<b>Alpha Sum</b>	<b>8.51E+00</b>	<b>2.27E+00</b>															
Total U by KPA																	
Total U by KPA																	
U-235 wt% (by alpha spect)																	
U-233 wt%																	
<b>Total U Alpha (Calc)</b>																	
Total Radiological Sr																	
Cs-137	1.16E-01	6.70E-02															
Th-234 (Assumed from U-238)	8.10E-01	2.30E-01								2.10E+00	1.40E+00						
Pa-234m (Assumed from U-238)	8.10E-01	2.30E-01								6.00E+00	1.20E+01						U
K-40	2.01E+01	4.10E+00															
Ra-228	9.70E-01	2.80E-01															
Pa-231	2.20E+00	2.30E+00															
<b>Beta Sum</b>	<b>2.31E+01</b>	<b>4.13E+00</b>								<b>2.96E+01</b>	<b>1.28E+01</b>						
<b>Total Activity Sum</b>	<b>3.16E+01</b>	<b>4.71E+00</b>								<b>3.81E+01</b>	<b>1.30E+01</b>						
<b>DER (sums to gross)</b>																	
Gross Alpha	5.50E+00	1.00E+00								<b>1.21</b>	<b>(from gamma)</b>					<b>42.9</b>	
Gross Beta	6.50E+00	1.00E+00						J		<b>3.90</b>	<b>1.80</b>					<b>112</b>	
Total Activity	9.90E+00	3.80E+00						J		<b>3.58</b>	<b>2.08</b>					<b>105</b>	



**Tonawanda Landfill Data Summary Tables**

Analyses	0107025-14		TMF-0006		FROM GAMMA											
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q
Am-241									0.00E+00	3.10E-01						U
Ra-226	7.80E-01	2.60E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	8.90E-01	3.50E-01					J									
Th-230	7.80E-01	2.90E-01					J									
Th-232	1.03E+00	3.50E-01					J									
U-234	8.60E-01	2.20E-01														
U-235	4.20E-02	4.10E-02							5.00E-02	3.20E-01						U
U-238	7.20E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>3.00E-01</b>														
<b>Alpha Sum</b>	<b>4.02E+00</b>	<b>1.68E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.20E-01	2.00E-01							2.50E-01	5.00E-01						U
Pa-234m (Assumed from U-238)	7.20E-01	2.00E-01							5.20E+00	7.90E+00						U
K-40	1.63E+01	3.40E+00														
Ra-228	9.10E-01	2.50E-01														
Pa-231	-1.20E+00	1.70E+00					U									
<b>Beta Sum</b>	<b>1.85E+01</b>	<b>3.43E+00</b>							<b>2.25E+01</b>	<b>8.62E+00</b>						
<b>Total Activity Sum</b>	<b>2.25E+01</b>	<b>3.82E+00</b>							<b>2.65E+01</b>	<b>8.78E+00</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	4.77E+00	9.20E-01							<b>0.39</b>	<b>(from gamma)</b>						<b>17.0</b>
Gross Beta	4.18E+00	7.20E-01					J		<b>4.09</b>	<b>2.12</b>						<b>126</b>
Total Activity	7.00E+00	3.60E+00					J		<b>2.96</b>	<b>2.06</b>						<b>105</b>

**Tonawanda Landfill Data Summary Tables**

Analyses	0107025-15		TMF-0013						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD		
Am-241							5.00E-02	1.10E-01							U
Ra-226	1.07E+00	3.00E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.22E+00	4.60E-01													J
Th-230	1.49E+00	5.10E-01													J
Th-232	9.10E-01	3.60E-01													J
U-234	7.80E-01	2.10E-01													
U-235	7.30E-02	5.80E-02					1.40E-01	3.80E-01							U
U-238	6.80E-01	1.90E-01													
<b>Total U Alpha</b>	<b>1.53E+00</b>	<b>2.89E-01</b>													
<b>Alpha Sum</b>	<b>3.79E+00</b>	<b>2.08E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Cs-137	3.80E-01	1.40E-01													
Th-234 (Assumed from U-238)	6.80E-01	1.90E-01					1.56E+00	9.80E-01							
Pa-234m (Assumed from U-238)	6.80E-01	1.90E-01					8.00E+00	1.00E+01							U
K-40	2.15E+01	4.80E+00													
Ra-228	8.80E-01	3.40E-01													
Pa-231	-2.70E+00	2.10E+00													U
<b>Beta Sum</b>	<b>2.38E+01</b>	<b>4.83E+00</b>					<b>3.20E+01</b>	<b>1.11E+01</b>							
<b>Total Activity Sum</b>	<b>2.76E+01</b>	<b>5.26E+00</b>					<b>3.58E+01</b>	<b>1.13E+01</b>							
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>					
Gross Alpha	5.30E+00	9.40E-01					<b>0.66</b>	<b>(from gamma)</b>					<b>33.1</b>		
Gross Beta	5.30E+00	8.60E-01				J	<b>3.77</b>	<b>2.39</b>					<b>127</b>		
Total Activity	9.80E+00	3.80E+00				J	<b>2.74</b>	<b>2.17</b>					<b>95.2</b>		

**Tonawanda Landfill Data Summary Tables**

Analyses	0107025-16		TMF-0014		FROM GAMMA										
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									9.20E-02	9.70E-02					
Ra-226	6.30E-01	2.30E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	7.90E-01	2.90E-01					J								
Th-230	7.90E-01	2.80E-01					J								
Th-232	9.60E-01	3.10E-01					J								
U-234	7.00E-01	2.10E-01													
U-235	6.00E-02	5.40E-02						0.00E+00	2.70E-01						U
U-238	7.90E-01	2.20E-01													
<b>Total U Alpha</b>	<b>1.55E+00</b>	<b>3.09E-01</b>													
<b>Alpha Sum</b>	<b>3.28E+00</b>	<b>1.57E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.90E-01	2.20E-01						1.03E+00	8.50E-01						
Pa-234m (Assumed from U-238)	7.90E-01	2.20E-01						9.00E-01	7.20E+00						U
K-40	1.72E+01	3.60E+00													
Ra-228	7.40E-01	2.30E-01													
Pa-231	-1.60E+00	1.60E+00					U								
<b>Beta Sum</b>	<b>1.93E+01</b>	<b>3.63E+00</b>						<b>1.97E+01</b>	<b>8.10E+00</b>						
<b>Total Activity Sum</b>	<b>2.26E+01</b>	<b>3.95E+00</b>						<b>2.30E+01</b>	<b>8.25E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	4.75E+00	8.90E-01						<b>0.81</b>	<b>(from gamma)</b>					<b>36.6</b>	
Gross Beta	4.42E+00	7.50E-01				J		<b>4.03</b>	<b>1.88</b>					<b>126</b>	
Total Activity	8.70E+00	3.70E+00				J		<b>2.57</b>	<b>1.58</b>					<b>88.8</b>	

**Tonawanda Landfill Data Summary Tables**

Analyses	0107025-17		TMF-0023		FROM GAMMA										
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-2.90E-01	3.00E-01					U
Ra-226	9.10E-01	2.90E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.05E+00	3.40E-01					J								
Th-230	1.16E+00	3.50E-01					J								
Th-232	1.11E+00	3.40E-01					J								
U-234	9.50E-01	2.40E-01													
U-235	3.00E-02	3.90E-02						U	-1.00E-01	3.40E-01					U
U-238	7.40E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.72E+00</b>	<b>3.21E-01</b>													
<b>Alpha Sum</b>	<b>5.32E+00</b>	<b>1.70E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.40E-01	2.10E-01							2.70E-01	7.60E-01					U
Pa-234m (Assumed from U-238)	7.40E-01	2.10E-01							-7.10E+00	8.70E+00					U
K-40	2.51E+01	4.50E+00													
Ra-228	1.10E+00	2.60E-01													
Pa-231	-7.00E-01	1.70E+00						U							
<b>Beta Sum</b>	<b>2.76E+01</b>	<b>4.52E+00</b>							<b>1.93E+01</b>	<b>9.83E+00</b>					
<b>Total Activity Sum</b>	<b>3.29E+01</b>	<b>4.83E+00</b>							<b>2.46E+01</b>	<b>9.98E+00</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.50E+00	1.10E+00							<b>0.58</b>	<b>(from gamma)</b>			<b>20.0</b>		
Gross Beta	5.14E+00	8.50E-01					J		<b>4.88</b>	<b>1.43</b>			<b>137</b>		
Total Activity	9.20E+00	3.80E+00					J		<b>3.86</b>	<b>1.44</b>			<b>113</b>		

**Tonawanda Landfill Data Summary Tables**

Analyses	Result (pCi/g)	Uncertainty (pCi/g)	TMF-0024		FROM GAMMA												
			Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)					
Am-241										-2.00E-02	2.30E-01						U
Ra-226	8.30E-01	3.80E-01															
Np-237																	
Pu-238																	
Pu-239																	
Th-228	6.60E-01	2.50E-01						J									
Th-230	6.80E-01	2.40E-01						J									
Th-232	8.10E-01	2.70E-01						J									
U-234	8.00E-01	2.20E-01															
U-235	1.40E-01	8.60E-02								1.00E-02	2.80E-01						U
U-238	6.00E-01	1.90E-01															
<b>Total U Alpha</b>	<b>1.54E+00</b>	<b>3.03E-01</b>															
<b>Alpha Sum</b>	<b>5.06E+00</b>	<b>1.34E+00</b>															
Total U by KPA																	
Total U by KPA																	
U-235 wt% (by alpha spect)																	
U-233 wt%																	
<b>Total U Alpha (Calc)</b>																	
Total Radiological Sr																	
Tc-99																	
Th-234 (Assumed from U-238)	6.00E-01	1.90E-01								1.17E+00	9.10E-01						
Pa-234m (Assumed from U-238)	6.00E-01	1.90E-01								6.50E+00	6.80E+00						
K-40	1.85E+01	3.40E+00															
Ra-228	6.80E-01	1.80E-01															
Pa-231	6.00E-01	1.30E+00															U
<b>Beta Sum</b>	<b>2.05E+01</b>	<b>3.42E+00</b>								<b>2.69E+01</b>	<b>7.66E+00</b>						
<b>Total Activity Sum</b>	<b>2.55E+01</b>	<b>3.67E+00</b>								<b>3.20E+01</b>	<b>7.78E+00</b>						
										<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.37E+00	9.90E-01								<b>0.19</b>	<b>(from gamma)</b>						<b>5.94</b>
Gross Beta	4.44E+00	7.40E-01						J		<b>4.58</b>	<b>2.92</b>						<b>129</b>
Total Activity	8.90E+00	3.70E+00						J		<b>3.19</b>	<b>2.68</b>						<b>96.5</b>

**Tonawanda Landfill Data Summary Tables**

Analyses	0107025-19		TMF-0025		FROM GAMMA											
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q	
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									-0.02	0.56						U
Ra-226	6.50E-01	2.30E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	1.35E+00	4.30E-01					J									
Th-230	1.24E+00	3.90E-01					J									
Th-232	1.06E+00	3.50E-01					J									
U-234	7.80E-01	2.00E-01														
U-235	4.60E-02	4.60E-02							9.00E-02	3.30E-01						U
U-238	8.30E-01	2.10E-01														
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>2.94E-01</b>														
<b>Alpha Sum</b>	<b>4.61E+00</b>	<b>1.80E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	8.30E-01	2.10E-01							1.36E+00	9.90E-01						
Pa-234m (Assumed from U-238)	8.30E-01	2.10E-01							6.00E+00	1.10E+01						U
K-40	2.18E+01	4.40E+00														
Ra-228	8.50E-01	2.60E-01														
Pa-231	-1.50E+00	1.80E+00					U									
<b>Beta Sum</b>	<b>2.41E+01</b>	<b>4.42E+00</b>							<b>2.98E+01</b>	<b>1.19E+01</b>						
<b>Total Activity Sum</b>	<b>2.87E+01</b>	<b>4.77E+00</b>							<b>3.44E+01</b>	<b>1.20E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.00E+00	1.10E+00							<b>0.66</b>	<b>(from gamma)</b>						<b>26.3</b>
Gross Beta	6.12E+00	9.50E-01					J		<b>3.98</b>	<b>1.99</b>						<b>119</b>
Total Activity	1.11E+01	3.80E+00					J		<b>2.89</b>	<b>1.85</b>						<b>88.5</b>

**Tonawanda Landfill Data Summary Tables**

0107025-20	TMF-0026				FROM GAMMA										
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-1.00E-01	3.60E-01					U
Ra-226	6.90E-01	2.50E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	7.90E-01	3.40E-01					J								
Th-230	7.80E-01	3.10E-01					J								
Th-232	1.28E+00	4.30E-01					J								
U-234	8.40E-01	2.30E-01													
U-235	2.60E-02	3.60E-02						U	3.70E-01	3.50E-01					
U-238	7.80E-01	2.20E-01													
<b>Total U Alpha</b>	<b>1.65E+00</b>	<b>3.20E-01</b>													
<b>Alpha Sum</b>	<b>4.20E+00</b>	<b>1.95E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.80E-01	2.20E-01							1.07E+00	9.90E-01					
Pa-234m (Assumed from U-238)	7.80E-01	2.20E-01							2.00E+00	1.10E+01					U
K-40	1.85E+01	3.90E+00													
Ra-228	9.00E-01	3.00E-01													
Pa-231	-1.10E+00	2.00E+00						U							
<b>Beta Sum</b>	<b>2.08E+01</b>	<b>3.93E+00</b>							<b>2.23E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.50E+01</b>	<b>4.39E+00</b>							<b>2.65E+01</b>	<b>1.19E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.14E+00	9.80E-01							<b>0.43</b>	<b>(from gamma)</b>			<b>20.2</b>		
Gross Beta	4.41E+00	7.50E-01					J		<b>4.10</b>	<b>1.53</b>			<b>130</b>		
Total Activity	7.60E+00	3.70E+00					J		<b>3.04</b>	<b>1.52</b>			<b>107</b>		

## Radiological Analytical Data Verification Comments on Data for SDG 0107026

This sample delivery group (SDG) contained fourteen (14) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 6, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-9089	0107026-1 and 0107026-1-D1
TMF-9090	0107026-2
TMF-0085	0107026-3
TMF-0086	0107026-4
TMF-0101	0107026-5 and 0107026-5-D-1
TMF-0102	0107026-6
TMF-0107	0107026-7
TMF-0108	0107026-8
TMF-0111	0107026-9
TMF-0112	0107026-10
TMF-0115	0107026-11
TMF-0116	0107026-12
TMF-0117	0107026-13
TMF-0118	0107026-14

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$



Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_S$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was reported by the laboratory in the EQ-1 and EQ-02 equipment rinsate blanks. However,  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for equipment rinsate sample # EQ-1. All associated sample results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). However, the  $^{137}\text{Cs}$  activity was only reported for one sample (TMF-0117), but it was observed in the gamma spectrometry reports for other samples but not reported. In all cases the  $^{137}\text{Cs}$  sample results are greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification on  $^{137}\text{Cs}$  results in the samples is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses except for  $^{231}\text{Pa}$  in sample TMF-9089, the DER (1.60) and RPD (2867%) are both outside acceptable limits. **Therefore it is recommended that the Pa-231 results for all samples be qualified as estimated (J).**

### Identification and Quantification:

All target radionuclides ( $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ ) were reported. There were no incidents of identified radionuclides being excluded from the laboratory reports. No problems were observed for the gamma spectrometry analyses.

## **2.0 ALPHA SPECTROMETRY**

### Method Blank:

There was no indication of blank contamination for all alpha spectrometry analyses.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses. No qualification is required.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 17.53% for all samples for the alpha analyses. The sample-specific percent recovery results of  $^{224/235/238}\text{U}$  for all samples have less than 10% uncertainty. However, due to low sample-specific percent recovery of  $^{228/230/232}\text{Th}$  for all samples, there is greater than 10% uncertainty in the sample-specific percent recovery results for all samples for the isotopic thorium analysis. There is between 11.7% - 19.3% uncertainty in the sample-specific percent recovery results for the isotopic thorium analysis for all samples. **Therefore, it is recommended that the  $^{228/230/232}\text{Th}$  results for all samples be qualified as estimated (J).**

### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium.

## **3.0 <sup>226</sup>Ra ANALYSES**

### Method Blank:

There is no indication of blank contamination either in the method blank sample for the <sup>226</sup>Ra analysis.

### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the <sup>226</sup>Ra analysis.

### Laboratory Control Sample:

The percent recoveries for the LCSs for the <sup>226</sup>Ra analysis were within acceptable limits.

### Duplicate Analysis:

One of the two duplicate DERs (1.72) is outside acceptable limits for the <sup>226</sup>Ra analysis. The RPD (122%) was also outside acceptable limits. **Therefore it is recommended that the <sup>226</sup>Ra results for all samples be qualified as estimated (J).**

### Chemical Recoveries:

The sample-specific chemical recoveries for the <sup>226</sup>Ra analysis were within acceptable limits.

### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for <sup>226</sup>Ra.

## **4.0 GROSS ALPHA AND BETA ANALYSIS**

### Method Blank:

There was no indication of blank contamination in the method blank for the gross alpha/beta analyses.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

#### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

#### Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

#### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{KCl}$ , and  $^{40}\text{KF}$ ). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

#### Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. All of the samples results did not meet the required MDL indicating that the laboratory did not meet the project DQOs for these samples. Since the gross alpha/beta analyses are just estimates, no qualification is recommended.

## **5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING**

#### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses. Therefore, no qualification is necessary.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

#### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis by liquid scintillation counting.

#### Duplicate Analysis:

The total activity by LCS duplicate DER is within acceptable limits.

#### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

#### Quantification:

**It is recommended that the total activity analysis results for samples TMF-9089, TMF-9090, TMF-0085, TMF-0086, TMF-0102, TMF-0107, TMF-0108, TMF-0112, TMF-0115, TMF-0116, TMF-0117, and TMF-0118 be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{KCl}$ , and  $^{40}\text{KF}$ ). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## **6.0 DATA INTERCOMPARISON**

#### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

#### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DER (1.49) for sample TMF-0111 total activity analysis indicates that the gross alpha analyses did not agree with the sum of the alpha emitters within a 99% confidence level. In addition, the RPD (59.1%) was also outside acceptable limits. The gross alpha activity was

greater than the alpha sum value by a factor of approximately 2. This may be indicative of missing activity, sample heterogeneity, or some bias on the analyses. There is not enough information to determine which of these or combinations of these possible problems exist. Since this one sample is an isolated instance, no further qualification of the results is recommended.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (1.39 to 4.75) for all samples are outside the acceptable limits as well as the RPD (51.4% to 133) values. The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

For the comparison of total activity to the sum of the alpha and beta emitters, the DERs for samples TMF-9089 (3.13), TMF-9090 (3.09), TMF-0085 (3.88), TMF-0086 (3.08), TMF-0102 (3.65), TMF-0107 (2.00), TMF-0108 (2.65), TMF-0112 (3.39), TMF-0115 (4.11), TMF-0116 (3.63), TMF-0117 (2.86), and TMF-0118 (3.18) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (81.1%, 118%, 155%, 89.5%, 111%, 78.1%, 74.3%, 107%, 139%, 114%, 86.0%, and 106% respectively) are also outside acceptable limits. Samples TMF-9089, TMF-9090, TMF-0085, TMF-0086, TMF-0102, TMF-0107, TMF-0108, TMF-0112, TMF-0115, TMF-0116, TMF-0117, and TMF-0118 have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 2 to 8. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta in gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples.

**Tonawanda Landfill Data Summary Tables**

Analyses	TMF-9089				FROM GAMMA									
	Result	Uncertainty	Duplicate	Duplicate	Val	DER	RPD	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val
	(pCi/g)	(pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.00E-02	2.90E-01	-3.00E-02	5.90E-01	<b>0.06</b>	<b>400</b>	U
Ra-226	8.50E-01	2.60E-01			J									
Np-237														
Pu-238														
Pu-239														
Th-228	8.20E-01	2.70E-01			J									
Th-230	8.00E-01	2.60E-01			J									
Th-232	9.80E-01	2.90E-01			J									
U-234	1.21E+00	2.80E-01												
U-235	8.00E-02	6.00E-02						2.20E-01	3.20E-01	3.70E-01	3.90E-01	<b>0.30</b>	<b>50.8</b>	U
U-238	1.02E+00	2.50E-01												
<b>Total U Alpha</b>	<b>2.31E+00</b>	<b>3.80E-01</b>												
<b>Alpha Sum</b>	<b>7.83E+00</b>	<b>1.42E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Ac-228														
Th-234 (Assumed from U-238)	1.02E+00	2.50E-01						3.00E-01	1.10E+00	1.00E+00	1.50E+00	<b>0.38</b>	<b>108</b>	U
Pa-234m (Assumed from U-238)	1.02E+00	2.50E-01						2.00E-01	8.50E+00	1.00E+00	8.80E+00	<b>0.07</b>	<b>133</b>	U
K-40	2.04E+01	3.70E+00	2.26E+01	4.60E+00	<b>0.37</b>	<b>10.2</b>								
Ra-228	9.10E-01	2.30E-01	9.60E-01	2.80E-01	<b>0.14</b>	<b>5.35</b>								
Pa-231	2.30E+00	1.40E+00	-2.00E+00	2.30E+00	<b>1.60</b>	<b>2867</b>	J							
<b>Beta Sum</b>	<b>2.36E+01</b>	<b>3.73E+00</b>						<b>2.21E+01</b>	<b>9.34E+00</b>	<b>2.53E+01</b>	<b>1.01E+01</b>			
<b>Total Activity Sum</b>	<b>3.15E+01</b>	<b>3.99E+00</b>						<b>2.99E+01</b>	<b>9.45E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.10E+00	1.20E+00						<b>0.39</b>	<b>(from gamma)</b>		<b>9.78</b>			
Gross Beta	5.92E+00	9.60E-01					J	<b>4.60</b>	<b>1.72</b>		<b>120</b>			
Total Activity	1.33E+01	4.20E+00					J	<b>3.13</b>	<b>1.61</b>		<b>81.1</b>			

**Tonawanda Landfill Data Summary Tables**

0107026-2	TMF-9090							FROM GAMMA							
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
											Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-4.70E-01	5.20E-01						U
Ra-226	8.90E-01	2.60E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.02E+00	3.10E-01	1.26E+00	3.40E-01	0.52	21.1	J								
Th-230	9.40E-01	2.80E-01	9.90E-01	2.80E-01	0.13	5.18	J								
Th-232	1.02E+00	2.90E-01	1.24E+00	3.30E-01	0.50	19.5	J								
U-234	8.90E-01	1.80E-01													
U-235	7.50E-02	4.30E-02						-6.00E-02	3.30E-01						U
U-238	7.40E-01	1.60E-01													
<b>Total U Alpha</b>	<b>1.71E+00</b>	<b>2.45E-01</b>													
<b>Alpha Sum</b>	<b>3.60E+00</b>	<b>1.82E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Ac-228															
Th-234 (Assumed from U-238)	7.40E-01	1.60E-01						1.90E-01	7.20E-01						U
Pa-234m (Assumed from U-238)	7.40E-01	1.60E-01						5.30E+00	9.10E+00						U
K-40	1.71E+01	3.60E+00													
Ra-228	1.00E+00	2.90E-01													
Pa-231	-2.20E+00	1.90E+00													
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>3.62E+00</b>						<b>2.36E+01</b>	<b>9.82E+00</b>						
<b>Total Activity Sum</b>	<b>2.32E+01</b>	<b>4.05E+00</b>						<b>2.72E+01</b>	<b>9.98E+00</b>						
								<b>DER (sums to gross )</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.80E+00	1.10E+00						<b>1.04</b>	<b>(from gamma)</b>			<b>46.9</b>			
Gross Beta	4.62E+00	8.10E-01					J	<b>4.03</b>	<b>1.93</b>			<b>124</b>			
Total Activity	6.00E+00	3.80E+00					J	<b>3.09</b>	<b>1.98</b>			<b>118</b>			



**Tonawanda Landfill Data Summary Tables**

0107026-3	TMF-0085						FROM GAMMA								
							Duplicate		Duplicate		Duplicate		Duplicate		Val
							Result	Uncertainty	Result	Uncertainty	Result	Uncertainty	Result	Uncertainty	
Analyses	(pCi/g)	(pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)	DER	RPD	Val Q	
Am-241									-9.00E-02	1.10E-01					U
Ra-226	8.90E-01	2.40E-01						J							
Np-237															
Pu-238															
Pu-239															
Th-228	9.20E-01	2.70E-01						J							
Th-230	7.80E-01	2.30E-01						J							
Th-232	8.30E-01	2.40E-01						J							
U-234	7.70E-01	1.60E-01	9.10E-01	1.80E-01	<b>0.58</b>	<b>16.7</b>									
U-235	1.44E-01	6.00E-02	7.00E-02	4.20E-02	<b>1.01</b>	<b>69.2</b>		1.90E-01	2.90E-01						U
U-238	9.40E-01	1.90E-01	1.01E+00	2.00E-01	<b>0.25</b>	<b>7.18</b>									
<b>Total U Alpha</b>	<b>1.85E+00</b>	<b>2.56E-01</b>	<b>1.99E+00</b>	<b>2.72E-01</b>											
<b>Alpha Sum</b>	<b>5.27E+00</b>	<b>5.53E-01</b>	<b>1.99E+00</b>	<b>2.72E-01</b>											
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Ac-228															
Th-234 (Assumed from U-238)	9.40E-01	1.90E-01	1.01E+00	2.00E-01	<b>0.25</b>	<b>7.18</b>		4.20E-01	9.20E-01						U
Pa-234m (Assumed from U-238)	9.40E-01	1.90E-01	1.01E+00	2.00E-01	<b>0.25</b>	<b>7.18</b>		7.00E+00	1.10E+01						U
K-40	1.65E+01	3.90E+00													
Ra-228	7.50E-01	3.10E-01													
Pa-231	-9.00E-01	2.00E+00													
<b>Beta Sum</b>	<b>1.91E+01</b>	<b>3.92E+00</b>	<b>2.02E+00</b>	<b>2.83E-01</b>				<b>2.47E+01</b>	<b>1.17E+01</b>						
<b>Total Activity Sum</b>	<b>2.44E+01</b>	<b>3.96E+00</b>	<b>4.01E+00</b>	<b>3.93E-01</b>				<b>2.99E+01</b>	<b>1.17E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.30E+00	1.10E+00						<b>0.83</b>	<b>(from gamma)</b>		<b>17.7</b>				
Gross Beta	5.44E+00	8.90E-01					J	<b>3.40</b>	<b>1.64</b>		<b>111</b>				
Total Activity	3.10E+00	3.80E+00					UJ	<b>3.88</b>	<b>2.18</b>		<b>155</b>				

Tonawanda Landfill Data Summary Tables

Analyses	TMF-0086						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241							1.00E-02	2.30E-01					U
Ra-226	1.06E+00	3.30E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	7.00E-01	2.20E-01											J
Th-230	7.20E-01	2.20E-01											J
Th-232	8.10E-01	2.40E-01											J
U-234	7.70E-01	1.60E-01											
U-235	2.70E-02	2.90E-02					2.00E-02	2.70E-01					U
U-238	8.20E-01	1.70E-01											
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>2.35E-01</b>											
<b>Alpha Sum</b>	<b>4.91E+00</b>	<b>5.64E-01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	8.20E-01	1.70E-01					8.10E-01	7.20E-01					
Pa-234m (Assumed from U-238)	8.20E-01	1.70E-01					1.14E+01	7.80E+00					
K-40	1.94E+01	3.50E+00											
Ra-228	7.60E-01	1.90E-01											
Pa-231	-7.00E-01	2.00E+00											UJ
<b>Beta Sum</b>	<b>2.18E+01</b>	<b>3.51E+00</b>					<b>3.24E+01</b>	<b>8.58E+00</b>					
<b>Total Activity Sum</b>	<b>2.67E+01</b>	<b>3.56E+00</b>					<b>3.73E+01</b>	<b>8.60E+00</b>					
							<b>DER (sums to gross )</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	6.40E+00	1.10E+00					<b>1.21</b>	<b>(from gamma)</b>				<b>26.4</b>	
Gross Beta	4.83E+00	7.90E-01				J	<b>4.71</b>	<b>3.20</b>				<b>127</b>	
Total Activity	1.02E+01	4.00E+00				J	<b>3.08</b>	<b>2.85</b>				<b>89.5</b>	

**Tonawanda Landfill Data Summary Tables**

0107026-5	TMF-0101							FROM GAMMA							
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
											Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.50E-01	2.40E-01	8.00E-02	3.90E-01	0.15	60.9	U	
Ra-226	1.80E-01	2.10E-01	7.40E-01	2.50E-01	1.72	122	J								
Np-237															
Pu-238															
Pu-239															
Th-228	1.80E-01	1.20E-01	3.10E-01	2.30E-01	0.50	53.1	J								
Th-230	3.40E-01	1.50E-01	3.80E-01	2.00E-01	0.16	11.1	J								
Th-232	2.50E-01	1.30E-01	3.50E-01	1.90E-01	0.43	33.3	J								
U-234	3.59E-01	1.00E-01													
U-235	2.90E-02	2.80E-02						-2.10E-01	2.30E-01	5.00E-02	2.70E-01	0.73	325	U	
U-238	3.90E-01	1.10E-01													
<b>Total U Alpha</b>	<b>7.78E-01</b>	<b>1.51E-01</b>													
<b>Alpha Sum</b>	<b>2.27E+00</b>	<b>1.13E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Ac-228															
Th-234 (Assumed from U-238)	3.90E-01	1.10E-01						3.10E-01	6.80E-01	9.20E-01	1.00E+00	0.50	99.2	U	
Pa-234m (Assumed from U-238)	3.90E-01	1.10E-01						1.70E+00	6.40E+00	-5.20E+00	8.00E+00	0.67	394	U	
K-40	4.10E+00	1.10E+00	3.20E+00	1.20E+00	0.55	24.7									
Ra-228	1.40E-01	1.50E-01	9.00E-02	2.00E-01	0.20	43.5									
Pa-231	6.00E-01	1.20E+00	0.00E+00	1.60E+00	0.30	200	UJ								
<b>Beta Sum</b>	<b>5.09E+00</b>	<b>1.13E+00</b>						<b>6.32E+00</b>	<b>6.53E+00</b>	<b>-9.90E-01</b>	<b>8.16E+00</b>				
<b>Total Activity Sum</b>	<b>7.36E+00</b>	<b>1.60E+00</b>						<b>8.59E+00</b>	<b>6.63E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	3.90E+00	1.20E+00	3.10E+00	1.10E+00	0.49	22.9		0.99	(from gamma)			52.9			
Gross Beta	3.01E+00	9.90E-01	3.00E+00	1.00E+00	0.01	0.33	J	1.39	0.50			51.4			
Total Activity	5.00E+00	3.80E+00						0.57	0.47			38.2			

**Tonawanda Landfill Data Summary Tables**

0107026-6	TMF-0102						FROM GAMMA							
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								1.20E-01	1.10E-01					
Ra-226	1.03E+00	2.80E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.20E-01	2.30E-01					J							
Th-230	9.10E-01	2.20E-01					J							
Th-232	8.70E-01	2.20E-01					J							
U-234	1.07E+00	2.20E-01	1.27E+00	2.50E-01	<b>0.60</b>	<b>17.1</b>								
U-235	8.30E-02	4.80E-02	1.17E-01	6.00E-02	<b>0.44</b>	<b>34.0</b>		1.50E-01	2.90E-01					U
U-238	1.04E+00	2.10E-01	1.00E+00	2.10E-01	<b>0.13</b>	<b>3.92</b>								
<b>Total U Alpha</b>	<b>2.19E+00</b>	<b>2.10E-01</b>	<b>2.39E+00</b>	<b>3.32E-01</b>										
<b>Alpha Sum</b>	<b>5.92E+00</b>	<b>5.68E-01</b>	<b>2.39E+00</b>	<b>3.32E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Ac-228														
Th-234 (Assumed from U-238)	1.04E+00	2.10E-01	1.00E+00	2.10E-01	<b>0.13</b>	<b>3.92</b>		1.40E+00	7.80E-01					
Pa-234m (Assumed from U-238)	1.04E+00	2.10E-01	1.00E+00	2.10E-01	<b>0.13</b>	<b>3.92</b>		1.00E+00	1.20E+01					U
K-40	2.26E+01	4.70E+00												
Ra-228	8.40E-01	3.10E-01												
Pa-231	-1.10E+00	1.90E+00					UJ							
<b>Beta Sum</b>	<b>2.55E+01</b>	<b>4.72E+00</b>	<b>2.00E+00</b>	<b>2.97E-01</b>				<b>2.58E+01</b>	<b>1.29E+01</b>					
<b>Total Activity Sum</b>	<b>3.14E+01</b>	<b>4.75E+00</b>	<b>4.39E+00</b>	<b>4.45E-01</b>				<b>3.18E+01</b>	<b>1.29E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.10E+00	1.00E+00						<b>0.15</b>	<b>(from gamma)</b>			<b>2.94</b>		
Gross Beta	5.10E+00	8.40E-01					J	<b>4.26</b>	<b>1.60</b>			<b>133</b>		
Total Activity	9.00E+00	3.90E+00					J	<b>3.65</b>	<b>1.69</b>			<b>111</b>		

**Tonawanda Landfill Data Summary Tables**

0107026-7	TMF-0107						FROM GAMMA								
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
											Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-2.00E-02	9.60E-02						U
Ra-226	6.90E-01	2.20E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	7.60E-01	2.10E-01					J								
Th-230	8.80E-01	2.30E-01					J								
Th-232	6.60E-01	1.90E-01					J								
U-234	7.70E-01	1.70E-01													
U-235	3.30E-02	2.90E-02						3.00E-01	2.90E-01						
U-238	7.40E-01	1.70E-01													
<b>Total U Alpha</b>	<b>1.54E+00</b>	<b>2.42E-01</b>													
<b>Alpha Sum</b>	<b>4.53E+00</b>	<b>1.78E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Ac-228															
Th-234 (Assumed from U-238)	7.40E-01	1.70E-01						1.29E+00	7.20E-01						
Pa-234m (Assumed from U-238)	7.40E-01	1.70E-01						1.00E+01	1.30E+01						U
K-40	1.38E+01	3.40E+00													
Ra-228	7.30E-01	2.80E-01													
Pa-231	0.00E+00	1.90E+00													
<b>Beta Sum</b>	<b>1.60E+01</b>	<b>3.43E+00</b>						<b>2.58E+01</b>	<b>1.35E+01</b>						
<b>Total Activity Sum</b>	<b>2.05E+01</b>	<b>3.86E+00</b>						<b>3.04E+01</b>	<b>1.36E+01</b>						
								<b>DER (sums to gross )</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.30E+00	8.90E-01						<b>0.39</b>	<b>(from gamma)</b>		<b>15.6</b>				
Gross Beta	3.96E+00	6.70E-01					J	<b>3.45</b>	<b>1.62</b>		<b>121</b>				
Total Activity	9.00E+00	4.30E+00					J	<b>2.00</b>	<b>1.50</b>		<b>78.1</b>				

Tonawanda Landfill Data Summary Tables

Analyses	TMF-0108						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241							-9.00E-02	2.40E-01					U
Ra-226	1.18E+00	3.20E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	8.30E-01	2.70E-01											J
Th-230	8.20E-02	2.50E-01											UJ
Th-232	9.20E-01	2.80E-01											J
U-234	8.30E-01	1.70E-01											
U-235	5.90E-02	3.80E-02					-2.00E-02	2.80E-01					U
U-238	7.70E-01	1.60E-01											
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>2.37E-01</b>											
<b>Alpha Sum</b>	<b>4.67E+00</b>	<b>6.10E-01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	7.70E-01	1.60E-01					5.90E-01	7.80E-01					U
Pa-234m (Assumed from U-238)	7.70E-01	1.60E-01					3.00E-01	7.00E+00					U
K-40	1.94E+01	3.50E+00											
Ra-228	5.60E-01	1.60E-01											
Pa-231	-2.00E-01	1.30E+00											UJ
<b>Beta Sum</b>	<b>2.15E+01</b>	<b>3.51E+00</b>					<b>2.09E+01</b>	<b>7.87E+00</b>					
<b>Total Activity Sum</b>	<b>2.62E+01</b>	<b>3.56E+00</b>					<b>2.55E+01</b>	<b>7.89E+00</b>					
							<b>DER (sums to gross )</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.00E+00	1.00E+00					<b>0.28</b>	<b>(from gamma)</b>					<b>6.80</b>
Gross Beta	4.32E+00	8.80E-01				J	<b>4.75</b>	<b>2.09</b>					<b>133</b>
Total Activity	1.20E+01	4.00E+00				J	<b>2.65</b>	<b>1.53</b>					<b>74.3</b>

**Tonawanda Landfill Data Summary Tables**

Analyses	TMF-0111						FROM GAMMA						Val Q
	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	
	(pCi/g)	(pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241							4.60E-02	8.40E-02					U
Ra-226	1.40E-01	1.60E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	3.40E-01	1.60E-01											J
Th-230	3.90E-01	1.60E-01											J
Th-232	2.50E-01	1.20E-01											J
U-234	5.60E-01	1.40E-01											
U-235	3.00E-02	2.80E-02					1.00E-02	2.60E-01					U
U-238	5.20E-01	1.30E-01											
<b>Total U Alpha</b>	<b>1.11E+00</b>	<b>1.93E-01</b>											
<b>Alpha Sum</b>	<b>2.23E+00</b>	<b>3.58E-01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	5.20E-01	1.30E-01					8.10E-01	5.40E-01					
Pa-234m (Assumed from U-238)	5.20E-01	1.30E-01					0.00E+00	1.00E+01					U
K-40	9.10E+00	2.60E+00											
Ra-228	5.80E-01	2.60E-01											
Pa-231	-1.00E+00	1.70E+00											UJ
<b>Beta Sum</b>	<b>1.07E+01</b>	<b>2.62E+00</b>					<b>1.05E+01</b>	<b>1.03E+01</b>					
<b>Total Activity Sum</b>	<b>1.30E+01</b>	<b>2.64E+00</b>					<b>1.27E+01</b>	<b>1.04E+01</b>					
<b>DER (sums to gross)</b>													
Gross Alpha	4.10E+00	1.20E+00					<b>1.49</b>	<b>(from gamma)</b>					<b>59.1</b>
Gross Beta	3.10E+00	1.10E+00					<b>2.68</b>	<b>0.71</b>					<b>110</b>
Total Activity	7.10E+00	4.00E+00					<b>1.22</b>	<b>0.51</b>					<b>58.4</b>

**Tonawanda Landfill Data Summary Tables**

0107026-10	TMF-0112							FROM GAMMA							
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
											Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-3.00E-02	1.10E-01						U
Ra-226	1.33E+00	3.30E-01	1.21E+00	3.00E-01	0.27	9.45	J								
Np-237															
Pu-238															
Pu-239															
Th-228	1.04E+00	3.30E-01					J								
Th-230	1.38E+00	3.90E-01					J								
Th-232	1.13E+00	3.40E-01					J								
U-234	7.40E-01	1.60E-01													
U-235	9.90E-02	5.00E-02						1.00E-01	2.70E-01						U
U-238	7.90E-01	1.70E-01													
<b>Total U Alpha</b>	<b>1.63E+00</b>	<b>2.39E-01</b>													
<b>Alpha Sum</b>	<b>6.60E+00</b>	<b>1.54E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Ac-228															
Th-234 (Assumed from U-238)	7.90E-01	1.70E-01						1.03E+00	7.90E-01						
Pa-234m (Assumed from U-238)	7.90E-01	1.70E-01						3.70E+00	9.00E+00						U
K-40	1.90E+01	4.00E+00													
Ra-228	1.13E+00	3.10E-01													
Pa-231	1.00E-01	1.50E+00													
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>4.02E+00</b>						<b>2.49E+01</b>	<b>9.89E+00</b>						
<b>Total Activity Sum</b>	<b>2.83E+01</b>	<b>4.31E+00</b>						<b>3.15E+01</b>	<b>1.00E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.10E+00	1.00E+00	6.60E+00	1.10E+00	0.34	7.87		0.27	(from gamma)				7.86		
Gross Beta	4.84E+00	8.00E-01	4.60E+00	7.70E-01	0.22	5.08	J	4.12	2.02				127		
Total Activity	8.60E+00	3.90E+00					J	3.39	2.13				107		



Tonawanda Landfill Data Summary Tables

Analyses	TMF-0115						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241							-2.00E-02	5.00E-01					U
Ra-226	1.60E-01	2.70E-01											UJ
Np-237													
Pu-238													
Pu-239													
Th-228	9.50E-01	3.00E-01											J
Th-230	9.80E-01	3.00E-01											J
Th-232	1.19E+00	3.40E-01											J
U-234	9.40E-01	1.90E-01											
U-235	1.27E-01	5.80E-02					-7.00E-02	3.50E-01					U
U-238	9.20E-01	1.90E-01											
<b>Total U Alpha</b>	<b>1.99E+00</b>	<b>2.75E-01</b>											
<b>Alpha Sum</b>	<b>5.27E+00</b>	<b>6.66E-01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	9.20E-01	1.90E-01					7.00E-01	1.00E+00					U
Pa-234m (Assumed from U-238)	9.20E-01	1.90E-01					1.10E+01	1.20E+01					
K-40	2.07E+01	4.20E+00											
Ra-228	7.90E-01	2.40E-01											
Pa-231	-2.10E+00	1.80E+00											UJ
<b>Beta Sum</b>	<b>2.33E+01</b>	<b>4.22E+00</b>					<b>3.32E+01</b>	<b>1.28E+01</b>					
<b>Total Activity Sum</b>	<b>2.86E+01</b>	<b>4.27E+00</b>					<b>3.85E+01</b>	<b>1.28E+01</b>					
							<b>DER (sums to gross )</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.70E+00	1.00E+00					<b>0.36</b>	<b>(from gamma)</b>		<b>7.90</b>			
Gross Beta	4.70E+00	8.10E-01				J	<b>4.34</b>	<b>2.23</b>		<b>133</b>			
Total Activity	5.10E+00	3.80E+00				J	<b>4.11</b>	<b>2.50</b>		<b>139</b>			

Tonawanda Landfill Data Summary Tables

Analyses	TMF-0116						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241							-9.00E-02	2.40E-01					U
Ra-226	7.70E-01	2.60E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	6.80E-01	2.00E-01											J
Th-230	6.80E-01	1.90E-01											J
Th-232	7.70E-01	2.10E-01											J
U-234	7.00E-01	1.50E-01											
U-235	1.08E-01	5.10E-02					-6.00E-02	2.70E-01					U
U-238	8.40E-01	1.70E-01											
<b>Total U Alpha</b>	<b>1.65E+00</b>	<b>2.32E-01</b>											
<b>Alpha Sum</b>	<b>5.27E+00</b>	<b>1.27E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	8.40E-01	1.70E-01					1.22E+00	9.00E-01					
Pa-234m (Assumed from U-238)	8.40E-01	1.70E-01					-4.20E+00	6.70E+00					U
K-40	1.93E+01	3.50E+00											
Ra-228	6.60E-01	2.00E-01											
Pa-231	8.00E-01	1.30E+00											UJ
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>3.52E+00</b>					<b>1.71E+01</b>	<b>7.62E+00</b>					
<b>Total Activity Sum</b>	<b>2.70E+01</b>	<b>3.74E+00</b>					<b>2.23E+01</b>	<b>7.72E+00</b>					
							<b>DER (sums to gross )</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	4.80E+00	1.00E+00					<b>0.29</b>	<b>(from gamma)</b>					<b>9.30</b>
Gross Beta	4.75E+00	8.20E-01				J	<b>4.70</b>	<b>1.61</b>					<b>128</b>
Total Activity	7.40E+00	3.90E+00				J	<b>3.63</b>	<b>1.73</b>					<b>114</b>

**Tonawanda Landfill Data Summary Tables**

0107026-13	TMF-0117						FROM GAMMA								
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
											Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-6.00E-02	1.20E-01						U
Ra-226	8.60E-01	3.00E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	1.09E+00	2.90E-01					J								
Th-230	1.00E+00	2.70E-01					J								
Th-232	1.20E+00	3.10E-01					J								
U-234	8.80E-01	1.90E-01													
U-235	1.71E-01	7.10E-02						2.90E-01	3.10E-01						
U-238	9.80E-01	2.00E-01													
<b>Total U Alpha</b>	<b>2.03E+00</b>	<b>2.85E-01</b>													
<b>Alpha Sum</b>	<b>6.18E+00</b>	<b>6.51E-01</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Cs-137	1.19E-01	7.20E-02													
Th-234 (Assumed from U-238)	9.80E-01	2.00E-01						2.37E+00	9.20E-01						
Pa-234m (Assumed from U-238)	9.80E-01	2.00E-01						-8.00E+00	1.10E+01						U
K-40	1.80E+01	3.90E+00													
Ra-228	8.50E-01	2.70E-01													
Pa-231	-1.50E+00	1.70E+00													
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>3.92E+00</b>						<b>1.33E+01</b>	<b>1.17E+01</b>						
<b>Total Activity Sum</b>	<b>2.71E+01</b>	<b>3.97E+00</b>						<b>1.95E+01</b>	<b>1.17E+01</b>						
								<b>DER (sums to gross )</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.50E+00	1.10E+00						<b>0.25</b>	<b>(from gamma)</b>		<b>5.03</b>				
Gross Beta	5.70E+00	9.20E-01					J	<b>3.78</b>	<b>0.65</b>		<b>114</b>				
Total Activity	1.08E+01	4.10E+00					J	<b>2.86</b>	<b>0.70</b>		<b>86.0</b>				

Tonawanda Landfill Data Summary Tables

Analyses	TMF-0118						FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	
Am-241							-6.20E-02	8.40E-02					U
Ra-226	7.10E-01	2.30E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	8.20E-01	2.40E-01											J
Th-230	8.60E-01	2.40E-01											J
Th-232	1.02E+00	2.70E-01											J
U-234	9.30E-01	1.90E-01											
U-235	9.40E-02	5.00E-02					6.00E-02	2.80E-01					U
U-238	8.00E-01	1.70E-01											
<b>Total U Alpha</b>	<b>1.82E+00</b>	<b>2.60E-01</b>											
<b>Alpha Sum</b>	<b>5.23E+00</b>	<b>5.55E-01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Ac-228													
Th-234 (Assumed from U-238)	8.00E-01	1.70E-01					8.00E-01	6.30E-01					
Pa-234m (Assumed from U-238)	8.00E-01	1.70E-01					-2.00E+00	1.10E+01					U
K-40	1.80E+01	3.90E+00											
Ra-228	6.10E-01	2.30E-01											
Pa-231	-1.80E+00	1.80E+00											UJ
<b>Beta Sum</b>	<b>2.02E+01</b>	<b>3.91E+00</b>					<b>1.74E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.54E+01</b>	<b>3.95E+00</b>					<b>2.26E+01</b>	<b>1.17E+01</b>					
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.14E+00	9.60E-01					<b>0.08</b>	<b>(from gamma)</b>					<b>1.81</b>
Gross Beta	4.45E+00	7.50E-01				J	<b>3.95</b>	<b>1.11</b>					<b>128</b>
Total Activity	7.80E+00	3.90E+00				J	<b>3.18</b>	<b>1.20</b>					<b>106</b>

## Radiological Analytical Data Verification Comments on Data for SDG 0107027

This sample delivery group (SDG) contained fourteen (14) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 6, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0071	0107027-1
TMF-0072	0107027-2
TMF-0105	0107023-3
TMF-0106	0107027-4
TMF-0109	0107027-5
TMF-0110	0107027-6
TMF-0113	0107027-7
TMF-0114	0107027-8
TMF-9119	0107027-9
TMF-9120	0107027-10
TMF-0123	0107027-11
TMF-0124	0107027-12
TMF-0125	0107027-13
TMF-0126	0107027-14

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_S$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was observed in the EQ-1 and EQ-2 equipment rinsate blanks. However,  $^{137}\text{Cs}$  activity was observed in the equipment rinsate blank EQ-1. All associated sample results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). There was  $^{137}\text{Cs}$  activity reported by the laboratory in two samples TMF-0123 and TMF-0125. The  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for TMF-0109 and TMF-9119 but not reported by the laboratory. The  $^{137}\text{Cs}$  activity in those samples was higher than the DL (1.65\*TPU). However,  $^{137}\text{Cs}$  activity values observed in the samples are greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification of the  $^{137}\text{Cs}$  results in the samples is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

All target radionuclides ( $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ ) plus  $^{40}\text{K}$  were reported for all samples. There were  $^{137}\text{Cs}$  results reported in two samples TMF-0123 and TMF-0125. The  $^{137}\text{Cs}$  peak was identified in the gamma spectrometry report for two samples TMF-0109 and

TMF-9119 but not reported by the laboratory. **It is recommended that the laboratory report all gamma emitters that are greater than the DL.** No other problems were observed for the gamma spectrometry analyses.

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was an indication of blank contamination for  $^{234/235}\text{U}$  and  $^{230}\text{Th}$  in the method blank. All associated samples result less than 5 times the blank value for  $^{234/235}\text{U}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). The  $^{234}\text{U}$  and  $^{230}\text{Th}$  results for all samples are greater than 5 times the method blank, therefore no qualification is necessary. **It is recommended that the  $^{235}\text{U}$  results for samples TMF-0071, TMF-0072, TMF-0106, TMF-0109, TMF-0110, TMF-0113, TMF-0114, TMF-9119, TMF-9120, TMF-0123, TMF-0124, TMF-0125 and TMF-0126 be qualified as estimated (J).**

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses. No qualification is required.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 33.06% for all samples for the alpha spectrometry analyses. The sample-specific percent recovery results of  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  for all samples have less than 10% uncertainty. No qualification is necessary.

### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium analyses.

Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 1.0 pCi/g for the isotopic uranium and thorium analyses.

### **3.0 <sup>226</sup>Ra ANALYSIS**

Method Blank:

There is no indication of blank contamination in the method blank sample for the <sup>226</sup>Ra analysis.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the <sup>226</sup>Ra analysis.

Laboratory Control Sample:

The percent recoveries for the LCSs for the <sup>226</sup>Ra analyses were within acceptable limits.

Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all <sup>226</sup>Ra analyses.

Chemical Recoveries:

The sample-specific chemical recoveries were greater than 83.23% for <sup>226</sup>Ra analysis which is within acceptable limits.

Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for <sup>226</sup>Ra.

### **4.0 GROSS ALPHA AND BETA ANALYSIS**

Method Blank:

There was no indication of blank contamination in method blank for the gross alpha/beta analyses.

Equipment Rinsate Blank:



There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

Quantitation and Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. All of the samples results that did not meet the required MDL as identified in the narrative section indicating that the laboratory did not meet the project DQOs for these samples. Since the gross alpha/beta analyses are just estimates, no qualification is recommended.

## **5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING**

Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis by liquid scintillation counting.

### Duplicate Analysis:

The duplicate sample DER for total activity analysis is within acceptable limits.

### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

### Quantitation:

**It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## **6.0 DATA INTERCOMPARISON**

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities are within acceptable limits indicating that the gross alpha analyses agree with the sum of the alpha emitters within a 99% confidence level.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.67 – 4.48) for all samples are outside the acceptable limits as well as the RPD values (109% - 135%). The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts and/or the preparation method as discussed above. Since all of the gross beta

results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

For the comparison of total activity to the sum of the alpha and beta emitters, the DERs for samples TMF-0071 (2.91), TMF-0072 (1.91), TMF-0105 (2.96), TMF-0106 (2.33), TMF-0109 (1.83), TMF-0110 (3.06), TMF-0113 (1.88), TMF-0114 (1.95), TMF-9119 (1.95), TMF-9120 (2.62), TMF-0123 (1.80), TMF-0124 (2.54), TMF-0125 (2.04), and TMF-0126 (2.17) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (95.5%, 62.4%, 87.2%, 71.7%, 64.2%, 92.0%, 89.2%, 69.5%, 78.6%, 88.8%, 52.6%, 93.6%, 83.5%, and 74.6% respectively) are also outside acceptable limits. Samples TMF-0071, TMF-0072, TMF-0105, TMF-0106, TMF-0109, TMF-0110, TMF-0113, TMF-0114, TMF-9119, TMF-9120, TMF-0123, TMF-0124, TMF-0125, and TMF-0126 have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 1.6 to 2. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts and/or the preparation method as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta in gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.

Revised

TONAWANDA L.F Groundwater Data Summary Tables

0107027-1		TMF-0071				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.10E-01	3.80E-01	5.00E-02	1.30E-01	0.40	533	U
Ra-226	9.70E-01	2.60E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	8.90E-01	1.50E-01	9.40E-01	1.80E-01	0.21	5.46								
Th-230	9.10E-01	1.50E-01	7.90E-01	1.50E-01	0.57	14.1								
Th-232	8.00E-01	1.40E-01	8.20E-01	1.50E-01	0.10	2.47								
U-234	6.70E-01	1.90E-01												
U-235	7.50E-02	5.70E-02					J	-2.00E-01	4.20E-01	7.00E-02	4.00E-01	0.47	415	U
U-238	5.80E-01	1.80E-01												
<b>Total U Alpha</b>	<b>1.33E+00</b>	<b>2.68E-01</b>												
<b>Alpha Sum</b>	<b>6.07E+00</b>	<b>2.21E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	5.80E-01	1.80E-01						1.30E+00	1.40E+00	7.20E-01	8.50E-01	0.35	57.4	
Pa-234m (Assumed from U-238)	5.80E-01	1.80E-01						-1.00E+01	1.60E+01	-1.10E+01	1.90E+01	0.04	9.52	U
K-40	1.95E+01	4.10E+00	1.77E+01	5.20E+00	0.27	9.68								
Ra-228	8.30E-01	3.10E-01	6.00E-01	5.10E-01	0.39	32.2								
Pa-231	1.30E+00	2.40E+00	-2.80E+00	3.00E+00	1.07	547	U							
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>4.13E+00</b>						<b>1.18E+01</b>	<b>1.66E+01</b>	<b>7.68E+00</b>	<b>1.97E+01</b>			
<b>Total Activity Sum</b>	<b>2.77E+01</b>	<b>4.68E+00</b>						<b>1.79E+01</b>	<b>1.67E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.50E+00	1.30E+00						0.17	(from gamma)			6.92		
Gross Beta	5.30E+00	1.10E+00					J	3.82	0.39			121		
Total Activity	9.80E+00	4.00E+00					J	2.91	0.47			95.5		

Revised  
TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-0072				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								3.00E-02	1.20E-01			U
Ra-226	9.80E-01	2.80E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.90E-01	1.50E-01										
Th-230	8.40E-01	1.40E-01										
Th-232	8.10E-01	1.30E-01										
U-234	1.01E+00	2.60E-01										
U-235	2.00E-01	1.00E-01					J	1.00E-01	3.70E-01			U
U-238	8.10E-01	2.30E-01										
<b>Total U Alpha</b>	<b>2.02E+00</b>	<b>3.61E-01</b>										
<b>Alpha Sum</b>	<b>5.54E+00</b>	<b>2.48E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.10E-01	2.30E-01						1.60E+00	1.10E+00			
Pa-234m (Assumed from U-238)	8.10E-01	2.30E-01						-4.00E+00	1.60E+01			U
K-40	1.94E+01	4.90E+00										
Ra-228	1.08E+00	4.10E-01										
Pa-231	0.00E+00	2.70E+00					U					
<b>Beta Sum</b>	<b>2.21E+01</b>	<b>4.94E+00</b>						<b>1.81E+01</b>	<b>1.68E+01</b>			
<b>Total Activity Sum</b>	<b>2.76E+01</b>	<b>5.53E+00</b>						<b>2.36E+01</b>	<b>1.70E+01</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	4.80E+00	1.00E+00						<b>0.28</b>	<b>(from gamma)</b>			<b>14.3</b>
Gross Beta	4.95E+00	8.40E-01					J	<b>3.42</b>	<b>0.78</b>			<b>127</b>
Total Activity	1.45E+01	4.10E+00					J	<b>1.91</b>	<b>0.52</b>			<b>62.4</b>
<b>RPD (sums to gross)</b>												

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TONAWANDA L.F Groundwater Data Summary Tables

0107027-3		TMF-0105				FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-2.00E-02	2.90E-01	7.00E-02	1.10E-01	0.29	360	U
Ra-226	1.05E+00	3.00E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	9.50E-01	1.60E-01													
Th-230	9.10E-01	1.50E-01													
Th-232	9.00E-01	1.50E-01													
U-234	1.02E+00	2.40E-01													
U-235	2.70E-01	1.10E-01							-6.00E-02	3.10E-01	2.10E-01	3.30E-01	0.60	360	U
U-238	1.02E+00	2.40E-01													
<b>Total U Alpha</b>	<b>2.31E+00</b>	<b>3.57E-01</b>													
<b>Alpha Sum</b>	<b>6.66E+00</b>	<b>2.23E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	1.02E+00	2.40E-01							8.50E-01	9.30E-01	1.52E+00	9.80E-01	0.50	56.5	
Pa-234m (Assumed from U-238)	1.02E+00	2.40E-01							2.80E+00	8.20E+00	1.20E+01	1.10E+01	0.67	124	U
K-40	1.89E+01	3.50E+00	1.85E+01	4.20E+00	0.07	2.14									
Ra-228	8.40E-01	2.10E-01	8.70E-01	3.30E-01	0.08	3.51									
Pa-231	6.00E-01	2.40E+00	-1.50E+00	1.90E+00	0.69	467	U								
<b>Beta Sum</b>	<b>2.19E+01</b>	<b>3.53E+00</b>							<b>2.35E+01</b>	<b>8.97E+00</b>	<b>3.27E+01</b>	<b>1.18E+01</b>			
<b>Total Activity Sum</b>	<b>2.85E+01</b>	<b>4.18E+00</b>							<b>3.01E+01</b>	<b>9.24E+00</b>					
									<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	6.20E+00	1.20E+00							0.18	(from gamma)			7.15		
Gross Beta	5.40E+00	1.00E+00						J	4.48	2.00			121		
Total Activity	1.12E+01	4.10E+00						J	2.96	1.87			87.2		

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TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-0106				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								2.30E-01	4.90E-01			U
Ra-226	9.00E-01	2.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.80E-01	1.50E-01										
Th-230	8.50E-01	1.40E-01										
Th-232	8.50E-01	1.40E-01										
U-234	7.80E-01	2.10E-01										
U-235	8.30E-02	6.40E-02					J	2.00E-01	3.10E-01			U
U-238	9.80E-01	2.50E-01										
<b>Total U Alpha</b>	<b>1.84E+00</b>	<b>3.33E-01</b>										
<b>Alpha Sum</b>	<b>5.05E+00</b>	<b>2.21E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	9.80E-01	2.50E-01						1.70E-01	9.80E-01			U
Pa-234m (Assumed from U-238)	9.80E-01	2.50E-01						-3.90E+00	8.70E+00			U
K-40	1.83E+01	3.70E+00										
Ra-228	7.80E-01	2.30E-01										
Pa-231	-3.00E-01	2.40E+00					U					
<b>Beta Sum</b>	<b>2.10E+01</b>	<b>3.74E+00</b>						<b>1.53E+01</b>	<b>9.51E+00</b>			
<b>Total Activity Sum</b>	<b>2.61E+01</b>	<b>4.34E+00</b>						<b>2.04E+01</b>	<b>9.77E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.70E+00	1.20E+00						<b>0.65</b>	<b>(from gamma)</b>	<b>28.0</b>		
Gross Beta	5.13E+00	8.30E-01					J	<b>4.15</b>	<b>1.07</b>	<b>121</b>		
Total Activity	1.23E+01	4.00E+00					J	<b>2.33</b>	<b>0.76</b>	<b>71.7</b>		

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TONAWANDA L.F Groundwater Data Summary Tables

0107027-5		TMF-0109					FROM GAMMA						
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER	RPD	Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-2.30E-01	4.00E-01			U	
Ra-226	1.28E+00	4.00E-01	1.01E+00	2.70E-01	<b>0.56</b>	<b>23.6</b>							
Np-237													
Pu-238													
Pu-239													
Th-228	1.09E+00	1.80E-01	1.13E+00	1.90E-01	<b>0.15</b>	<b>3.60</b>							
Th-230	1.01E+00	1.60E-01	9.90E-01	1.60E-01	<b>0.09</b>	<b>2.00</b>							
Th-232	1.01E+00	1.60E-01	1.07E+00	1.70E-01	<b>0.26</b>	<b>5.77</b>							
U-234	1.02E+00	2.70E-01											
U-235	1.72E-01	1.00E-01					J	-1.40E-01	5.00E-01			U	
U-238	1.06E+00	2.80E-01											
<b>Total U Alpha</b>	<b>2.25E+00</b>	<b>4.02E-01</b>											
<b>Alpha Sum</b>	<b>5.20E+00</b>	<b>2.42E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	1.06E+00	2.80E-01						6.00E-01	1.10E+00			U	
Pa-234m (Assumed from U-238)	1.06E+00	2.80E-01						1.40E+01	1.60E+01				
K-40	1.53E+01	3.60E+00											
Ra-228	7.30E-01	3.20E-01											
Pa-231	-1.60E+00	2.60E+00					U						
<b>Beta Sum</b>	<b>1.80E+01</b>	<b>3.65E+00</b>						<b>3.04E+01</b>	<b>1.64E+01</b>				
<b>Total Activity Sum</b>	<b>2.32E+01</b>	<b>4.38E+00</b>						<b>3.56E+01</b>	<b>1.66E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	6.10E+00	1.00E+00						<b>0.34</b>	<b>(from gamma)</b>	<b>15.9</b>			
Gross Beta	5.30E+00	8.40E-01					J	<b>3.38</b>	<b>1.53</b>	<b>109</b>			
Total Activity	1.19E+01	4.30E+00					J	<b>1.83</b>	<b>1.38</b>	<b>64.2</b>			



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TONAWANDA L.F Groundwater Data Summary Tables

0107027-6		TMF-0110				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								8.00E-02	3.70E-01					U
Ra-226	8.10E-01	2.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.01E+00	1.70E-01												
Th-230	8.60E-01	1.50E-01												
Th-232	8.60E-01	1.50E-01												
U-234	8.90E-01	2.30E-01												
U-235	9.50E-02	6.70E-02					J	-1.30E-01	3.40E-01					U
U-238	8.40E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.83E+00</b>	<b>3.25E-01</b>												
<b>Alpha Sum</b>	<b>5.82E+00</b>	<b>1.53E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.40E-01	2.20E-01						8.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	8.40E-01	2.20E-01						2.00E+00	1.10E+01					U
K-40	2.07E+01	4.20E+00												
Ra-228	9.40E-01	2.70E-01												
Pa-231	5.00E-01	1.60E+00					U							
<b>Beta Sum</b>	<b>2.34E+01</b>	<b>4.22E+00</b>						<b>2.45E+01</b>	<b>1.18E+01</b>					
<b>Total Activity Sum</b>	<b>2.92E+01</b>	<b>4.49E+00</b>						<b>3.03E+01</b>	<b>1.19E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.20E+00	1.10E+00						<b>0.20</b>	<b>(from gamma)</b>			<b>6.41</b>		
Gross Beta	4.80E+00	9.00E-01					J	<b>4.30</b>	<b>1.66</b>			<b>132</b>		
Total Activity	1.08E+01	4.00E+00					J	<b>3.06</b>	<b>1.55</b>			<b>92.0</b>		

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**TONAWANDA L.F Groundwater Data Summary Tables**

Analyses	TMF-0113				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241							5.00E-02	1.50E-01				U
Ra-226	6.70E-01	2.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.50E-01	1.60E-01										
Th-230	9.70E-01	1.50E-01										
Th-232	8.60E-01	1.40E-01										
U-234	9.80E-01	2.70E-01										
U-235	7.10E-02	6.40E-02				J	2.00E-01	5.70E-01				U
U-238	6.50E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.70E+00</b>	<b>3.48E-01</b>										
<b>Alpha Sum</b>	<b>3.26E+00</b>	<b>3.28E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	6.50E-01	2.10E-01					1.20E+00	1.20E+00				
Pa-234m (Assumed from U-238)	6.50E-01	2.10E-01					7.00E+00	2.30E+01				U
K-40	1.91E+01	5.90E+00										
Ra-228	8.50E-01	6.60E-01										
Pa-231	-2.10E+00	3.60E+00				U						
<b>Beta Sum</b>	<b>2.10E+01</b>	<b>5.96E+00</b>					<b>2.79E+01</b>	<b>2.38E+01</b>				
<b>Total Activity Sum</b>	<b>2.43E+01</b>	<b>6.80E+00</b>					<b>3.12E+01</b>	<b>2.40E+01</b>				
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>		
Gross Alpha	5.91E+00	9.80E-01					<b>0.77</b>	<b>(from gamma)</b>			<b>57.8</b>	
Gross Beta	4.95E+00	8.10E-01				J	<b>2.67</b>	<b>0.96</b>			<b>124</b>	
Total Activity	9.30E+00	4.10E+00				J	<b>1.88</b>	<b>0.90</b>			<b>89.2</b>	

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TONAWANDA L.F Groundwater Data Summary Tables

0107027-8		TMF-0114				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								3.40E-02	9.90E-02					U
Ra-226	1.12E+00	3.10E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	1.60E-01												
Th-230	9.10E-01	1.50E-01												
Th-232	8.50E-01	1.40E-01												
U-234	7.30E-01	2.10E-01												
U-235	1.12E-01	7.40E-02					J	4.00E-01	3.20E-01					
U-238	8.40E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.68E+00</b>	<b>3.20E-01</b>												
<b>Alpha Sum</b>	<b>2.89E+00</b>	<b>1.79E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.40E-01	2.30E-01						5.60E-01	8.00E-01					U
Pa-234m (Assumed from U-238)	5.80E-01	2.30E-01						1.10E+01	1.10E+01					
K-40	1.78E+01	4.00E+00												
Ra-228	7.50E-01	3.00E-01												
Pa-231	-2.90E+00	1.90E+00					U							
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>4.03E+00</b>						<b>2.98E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.25E+01</b>	<b>4.41E+00</b>						<b>3.27E+01</b>	<b>1.19E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.40E+00	1.10E+00						1.20	(from gamma)					60.5
Gross Beta	5.01E+00	9.80E-01					J	3.52	2.10					119
Total Activity	1.09E+01	4.00E+00					J	1.95	1.74					69.5

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TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-9119				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-1.20E-01	1.20E-01			U
Ra-226	6.80E-01	2.30E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.00E+00	1.80E-01										
Th-230	9.10E-01	1.60E-01										
Th-232	1.06E+00	1.80E-01										
U-234	8.50E-01	2.40E-01										
U-235	9.20E-02	7.00E-02					J	-8.00E-02	3.90E-01			U
U-238	8.20E-01	2.30E-01										
<b>Total U Alpha</b>	<b>1.76E+00</b>	<b>3.40E-01</b>										
<b>Alpha Sum</b>	<b>3.16E+00</b>	<b>2.66E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.20E-01	2.30E-01						4.00E-01	1.20E+00			U
Pa-234m (Assumed from U-238)	8.20E-01	2.30E-01						-7.00E+00	1.70E+01			U
K-40	1.95E+01	5.10E+00										
Ra-228	7.70E-01	4.80E-01										
Pa-231	-2.50E+00	2.90E+00					U					
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>5.14E+00</b>						<b>1.34E+01</b>	<b>1.78E+01</b>			
<b>Total Activity Sum</b>	<b>2.48E+01</b>	<b>5.79E+00</b>						<b>1.65E+01</b>	<b>1.80E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.02E+00	9.90E-01						<b>1.01</b>	<b>(from gamma)</b>			<b>62.3</b>
Gross Beta	5.06E+00	8.10E-01					J	<b>3.18</b>	<b>0.47</b>			<b>124</b>
Total Activity	1.08E+01	4.20E+00					J	<b>1.95</b>	<b>0.31</b>			<b>78.6</b>

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TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-9120				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								-1.40E-01	1.20E-01					U
Ra-226	1.12E+00	3.20E-01	1.04E+00	2.50E-01	0.20	7.41								
Np-237														
Pu-238														
Pu-239														
Th-228	9.60E-01	1.80E-01												
Th-230	8.40E-01	1.50E-01												
Th-232	1.04E+00	1.80E-01												
U-234	7.60E-01	2.10E-01												
U-235	7.10E-02	5.60E-02					J	-1.10E-01	2.60E-01					U
U-238	8.00E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.63E+00</b>	<b>3.02E-01</b>												
<b>Alpha Sum</b>	<b>4.42E+00</b>	<b>1.53E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.00E-01	2.10E-01						6.90E-01	9.00E-01					U
Pa-234m (Assumed from U-238)	8.00E-01	2.10E-01						-2.00E+00	9.60E+00					U
K-40	1.73E+01	3.70E+00												
Ra-228	7.30E-01	2.50E-01												
Pa-231	-1.30E+00	1.60E+00					U							
<b>Beta Sum</b>	<b>1.95E+01</b>	<b>3.73E+00</b>						<b>1.66E+01</b>	<b>1.03E+01</b>					
<b>Total Activity Sum</b>	<b>2.39E+01</b>	<b>4.03E+00</b>						<b>2.10E+01</b>	<b>1.04E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.60E+00	1.10E+00						<b>0.62</b>	<b>(from gamma)</b>					<b>23.5</b>
Gross Beta	4.38E+00	8.70E-01					J	<b>3.95</b>	<b>1.18</b>					<b>127</b>
Total Activity	9.20E+00	3.90E+00					J	<b>2.62</b>	<b>1.06</b>					<b>88.8</b>

Revised  
TONAWANDA L.F Groundwater Data Summary Tables

0107027-11		TMF-0123				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)			
Am-241								3.00E-02	3.10E-01					U
Ra-226	9.30E-01	2.80E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.11E+00	1.80E-01												
Th-230	1.00E+00	1.60E-01												
Th-232	9.60E-01	1.60E-01												
U-234	1.01E+00	2.70E-01												
U-235	2.10E-01	1.10E-01					J	-2.90E-01	3.30E-01					U
U-238	8.80E-01	2.40E-01												
<b>Total U Alpha</b>	<b>2.10E+00</b>	<b>3.78E-01</b>												
<b>Alpha Sum</b>	<b>5.02E+00</b>	<b>1.46E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Cs-137	2.71E-01	8.50E-02												
Th-234 (Assumed from U-238)	8.80E-01	2.40E-01						1.30E+00	1.10E+00					
Pa-234m (Assumed from U-238)	8.80E-01	2.40E-01						3.00E-01	9.60E+00					U
K-40	1.79E+01	3.40E+00												
Ra-228	7.40E-01	2.10E-01												
Pa-231	-1.20E+00	1.50E+00					U							
<b>Beta Sum</b>	<b>2.05E+01</b>	<b>3.43E+00</b>						<b>2.04E+01</b>	<b>1.02E+01</b>					
<b>Total Activity Sum</b>	<b>2.55E+01</b>	<b>3.73E+00</b>						<b>2.54E+01</b>	<b>1.04E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.00E+00	1.00E+00						0.55	(from gamma)					17.8
Gross Beta	5.74E+00	9.30E-01					J	4.16	1.42					113
Total Activity	1.49E+01	4.60E+00					J	1.80	0.93					52.6

Revised  
TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-0124				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								1.10E-01	5.20E-01			U
Ra-226	8.20E-01	2.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.20E-01	1.70E-01										
Th-230	7.30E-01	1.30E-01										
Th-232	8.60E-01	1.50E-01										
U-234	6.40E-01	1.90E-01										
U-235	5.70E-02	5.20E-02					J	2.80E-01	3.40E-01			U
U-238	8.00E-01	2.20E-01										
<b>Total U Alpha</b>	<b>1.50E+00</b>	<b>2.95E-01</b>										
<b>Alpha Sum</b>	<b>3.57E+00</b>	<b>1.77E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.00E-01	2.20E-01						7.00E-01	1.10E+00			U
Pa-234m (Assumed from U-238)	8.00E-01	2.20E-01						-2.00E+00	1.30E+01			U
K-40	1.72E+01	3.80E+00										
Ra-228	7.10E-01	3.10E-01										
Pa-231	-1.40E+00	1.90E+00					U					
<b>Beta Sum</b>	<b>1.93E+01</b>	<b>3.83E+00</b>						<b>1.64E+01</b>	<b>1.36E+01</b>			
<b>Total Activity Sum</b>	<b>2.29E+01</b>	<b>4.22E+00</b>						<b>2.00E+01</b>	<b>1.37E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.00E+00	1.20E+00						1.14	(from gamma)			50.9
Gross Beta	3.75E+00	8.70E-01					J	3.97	0.93			135
Total Activity	8.30E+00	3.90E+00					J	2.54	0.82			93.6

Revised  
**TONAWANDA L.F Groundwater Data Summary Tables**

Analyses	TMF-0125				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								3.00E-02	1.20E-01			U
Ra-226	8.60E-01	2.50E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.70E-01	1.50E-01										
Th-230	9.10E-01	1.50E-01										
Th-232	8.50E-01	1.40E-01										
U-234	9.60E-01	2.40E-01										
U-235	1.02E-01	6.80E-02					J	1.90E-01	3.10E-01			U
U-238	9.60E-01	2.40E-01										
<b>Total U Alpha</b>	<b>2.02E+00</b>	<b>3.46E-01</b>										
<b>Alpha Sum</b>	<b>4.07E+00</b>	<b>1.95E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Cs-137	3.70E-01	1.30E-01										
Th-234 (Assumed from U-238)	9.60E-01	2.40E-01						1.40E+00	1.10E+00			
Pa-234m (Assumed from U-238)	9.60E-01	2.40E-01						1.00E+00	1.20E+01			U
K-40	1.27E+01	3.10E+00										
Ra-228	8.30E-01	2.90E-01										
Pa-231	-1.60E+00	2.10E+00					U					
<b>Beta Sum</b>	<b>1.56E+01</b>	<b>3.14E+00</b>						<b>1.61E+01</b>	<b>1.24E+01</b>			
<b>Total Activity Sum</b>	<b>1.97E+01</b>	<b>3.70E+00</b>						<b>2.02E+01</b>	<b>1.26E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	4.38E+00	7.50E-01						<b>0.15</b>	<b>(from gamma)</b>			<b>7.29</b>
Gross Beta	3.58E+00	6.30E-01					J	<b>3.76</b>	<b>1.01</b>			<b>125</b>
Total Activity	8.10E+00	4.30E+00					J	<b>2.04</b>	<b>0.91</b>			<b>83.5</b>



Revised  
TONAWANDA L.F Groundwater Data Summary Tables

Analyses	TMF-0126				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								2.00E-02	4.90E-01					U
Ra-226	7.40E-01	2.40E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.50E-01	1.80E-01												
Th-230	7.70E-01	1.50E-01												
Th-232	8.30E-01	1.50E-01												
U-234	7.90E-01	2.10E-01												
U-235	1.80E-01	9.00E-02					J	2.40E-01	3.20E-01					U
U-238	6.30E-01	1.80E-01												
<b>Total U Alpha</b>	<b>1.60E+00</b>	<b>2.91E-01</b>												
<b>Alpha Sum</b>	<b>5.79E+00</b>	<b>1.77E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	6.30E-01	1.80E-01						-6.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	6.30E-01	1.80E-01						1.00E+00	1.30E+01					U
K-40	1.36E+01	3.20E+00												
Ra-228	6.90E-01	2.70E-01												
Pa-231	1.00E+00	1.90E+00					U							
<b>Beta Sum</b>	<b>1.57E+01</b>	<b>3.23E+00</b>						<b>1.48E+01</b>	<b>1.34E+01</b>					
<b>Total Activity Sum</b>	<b>2.15E+01</b>	<b>3.68E+00</b>						<b>2.06E+01</b>	<b>1.36E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.00E+00	1.10E+00						<b>0.38</b>	<b>(from gamma)</b>				<b>14.6</b>	
Gross Beta	5.13E+00	9.60E-01					J	<b>3.13</b>	<b>0.72</b>				<b>101</b>	
Total Activity	9.80E+00	3.90E+00					J	<b>2.17</b>	<b>0.77</b>				<b>74.6</b>	

## Radiological Analytical Data Verification Comments on Data for SDG 0107028

This sample delivery group (SDG) contained twenty (20) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 6, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-9043	0107028-1
TMF-9044	0107028-2
TMF-0059	0107028-3
TMF-0060	0107028-4
TMF-0051	0107028-5
TMF-0052	0107028-6
TMF-0065	0107028-7
TMF-0066	0107028-8
TMF-0063	0107028-9
TMF-0064	0107028-10
TMF-0103	0107028-11
TMF-0104	0107028-12
TMF-0083	0107028-13
TMF-0084	0107028-14
TMF-0081	0107028-15
TMF-0082	0107028-16
TMF-9087	0107028-17
TMF-9088	0107028-18
TMF-0077	0107028-19
TMF-0078	0107028-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$DER = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was observed in the EQ-1 and EQ-2 equipment rinsate blanks.  $^{137}\text{Cs}$  activity was observed in the equipment rinsate blank EQ-1, but it was not observed in all samples. However,  $^{137}\text{Cs}$  activity was reported by the laboratory in three samples TMF-9043, TMF-0059 and TMF-0083 as the  $^{137}\text{Cs}$  activity in those samples was higher than the required DL ( $1.65 \times \text{TPU}$ ). All associated samples results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). The  $^{137}\text{Cs}$  activity values observed in these samples are greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification of Cs-137 results for these samples is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

All target radionuclides ( $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ ) plus  $^{40}\text{K}$  were reported for all samples. The result for the fission product  $^{137}\text{Cs}$  activity was also reported for samples TMF-9043, TMF-0059 and TMF-0083 as the  $^{137}\text{Cs}$  activity in those samples was higher than the required DL ( $1.65 \times \text{TPU}$ ). There were no incidents of identified radionuclides being excluded from the laboratory reports.

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtraction was indicated for  $^{241}\text{Am}$  result for sample TMF-0060 ( $-4.20\text{E-}01 \pm 3.00\text{E-}01$ ),  $^{231}\text{Pa}$  result for samples TMF-0060 ( $-1.90 \pm 1.60$ ), TMF-0103 ( $-2.30 \pm 2.10$ ) and TMF-0083 ( $-3.6 \pm 3.10$ ). **Therefore, it is recommended that the  $^{241}\text{Am}$  result for TMF-0060 and  $^{231}\text{Pa}$  results for samples TMF-0060, TMF-0103 and TMF-0083 be qualified as estimated (J).** No other problems were observed for the gamma spectrometry analyses.

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  in the method blank.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses. No qualification is required.

#### Sample-Specific Chemical Recovery:

The tracer recoveries are within acceptable limit. The tracer recoveries were greater than 29.06% for all samples for the alpha spectrometry analyses. The sample-specific percent recovery results of  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  for all samples have less than 10% uncertainty. No qualification is necessary.

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  analysis.

#### Method Detection Limit and Quantitaion:

All samples met the required method detection limit (MDL) of 1.0 pCi/g for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$ .

### **3.0 $^{226}\text{Ra}$ ANALYSES**

#### Method Blank:

There is no indication of blank contamination in the method blank sample for  $^{226}\text{Ra}$  analysis.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for  $^{226}\text{Ra}$  analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all  $^{226}\text{Ra}$  analysis. No qualification is required.

#### Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

#### Method Detection Limit and Quantitaion:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

#### 4.0 GROSS ALPHA AND BETA ANALYSIS

##### Method Blank:

There was no indication of blank contamination in method blank for the gross alpha/beta analyses.

##### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

##### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

##### Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

##### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

#### 5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING

##### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses. Therefore, no qualification is necessary.

##### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

##### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis by liquid scintillation counting.

Duplicate Analysis:

The total activity analysis duplicate DER is within acceptable limits.

Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC. **It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities are within acceptable limits for all samples except TMF-0060 and TMF-0083 indicating that the gross alpha analyses for all with the exception of samples TMF-0060 and TMF-0083 agree with the sum of the alpha emitters within a 99% confidence level. The DERs for samples TMF-0060 (1.63) and TMF-0083 (1.71) are outside the acceptable limits as well as the RPD values (68%) and (102%) respectively. The gross alpha result for samples TMF-0060 and TMF-0083 were greater than sum of the alpha

emitters by a factor of approximately 3. This may be due to heterogeneity or missing activity as analyzed for by individual analysis. **Therefore, it is recommended that the gross alpha results for samples TMF-0060 and TMF-0083 be qualified as estimated (J).**

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.89 – 4.86) for all samples the sums of the beta emitters activity and gross beta activity are outside the acceptable limits as well as the RPD values (106% - 135%). The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the total activity sum i.e., the sums of the beta emitters and the sum of alpha, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (1.95 – 3.15) for all samples are out side the acceptable limits as well as the RPD values (71.1%-121.1%). This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.



Revised  
Tonawanda Data Summary Tables

Analyses	TMF-9043				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.00E-02	3.80E-01	1.10E-01	1.30E-01	0.30	240	U
Ra-226	9.00E-01	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.00E+00	1.70E-01	1.01E+00	1.80E-01	0.04	1.00								
Th-230	9.80E-01	1.70E-01	9.30E-01	1.60E-01	0.21	5.24								
Th-232	9.50E-01	1.70E-01	8.90E-01	1.60E-01	0.26	6.52								
U-234	7.80E-01	2.00E-01												
U-235	2.80E-02	3.40E-02					U	4.20E-01	4.50E-01	1.70E-01	4.50E-01	0.39	84.7	
U-238	9.90E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.80E+00</b>	<b>3.14E-01</b>												
<b>Alpha Sum</b>	<b>4.73E+00</b>	<b>3.28E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Cs-137	1.60E-01	1.10E-01												
Th-234 (Assumed from U-238)	9.90E-01	2.40E-01						2.00E-01	1.20E+00	-1.00E+00	1.00E+00	0.77	300	U
Pa-234m (Assumed from U-238)	9.90E-01	2.40E-01						4.00E+00	1.40E+01	2.60E+01	2.40E+01	0.79	147	U
K-40	2.22E+01	4.50E+00	1.54E+01	4.60E+00	1.06	36.2								
Ra-228	8.10E-01	3.70E-01	9.50E-01	5.40E-01	0.21	15.9								
Pa-231	-1.00E+00	3.60E+00	-8.00E-01	2.90E+00	0.04	22.2	U							
<b>Beta Sum</b>	<b>2.50E+01</b>	<b>4.55E+00</b>						<b>2.73E+01</b>	<b>1.48E+01</b>	<b>4.13E+01</b>	<b>2.45E+01</b>			
<b>Total Activity Sum</b>	<b>2.98E+01</b>	<b>5.61E+00</b>						<b>3.20E+01</b>	<b>1.51E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	8.30E+00	1.50E+00						0.99	(from gamma)			54.8		
Gross Beta	7.70E+00	1.30E+00					J	3.66	1.32			106		
Total Activity	1.21E+01	4.10E+00					J	2.54	1.27			84.4		

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-9044				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate				
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER	RPD			
Am-241								-1.50E-01	5.00E-01	-5.00E-02	2.50E-01	0.18	100.0	U
Ra-226	1.33E+00	3.40E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	1.60E-01												
Th-230	8.20E-01	1.40E-01												
Th-232	9.30E-01	1.60E-01												
U-234	6.40E-01	1.80E-01	6.10E-01	1.70E-01	0.12	4.80								
U-235	6.00E-02	5.00E-02	7.80E-02	5.60E-02	0.24	26.1		2.80E-01	3.20E-01	-2.40E-01	2.80E-01	1.22	2600	
U-238	6.60E-01	1.80E-01	7.00E-01	1.90E-01	0.15	5.88								
<b>Total U Alpha</b>	<b>1.36E+00</b>	<b>2.59E-01</b>	<b>1.39E+00</b>	<b>2.61E-01</b>										
<b>Alpha Sum</b>	<b>5.92E+00</b>	<b>1.53E+00</b>	<b>2.11E+00</b>	<b>1.29E+00</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	6.60E-01	1.80E-01	7.00E-01	1.90E-01	0.15	5.88		1.30E+00	1.40E+00	7.80E-01	8.50E-01	0.32	50.0	
Pa-234m (Assumed from U-238)	6.60E-01	1.80E-01	7.00E-01	1.90E-01	0.15	5.88		-8.00E-01	8.00E+00	-1.00E+00	7.10E+00	0.02	22.2	U
K-40	1.86E+01	3.80E+00	1.91E+01	3.50E+00	0.10	2.65								
Ra-228	6.30E-01	2.20E-01	5.90E-01	1.70E-01	0.14	6.56								
Pa-231	6.00E-01	1.60E+00	8.00E-01	1.40E+00	0.09	28.6	U							
<b>Beta Sum</b>	<b>2.06E+01</b>	<b>3.82E+00</b>	<b>2.12E+01</b>	<b>3.52E+00</b>				<b>1.98E+01</b>	<b>8.97E+00</b>	<b>1.96E+01</b>	<b>7.96E+00</b>			
<b>Total Activity Sum</b>	<b>2.65E+01</b>	<b>4.11E+00</b>	<b>2.33E+01</b>	<b>3.75E+00</b>				<b>2.57E+01</b>	<b>9.10E+00</b>	<b>2.17E+01</b>	<b>8.07E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.90E+00	1.30E+00						0.01	(from gamma)		0.34			
Gross Beta	5.00E+00	1.00E+00					J	3.96	1.64		122			
Total Activity	1.00E+01	3.90E+00					J	2.92	1.59		90.5			

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0059				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								5.00E-02	2.70E-01			U
Ra-226	1.20E+00	2.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	7.00E-01	1.50E-01										
Th-230	7.30E-01	1.40E-01										
Th-232	6.50E-01	1.30E-01										
U-234	8.40E-01	2.20E-01										
U-235	2.90E-02	3.60E-02					U	3.00E-02	2.90E-01			U
U-238	7.50E-01	2.00E-01										
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>2.99E-01</b>										
<b>Alpha Sum</b>	<b>5.44E+00</b>	<b>1.43E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Cs-137	6.50E-02	4.50E-02										
Th-234 (Assumed from U-238)	7.50E-01	2.00E-01						5.50E-01	7.90E-01			U
Pa-234m (Assumed from U-238)	7.50E-01	2.00E-01						0.00E+00	7.80E+00			U
K-40	1.93E+01	3.50E+00										
Ra-228	7.70E-01	1.90E-01										
Pa-231	6.00E-01	1.50E+00					U					
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>3.52E+00</b>						<b>2.08E+01</b>	<b>8.59E+00</b>			
<b>Total Activity Sum</b>	<b>2.71E+01</b>	<b>3.80E+00</b>						<b>2.62E+01</b>	<b>8.71E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.50E+00	1.20E+00						<b>0.57</b>	<b>(from gamma)</b>			<b>17.8</b>
Gross Beta	6.30E+00	1.10E+00				J		<b>4.18</b>	<b>1.67</b>			<b>110</b>
Total Activity	1.27E+01	4.10E+00				J		<b>2.58</b>	<b>1.40</b>			<b>72.5</b>

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0060				FROM GAMMA						Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD	
Am-241								-4.20E-01	3.00E-01				UJ
Ra-226	8.10E-01	2.70E-01											
Np-237													
Pu-238													
Pu-239													
Th-228	7.80E-01	1.40E-01											
Th-230	7.90E-01	1.40E-01											
Th-232	7.40E-01	1.30E-01											
U-234	7.10E-01	1.90E-01											
U-235	1.02E-01	6.50E-02						1.70E-01	3.00E-01				U
U-238	7.40E-01	2.00E-01											
<b>Total U Alpha</b>	<b>1.55E+00</b>	<b>2.83E-01</b>											
<b>Alpha Sum</b>	<b>2.96E+00</b>	<b>1.51E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	7.40E-01	2.00E-01						-2.40E-01	7.60E-01				U
Pa-234m (Assumed from U-238)	7.40E-01	2.00E-01						1.90E+00	1.00E+01				U
K-40	1.71E+01	3.50E+00											
Ra-228	7.60E-01	2.50E-01											
Pa-231	-1.90E+00	1.60E+00											
<b>Beta Sum</b>	<b>1.91E+01</b>	<b>3.53E+00</b>						<b>1.93E+01</b>	<b>1.06E+01</b>				
<b>Total Activity Sum</b>	<b>2.21E+01</b>	<b>3.84E+00</b>						<b>2.23E+01</b>	<b>1.07E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	6.00E+00	1.10E+00					J	<b>1.63</b>	<b>(from gamma)</b>			<b>67.8</b>	
Gross Beta	5.17E+00	9.70E-01					J	<b>3.81</b>	<b>1.32</b>			<b>115</b>	
Total Activity	1.05E+01	3.90E+00					J	<b>2.12</b>	<b>1.03</b>			<b>71.1</b>	

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0051				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.20E-02	8.50E-02					U
Ra-226	9.60E-01	2.50E-01	7.70E-01	2.10E-01	0.58	22.0								
Np-237														
Pu-238														
Pu-239														
Th-228	7.70E-01	1.40E-01	9.00E-01	1.50E-01	0.63	15.6								
Th-230	7.70E-01	1.30E-01	8.30E-01	1.40E-01	0.31	7.50								
Th-232	8.00E-01	1.30E-01	8.30E-01	1.40E-01	0.16	3.68								
U-234	8.50E-01	2.20E-01												
U-235	5.10E-02	4.60E-02						1.60E-01	2.50E-01					U
U-238	8.30E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.73E+00</b>	<b>3.15E-01</b>												
<b>Alpha Sum</b>	<b>5.84E+00</b>	<b>1.51E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.30E-01	2.20E-01						7.70E-01	6.10E-01					
Pa-234m (Assumed from U-238)	8.30E-01	2.20E-01						1.10E+00	8.80E+00					U
K-40	1.55E+01	3.50E+00												
Ra-228	6.70E-01	2.30E-01												
Pa-231	9.00E-01	1.60E+00												U
<b>Beta Sum</b>	<b>1.79E+01</b>	<b>3.53E+00</b>						<b>1.81E+01</b>	<b>9.49E+00</b>					
<b>Total Activity Sum</b>	<b>2.38E+01</b>	<b>3.84E+00</b>						<b>2.40E+01</b>	<b>9.61E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.50E+00	1.10E+00	5.90E+00	1.10E+00	0.26	7.02		0.18	(from gamma)				6.01	
Gross Beta	5.45E+00	1.00E+00	4.45E+00	9.10E-01	0.74	20.2	J	3.41	1.33				107	
Total Activity	9.60E+00	3.90E+00					J	2.59	1.39				85.0	

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0052					FROM GAMMA					Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								6.00E-02	5.20E-01			U
Ra-226	9.20E-01	2.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.00E-01	1.50E-01										
Th-230	8.30E-01	1.40E-01										
Th-232	8.10E-01	1.40E-01										
U-234	7.50E-01	2.20E-01	9.40E-01	2.60E-01	0.56	22.5						
U-235	9.10E-02	6.90E-02	1.08E-01	7.70E-02	0.16	17.1		-3.00E-02	3.10E-01			U
U-238	6.40E-01	2.00E-01	8.60E-01	2.40E-01	0.70	29.3						
<b>Total U Alpha</b>	<b>1.48E+00</b>	<b>3.05E-01</b>	<b>1.91E+00</b>	<b>3.62E-01</b>								
<b>Alpha Sum</b>	<b>4.57E+00</b>	<b>1.60E+00</b>	<b>1.91E+00</b>	<b>3.62E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	6.40E-01	2.00E-01	8.60E-01	2.40E-01	0.70	29.3		7.70E-01	9.20E-01			
Pa-234m (Assumed from U-238)	6.40E-01	2.00E-01	8.60E-01	2.40E-01	0.70	29.3		-5.00E+00	1.20E+01			U
K-40	1.73E+01	3.70E+00										
Ra-228	9.40E-01	3.00E-01										
Pa-231	-3.00E-01	1.70E+00					U					
<b>Beta Sum</b>	<b>1.95E+01</b>	<b>3.73E+00</b>	<b>1.72E+00</b>	<b>3.39E-01</b>				<b>1.40E+01</b>	<b>1.26E+01</b>			
<b>Total Activity Sum</b>	<b>2.41E+01</b>	<b>4.06E+00</b>	<b>3.63E+00</b>	<b>4.96E-01</b>				<b>1.85E+01</b>	<b>1.27E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	4.66E+00	9.90E-01						0.05	(from gamma)			1.93
Gross Beta	4.11E+00	8.80E-01				J		4.01	0.78			130
Total Activity	9.40E+00	3.90E+00				J		2.60	0.69			87.6

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0065				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								-1.00E-02	3.20E-01			U
Ra-226	6.40E-01	2.20E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.70E-01	1.60E-01										
Th-230	8.20E-01	1.40E-01										
Th-232	7.70E-01	1.40E-01										
U-234	9.10E-01	2.30E-01										
U-235	1.51E-01	8.30E-02						0.00E+00	3.00E-01			U
U-238	8.90E-01	2.30E-01										
<b>Total U Alpha</b>	<b>1.95E+00</b>	<b>3.36E-01</b>										
<b>Alpha Sum</b>	<b>4.87E+00</b>	<b>1.77E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.90E-01	2.30E-01						7.00E-01	1.10E+00			U
Pa-234m (Assumed from U-238)	8.90E-01	2.30E-01						-3.60E+00	8.60E+00			U
K-40	1.74E+01	3.60E+00										
Ra-228	6.80E-01	2.30E-01										
Pa-231	-2.00E-01	1.90E+00										
<b>Beta Sum</b>	<b>1.98E+01</b>	<b>3.63E+00</b>						<b>1.52E+01</b>	<b>9.39E+00</b>			
<b>Total Activity Sum</b>	<b>2.47E+01</b>	<b>4.04E+00</b>						<b>2.00E+01</b>	<b>9.56E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.40E+00	1.20E+00						<b>0.71</b>	<b>(from gamma)</b>			<b>27.1</b>
Gross Beta	5.01E+00	9.30E-01					J	<b>3.96</b>	<b>1.07</b>			<b>119</b>
Total Activity	8.40E+00	3.90E+00					J	<b>2.90</b>	<b>1.13</b>			<b>98.5</b>

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0066				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					2.00E-02	3.30E-01					U
Ra-226	7.10E-01	2.10E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	8.60E-01	1.70E-01									
Th-230	9.20E-01	1.60E-01									
Th-232	8.20E-01	1.50E-01									
U-234	8.20E-01	2.20E-01									
U-235	6.60E-02	5.70E-02			1.20E-01	3.80E-01					U
U-238	8.80E-01	2.30E-01									
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.23E-01</b>									
<b>Alpha Sum</b>	<b>4.36E+00</b>	<b>2.12E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
Tc-99											
Th-234 (Assumed from U-238)	8.80E-01	2.30E-01			3.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	8.80E-01	2.30E-01			2.00E+00	1.40E+01					U
K-40	1.88E+01	3.90E+00									
Ra-228	6.40E-01	2.90E-01									
Pa-231	-8.00E-01	2.30E+00									U
<b>Beta Sum</b>	<b>2.11E+01</b>	<b>3.93E+00</b>			<b>2.16E+01</b>	<b>1.46E+01</b>					
<b>Total Activity Sum</b>	<b>2.55E+01</b>	<b>4.47E+00</b>			<b>2.60E+01</b>	<b>1.47E+01</b>					
					<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	4.76E+00	8.90E-01			<b>0.18</b>	<b>(from gamma)</b>			<b>8.86</b>		
Gross Beta	4.71E+00	7.80E-01			<b>4.09</b>	<b>1.16</b>	J		<b>127</b>		
Total Activity	8.30E+00	3.90E+00			<b>2.89</b>	<b>1.16</b>	J		<b>102</b>		



Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0063				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								3.00E-02	1.40E-01			U
Ra-226	1.10E+00	2.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.29E+00	2.10E-01										
Th-230	1.10E+00	1.80E-01										
Th-232	1.24E+00	2.00E-01										
U-234	1.17E+00	3.00E-01										
U-235	2.80E-02	4.00E-02					U	3.10E-01	4.60E-01			U
U-238	1.03E+00	2.80E-01										
<b>Total U Alpha</b>	<b>2.23E+00</b>	<b>4.12E-01</b>										
<b>Alpha Sum</b>	<b>4.35E+00</b>	<b>3.21E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	1.03E+00	2.80E-01						6.00E-01	1.20E+00			U
Pa-234m (Assumed from U-238)	1.03E+00	2.80E-01						0.00E+00	2.40E+01			U
K-40	2.18E+01	6.00E+00										
Ra-228	1.03E+00	4.90E-01										
Pa-231	-2.90E+00	3.50E+00					U					
<b>Beta Sum</b>	<b>2.45E+01</b>	<b>6.05E+00</b>						<b>2.31E+01</b>	<b>2.48E+01</b>			
<b>Total Activity Sum</b>	<b>2.89E+01</b>	<b>6.84E+00</b>						<b>2.74E+01</b>	<b>2.50E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.50E+00	1.10E+00						<b>0.63</b>	<b>(from gamma)</b>			<b>39.7</b>
Gross Beta	6.41E+00	1.00E+00				J		<b>2.96</b>	<b>0.67</b>			<b>117</b>
Total Activity	7.10E+00	4.10E+00				J		<b>2.73</b>	<b>0.80</b>			<b>121</b>

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0064				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								-3.00E-02	1.10E-01			U
Ra-226	8.80E-01	2.20E-01	7.80E-01	2.80E-01	0.28	12.0						
Np-237												
Pu-238												
Pu-239												
Th-228	7.60E-01	1.50E-01										
Th-230	8.10E-01	1.40E-01										
Th-232	8.00E-01	1.40E-01										
U-234	8.20E-01	2.20E-01										
U-235	7.80E-02	5.90E-02						7.00E-02	3.90E-01			U
U-238	1.04E+00	2.60E-01										
<b>Total U Alpha</b>	<b>1.94E+00</b>	<b>3.46E-01</b>										
<b>Alpha Sum</b>	<b>3.66E+00</b>	<b>2.21E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	1.04E+00	2.60E-01						3.80E-01	9.50E-01			U
Pa-234m (Assumed from U-238)	1.04E+00	2.60E-01						0.00E+00	1.50E+01			U
K-40	2.29E+01	5.60E+00										
Ra-228	1.12E+00	5.20E-01										
Pa-231	-1.70E+00	2.40E+00										
<b>Beta Sum</b>	<b>2.59E+01</b>	<b>5.64E+00</b>						<b>2.42E+01</b>	<b>1.61E+01</b>			
<b>Total Activity Sum</b>	<b>2.96E+01</b>	<b>6.06E+00</b>						<b>2.79E+01</b>	<b>1.62E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.40E+00	1.10E+00	5.10E+00	1.20E+00	0.18	5.71		0.71	(from gamma)			38.5
Gross Beta	5.00E+00	1.00E+00	5.40E+00	1.00E+00	0.28	7.69	J	3.65	1.19			135
Total Activity	1.25E+01	4.00E+00					J	2.35	0.92			81.1

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0103				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								-1.30E-01	3.10E-01			U
Ra-226	7.80E-01	2.90E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.00E-01	1.60E-01										
Th-230	7.60E-01	1.40E-01										
Th-232	8.30E-01	1.50E-01										
U-234	6.90E-01	2.00E-01										
U-235	5.00E-03	2.40E-02					U	-2.30E-01	3.70E-01			U
U-238	7.60E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.46E+00</b>	<b>2.91E-01</b>										
<b>Alpha Sum</b>	<b>2.66E+00</b>	<b>1.95E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	7.60E-01	2.10E-01						2.10E-01	9.10E-01			U
Pa-234m (Assumed from U-238)	7.60E-01	2.10E-01						9.00E+00	1.20E+01			U
K-40	1.90E+01	3.80E+00										
Ra-228	7.30E-01	2.50E-01										
Pa-231	-2.30E+00	2.10E+00					UJ					
<b>Beta Sum</b>	<b>2.10E+01</b>	<b>3.83E+00</b>						<b>2.87E+01</b>	<b>1.26E+01</b>			
<b>Total Activity Sum</b>	<b>2.36E+01</b>	<b>4.30E+00</b>						<b>3.13E+01</b>	<b>1.28E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.32E+00	9.90E-01						1.22	(from gamma)			66.8
Gross Beta	4.98E+00	8.30E-01				J		4.08	1.87			123
Total Activity	7.90E+00	3.90E+00				J		2.71	1.75			99.8

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0104				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								1.00E-02	1.10E-01			U
Ra-226	1.16E+00	2.80E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.23E+00	2.10E-01										
Th-230	1.21E+00	2.00E-01										
Th-232	1.15E+00	1.90E-01										
U-234	7.30E-01	2.10E-01										
U-235	5.30E-02	5.50E-02						2.00E-02	3.80E-01			U
U-238	1.02E+00	2.60E-01										
<b>Total U Alpha</b>	<b>1.80E+00</b>	<b>3.39E-01</b>										
<b>Alpha Sum</b>	<b>4.93E+00</b>	<b>2.67E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	1.02E+00	2.60E-01						1.10E+00	1.20E+00			
Pa-234m (Assumed from U-238)	1.02E+00	2.60E-01						3.00E+00	2.00E+01			U
K-40	2.10E+01	5.80E+00										
Ra-228	1.14E+00	5.30E-01										
Pa-231	-1.80E+00	2.90E+00										U
<b>Beta Sum</b>	<b>2.40E+01</b>	<b>5.85E+00</b>						<b>2.60E+01</b>	<b>2.09E+01</b>			
<b>Total Activity Sum</b>	<b>2.89E+01</b>	<b>6.43E+00</b>						<b>3.10E+01</b>	<b>2.10E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	7.10E+00	1.20E+00						<b>0.74</b>	<b>(from gamma)</b>			<b>36.0</b>
Gross Beta	5.59E+00	8.80E-01					J	<b>3.11</b>	<b>0.98</b>			<b>124</b>
Total Activity	8.20E+00	3.90E+00					J	<b>2.75</b>	<b>1.06</b>			<b>112</b>

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0083				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								7.00E-02	1.30E-01			U
Ra-226	7.00E-01	2.00E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.20E+00	2.20E-01										
Th-230	1.23E+00	2.20E-01										
Th-232	1.09E+00	2.00E-01										
U-234	7.40E-01	2.00E-01										
U-235	2.90E-02	3.70E-02					U	-1.60E-01	4.40E-01			U
U-238	8.20E-01	2.20E-01										
<b>Total U Alpha</b>	<b>1.59E+00</b>	<b>3.00E-01</b>										
<b>Alpha Sum</b>	<b>2.57E+00</b>	<b>2.84E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Cs-137	2.60E-01	1.40E-01										
Th-234 (Assumed from U-238)	8.20E-01	2.20E-01						8.00E-01	1.20E+00			U
Pa-234m (Assumed from U-238)	8.20E-01	2.20E-01						1.20E+01	2.30E+01			U
K-40	2.18E+01	5.70E+00										
Ra-228	7.80E-01	5.30E-01										
Pa-231	-3.60E+00	3.10E+00					UJ					
<b>Beta Sum</b>	<b>2.40E+01</b>	<b>5.75E+00</b>						<b>3.52E+01</b>	<b>2.37E+01</b>			
<b>Total Activity Sum</b>	<b>2.66E+01</b>	<b>6.41E+00</b>						<b>3.78E+01</b>	<b>2.39E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	7.90E+00	1.30E+00				J		1.71	(from gamma)			102
Gross Beta	6.50E+00	1.00E+00				J		3.01	1.21			115
Total Activity	1.18E+01	4.10E+00				J		1.95	1.07			77.1

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0084				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER		RPD
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.90E-01	3.30E-01			U
Ra-226	2.40E-01	1.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.00E-01	1.60E-01										
Th-230	8.60E-01	1.50E-01										
Th-232	9.00E-01	1.60E-01										
U-234	7.00E-01	1.90E-01										
U-235	4.80E-02	4.40E-02						-6.00E-02	3.80E-01			U
U-238	8.40E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.59E+00</b>	<b>2.87E-01</b>										
<b>Alpha Sum</b>	<b>4.40E+00</b>	<b>2.02E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.40E-01	2.10E-01						-3.00E-02	8.60E-01			U
Pa-234m (Assumed from U-238)	8.40E-01	2.10E-01						-1.70E+01	1.40E+01			U
K-40	2.14E+01	4.30E+00										
Ra-228	6.00E-01	2.40E-01										
Pa-231	-1.00E-01	2.20E+00										
<b>Beta Sum</b>	<b>2.37E+01</b>	<b>4.32E+00</b>						<b>4.96E+00</b>	<b>1.47E+01</b>			
<b>Total Activity Sum</b>	<b>2.81E+01</b>	<b>4.78E+00</b>						<b>9.36E+00</b>	<b>1.48E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.80E+00	1.20E+00						<b>0.60</b>	<b>(from gamma)</b>	<b>27.5</b>		
Gross Beta	4.79E+00	9.50E-01				J	<b>4.26</b>	<b>0.01</b>	<b>133</b>			
Total Activity	9.00E+00	3.90E+00				J	<b>3.09</b>	<b>0.02</b>	<b>103</b>			

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0081				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate				
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER	RPD			
Am-241								-7.00E-02	1.30E-01	9.00E-02	1.40E-01	0.84	1600	U
Ra-226	1.23E+00	2.80E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.02E+00	1.80E-01												
Th-230	9.30E-01	1.60E-01												
Th-232	8.60E-01	1.50E-01												
U-234	7.50E-01	2.10E-01												
U-235	5.60E-02	5.30E-02						3.30E-01	4.70E-01	1.70E-01	4.10E-01	0.26	64.0	U
U-238	8.10E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>3.09E-01</b>												
<b>Alpha Sum</b>	<b>6.56E+00</b>	<b>2.92E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.10E-01	2.20E-01						1.00E+00	1.00E+00	7.00E-01	1.10E+00	0.20	35.3	
Pa-234m (Assumed from U-238)	8.10E-01	2.20E-01						1.50E+01	2.30E+01	-2.00E+00	1.90E+01	0.57	262	U
K-40	1.97E+01	5.60E+00	1.85E+01	4.90E+00	0.16	6.28								
Ra-228	8.30E-01	6.10E-01	8.20E-01	4.30E-01	0.01	1.21								
Pa-231	1.00E+00	3.20E+00	6.00E-01	3.00E+00	0.09	50.0	U							
<b>Beta Sum</b>	<b>2.23E+01</b>	<b>5.65E+00</b>						<b>3.67E+01</b>	<b>2.37E+01</b>	<b>1.81E+01</b>	<b>1.97E+01</b>			
<b>Total Activity Sum</b>	<b>2.88E+01</b>	<b>6.37E+00</b>						<b>4.32E+01</b>	<b>2.39E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.40E+00	1.30E+00						0.26	(from gamma)			12.1		
Gross Beta	5.72E+00	9.20E-01					J	2.89	1.30			118		
Total Activity	1.03E+01	4.00E+00					J	2.46	1.36			94.7		

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0082				FROM GAMMA						Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD	
Am-241								2.30E-01	3.30E-01				U
Ra-226	1.08E+00	2.50E-01											
Np-237													
Pu-238													
Pu-239													
Th-228	8.30E-01	1.60E-01											
Th-230	8.50E-01	1.50E-01											
Th-232	8.20E-01	1.50E-01											
U-234	7.30E-01	2.10E-01											
U-235	6.90E-02	5.70E-02						0.00E+00	4.00E-01				U
U-238	6.10E-01	1.90E-01											
<b>Total U Alpha</b>	<b>1.41E+00</b>	<b>2.89E-01</b>											
<b>Alpha Sum</b>	<b>3.73E+00</b>	<b>2.12E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	6.10E-01	1.90E-01						4.00E-01	1.00E+00				U
Pa-234m (Assumed from U-238)	6.10E-01	1.90E-01						1.00E+00	1.50E+01				U
K-40	1.87E+01	3.90E+00											
Ra-228	6.70E-01	2.80E-01											
Pa-231	-1.40E+00	2.30E+00											U
<b>Beta Sum</b>	<b>2.04E+01</b>	<b>3.93E+00</b>						<b>2.06E+01</b>	<b>1.55E+01</b>				
<b>Total Activity Sum</b>	<b>2.42E+01</b>	<b>4.47E+00</b>						<b>2.43E+01</b>	<b>1.57E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	5.20E+00	1.00E+00						<b>0.63</b>	<b>(from gamma)</b>			<b>32.9</b>	
Gross Beta	4.92E+00	9.20E-01					J	<b>3.84</b>	<b>1.01</b>			<b>122</b>	
Total Activity	8.90E+00	3.90E+00					J	<b>2.57</b>	<b>0.96</b>			<b>92.3</b>	



Revised  
Tonawanda Data Summary Tables

Analyses	TMF-9087				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					0.00E+00	1.10E-01					U
Ra-226	1.05E+00	2.40E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	9.70E-01	1.60E-01									
Th-230	9.20E-01	1.50E-01									
Th-232	9.30E-01	1.50E-01									
U-234	8.50E-01	2.20E-01									
U-235	1.17E-01	7.20E-02			7.00E-02	4.30E-01					U
U-238	9.70E-01	2.40E-01									
<b>Total U Alpha</b>	<b>1.94E+00</b>	<b>3.33E-01</b>									
<b>Alpha Sum</b>	<b>5.36E+00</b>	<b>2.57E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
Tc-99											
Th-234 (Assumed from U-238)	9.70E-01	2.40E-01			2.20E-01	8.50E-01					U
Pa-234m (Assumed from U-238)	9.70E-01	2.40E-01			0.00E+00	2.30E+01					U
K-40	2.06E+01	5.60E+00									
Ra-228	4.80E-01	5.80E-01									
Pa-231	-5.00E-01	2.80E+00									U
<b>Beta Sum</b>	<b>2.30E+01</b>	<b>5.65E+00</b>			<b>2.12E+01</b>	<b>2.37E+01</b>					
<b>Total Activity Sum</b>	<b>2.83E+01</b>	<b>6.21E+00</b>			<b>2.66E+01</b>	<b>2.38E+01</b>					
					<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	7.50E+00	1.30E+00			<b>0.74</b>	<b>(from gamma)</b>				<b>33.3</b>	
Gross Beta	5.23E+00	8.50E-01			<b>3.10</b>	<b>0.68</b>				<b>126</b>	
Total Activity	1.00E+01	4.00E+00			<b>2.48</b>	<b>0.69</b>				<b>95.6</b>	

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-9088				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					-3.00E-02	1.20E-01					U
Ra-226	9.20E-01	2.10E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	9.60E-01	1.80E-01									
Th-230	8.80E-01	1.60E-01									
Th-232	8.30E-01	1.50E-01									
U-234	6.30E-01	1.90E-01									
U-235	7.50E-02	6.00E-02			6.00E-02	3.80E-01					U
U-238	7.20E-01	2.00E-01									
<b>Total U Alpha</b>	<b>1.43E+00</b>	<b>2.82E-01</b>									
<b>Alpha Sum</b>	<b>3.49E+00</b>	<b>2.29E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
Tc-99											
Th-234 (Assumed from U-238)	7.20E-01	2.00E-01			4.30E-01	8.60E-01					U
Pa-234m (Assumed from U-238)	7.20E-01	2.00E-01			6.00E+00	1.90E+01					U
K-40	1.99E+01	4.90E+00									
Ra-228	9.70E-01	3.80E-01									
Pa-231	-1.70E+00	2.50E+00									U
<b>Beta Sum</b>	<b>2.21E+01</b>	<b>4.93E+00</b>			<b>2.71E+01</b>	<b>1.96E+01</b>					
<b>Total Activity Sum</b>	<b>2.56E+01</b>	<b>5.44E+00</b>			<b>3.06E+01</b>	<b>1.98E+01</b>					
					<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	6.30E+00	1.10E+00			<b>1.11</b>	<b>(from gamma)</b>			<b>57.5</b>		
Gross Beta	4.76E+00	8.00E-01			<b>3.47</b>	<b>1.14</b>			<b>129</b>		
Total Activity	8.40E+00	3.90E+00			<b>2.57</b>	<b>1.10</b>			<b>101</b>		

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0077		FROM GAMMA												
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241							1.10E-01	3.80E-01							U
Ra-226	9.70E-01	2.30E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	8.50E-01	1.50E-01													
Th-230	1.20E+00	1.90E-01													
Th-232	8.50E-01	1.40E-01													
U-234	9.00E-01	2.30E-01													
U-235	3.80E-02	4.40E-02					-6.00E-02	4.70E-01							U
U-238	9.10E-01	2.30E-01													
<b>Total U Alpha</b>	<b>1.85E+00</b>	<b>3.28E-01</b>													
<b>Alpha Sum</b>	<b>5.45E+00</b>	<b>2.30E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.10E-01	2.30E-01					6.00E-01	1.20E+00							U
Pa-234m (Assumed from U-238)	9.10E-01	2.30E-01					-6.00E+00	1.60E+01							U
K-40	1.81E+01	3.90E+00													
Ra-228	6.80E-01	2.70E-01													
Pa-231	-3.00E-01	2.50E+00													U
<b>Beta Sum</b>	<b>2.06E+01</b>	<b>3.93E+00</b>					<b>1.33E+01</b>	<b>1.65E+01</b>							
<b>Total Activity Sum</b>	<b>2.60E+01</b>	<b>4.56E+00</b>					<b>1.88E+01</b>	<b>1.67E+01</b>							
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>					
Gross Alpha	6.60E+00	1.10E+00					<b>0.45</b>	<b>(from gamma)</b>					<b>19.1</b>		
Gross Beta	5.17E+00	8.30E-01				J	<b>3.83</b>	<b>0.49</b>					<b>120</b>		
Total Activity	7.10E+00	3.90E+00				J	<b>3.15</b>	<b>0.68</b>					<b>114</b>		

Revised  
Tonawanda Data Summary Tables

Analyses	TMF-0078				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								-7.00E-02	1.10E-01			U
Ra-226	1.03E+00	2.20E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.70E-01	1.60E-01										
Th-230	8.80E-01	1.50E-01										
Th-232	8.80E-01	1.50E-01										
U-234	7.60E-01	2.20E-01										
U-235	6.30E-02	5.70E-02						7.00E-02	3.50E-01			U
U-238	6.90E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.51E+00</b>	<b>3.09E-01</b>										
<b>Alpha Sum</b>	<b>3.65E+00</b>	<b>2.21E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	6.90E-01	2.10E-01						5.40E-01	7.00E-01			U
Pa-234m (Assumed from U-238)	6.90E-01	2.10E-01						1.20E+01	1.90E+01			U
K-40	1.90E+01	5.10E+00										
Ra-228	7.20E-01	3.90E-01										
Pa-231	-1.80E+00	2.40E+00										
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>5.13E+00</b>						<b>3.20E+01</b>	<b>1.97E+01</b>			
<b>Total Activity Sum</b>	<b>2.45E+01</b>	<b>5.59E+00</b>						<b>3.57E+01</b>	<b>1.98E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.90E+00	1.10E+00						<b>0.91</b>	<b>(from gamma)</b>			<b>47.0</b>
Gross Beta	4.29E+00	7.30E-01					J	<b>3.20</b>	<b>1.41</b>			<b>132</b>
Total Activity	8.50E+00	3.90E+00					J	<b>2.35</b>	<b>1.35</b>			<b>97.1</b>

## Radiological Analytical Data Verification Comments on Data for SDG 0107029

This sample delivery group (SDG) contained twenty (20) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 6, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0035	0107029-1
TMF-0036	0107029-2
TMF-0037	0107029-3
TMF-0038	0107029-4
TMF-0039	0107029-5
TMF-0040	0107029-6
TMF-0015	0107029-7
TMF-0016	0107029-8
TMF-0007	0107029-9
TMF-0008	0107029-10
TMF-0001	0107029-11
TMF-0002	0107029-12
TMF-0009	0107029-13
TMF-0010	0107029-14
TMF-9019	0107029-15
TMF-9020	0107029-16
TMF-0017	0107029-17
TMF-0018	0107029-18
TMF-0027	0107029-19
TMF-0028	0107029-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$DER = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was observed in the EQ-1 and EQ-2 equipment rinsate blanks. However,  $^{137}\text{Cs}$  activity was observed in the equipment rinsate blank EQ-1, but it was not reported by the laboratory in any samples. All associated samples results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). The  $^{137}\text{Cs}$  activity ( $8.81\text{E-}02 \pm 6.07\text{E-}02$ ) was identified in the gamma spectrometry report for the sample # TMF-0007 but not reported by the laboratory as required since the  $^{137}\text{Cs}$  activity in the sample is higher than the DL ( $1.65*\text{TPU}$ ). However,  $^{137}\text{Cs}$  activity value in sample TMF-0007 is greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification on Cs-137 results for this sample is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

All target radionuclides ( $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ ) plus  $^{40}\text{K}$  were reported for all samples. There were no incidents of identified radionuclides being excluded from the laboratory reports except  $^{137}\text{Cs}$  result for sample TMF-0007. The  $^{137}\text{Cs}$  activity ( $8.81\text{E-}02 \pm 6.07\text{E-}02$ ) was identified in the gamma spectrometry report for the sample # TMF-0007 but not reported by the laboratory as required since the  $^{137}\text{Cs}$  activity in the sample is higher than the DL ( $1.65*\text{TPU}$ ).

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtraction was indicated for  $^{231}\text{Pa}$  for sample TMF-0007. **It is recommended that the  $^{231}\text{Pa}$  result for sample TMF-0007 be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was an indication of blank contamination for  $^{230}\text{Th}$  in the method blank. All associated sample results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). However, the  $^{230}\text{Th}$  results for all samples were greater than 5 times the blank. No qualification is necessary.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 29.06% for all samples for the alpha spectrometry analyses. The sample-specific percent recovery results of  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  for all samples have less than 10% uncertainty. No qualification is necessary.

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium.

#### Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 1.0 pCi/g for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$ .

### **3.0 $^{226}\text{Ra}$ ANALYSES**

#### Method Blank:

There is no indication of blank contamination in the method blank sample for the  $^{226}\text{Ra}$  analysis.

#### Equipment Rinse Blank:

There was no indication of contamination in the equipment rinse blank for  $^{226}\text{Ra}$  analysis.

#### Laboratory Control Sample:

The percent recovery for the LCS (96%) for the  $^{226}\text{Ra}$  analyses was within acceptable limits.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all  $^{226}\text{Ra}$  analyses. No qualification is required.

#### Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis for all samples were within acceptable limits. No qualification of the samples is necessary.

#### Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

### **4.0 GROSS ALPHA AND BETA ANALYSIS**

#### Method Blank:



There was no indication of blank contamination in the method blank for the gross alpha/beta analyses.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. Some of the samples results did not meet the required MDC as identified in the narrative section indicating that the laboratory did not meet the project DQOs. The results for samples TMF-0035, TMF-0001, TMF-0002 and TMF-0017 did not meet the required MDC limits of both gross alpha and gross beta analyses. Whereas the results for samples TMF-0036, TMF-0038, TMF-0039, TMF-0040, TMF-0007, TMF-0009, TMF-0020 and TMF-0027 did not meet required MDC for gross beta analysis, Since the gross alpha/beta analyses are just estimates, no qualification is recommended.

## **5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING**

Method Blank:

There was no indication of blank contamination in the method blank samples for the total activity analyses.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

#### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis by liquid scintillation counting.

#### Duplicate Analysis:

The total activity by liquid scintillation counting duplicate DER is within acceptable limits.

#### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

#### Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC. **It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

#### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

#### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities is within acceptable limits for all samples except for TMF-0007, indicating that the gross alpha analyses for this sample does not agree with the sum of the alpha emitters within a 99% confidence level. The DER (1.84) and RPD (105%) for TMF-0007 are outside the acceptable limit. The gross alpha result for sample TMF-0007 was greater than sum of the alpha emitters. This may be due to heterogeneity or missing activity as analyzed for by individual analysis. Since the gross alpha analysis is an estimated value, no qualification of the gross alpha result for sample TMF-007 is necessary.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.62 - 4.54) for all samples are outside the acceptable limits as well as the RPD values (107 % - 149%). The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the total activity sum i.e., the sums of the beta emitters and the sum of alpha, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (1.75 – 3.22) for all samples are outside the acceptable limits as well as the RPD values (63.7%-117.1%). All samples have total activity results that are less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 1.6 to 2. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was less than the sum of the gross activities.

Tonwanda Data Summary Tables

0107029-1		TMF-0035					FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-2.00E-02	1.20E-01	-2.00E-02	1.20E-01	0.00	0.00	U
Ra-226	1.03E+00	2.70E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.80E-01	1.40E-01	8.60E-01	1.70E-01	0.36	9.76								
Th-230	7.30E-01	1.30E-01	8.70E-01	1.60E-01	0.68	17.5								
Th-232	8.00E-01	1.40E-01	8.50E-01	1.60E-01	0.24	6.06								
U-234	7.30E-01	2.10E-01												
U-235	7.40E-02	6.10E-02						1.00E-01	4.60E-01	2.20E-01	4.20E-01	0.19	75.0	U
U-238	5.80E-01	1.90E-01												
<b>Total U Alpha</b>	<b>1.38E+00</b>	<b>2.90E-01</b>												
<b>Alpha Sum</b>	<b>2.47E+00</b>	<b>2.65E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	5.80E-01	1.90E-01						1.00E+00	1.30E+00	6.20E-01	7.70E-01	0.25	46.9	U
Pa-234m (Assumed from U-238)	5.80E-01	1.90E-01						-2.40E+01	2.10E+01	1.00E+01	2.30E+01	1.09	486	U
K-40	1.64E+01	5.00E+00	1.54E+01	4.50E+00	0.15	6.29								
Ra-228	7.80E-01	6.50E-01	5.00E-01	3.80E-01	0.37	43.8								
Pa-231	-2.50E+00	2.90E+00	-4.00E-01	2.60E+00	0.54	145	U							
<b>Beta Sum</b>	<b>1.80E+01</b>	<b>5.06E+00</b>						<b>-6.12E+00</b>	<b>2.16E+01</b>	<b>2.65E+01</b>	<b>2.35E+01</b>			
<b>Total Activity Sum</b>	<b>2.05E+01</b>	<b>5.71E+00</b>						<b>-3.65E+00</b>	<b>2.18E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.40E+00	1.10E+00	5.20E+00	1.10E+00	0.13	3.77		1.02	(from gamma)			74.3		
Gross Beta	4.55E+00	9.80E-01	5.40E+00	1.00E+00	0.61	17.1	J	2.62	0.49			119		
Total Activity	8.40E+00	3.90E+00	1.05E+01	4.00E+00	0.38	22.2	J	1.75	0.54			83.8		

Tonwanda Data Summary Tables

0107029-2		TMF-0036					FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	2.30E-01					U
Ra-226	1.74E+00	3.60E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	1.70E-01												
Th-230	6.90E-01	1.30E-01												
Th-232	8.00E-01	1.40E-01												
U-234	8.60E-01	2.30E-01	7.60E-01	2.10E-01	0.16	5.13								
U-235	9.90E-02	7.10E-02	1.33E-01	8.20E-02	0.31	29.3		-3.00E-02	2.70E-01					U
U-238	8.40E-01	2.30E-01	9.50E-01	2.50E-01	0.32	12.3								
<b>Total U Alpha</b>	<b>2.60E+00</b>	<b>2.78E-01</b>	<b>1.84E+00</b>	<b>3.37E-01</b>										
<b>Alpha Sum</b>	<b>4.89E+00</b>	<b>1.29E+00</b>	<b>1.84E+00</b>	<b>3.37E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.40E-01	2.30E-01	9.50E-01	2.50E-01	0.32	12.3		6.20E-01	7.50E-01					
Pa-234m (Assumed from U-238)	8.40E-01	2.30E-01	9.50E-01	2.50E-01	0.32	12.3		-5.00E-01	6.90E+00					U
K-40	1.75E+01	3.20E+00												
Ra-228	6.50E-01	1.70E-01												
Pa-231	-1.20E+00	1.30E+00					U							
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.22E+00</b>	<b>1.90E+00</b>	<b>3.54E-01</b>				<b>1.81E+01</b>	<b>7.65E+00</b>					
<b>Total Activity Sum</b>	<b>2.46E+01</b>	<b>3.47E+00</b>	<b>3.74E+00</b>	<b>4.88E-01</b>				<b>2.30E+01</b>	<b>7.76E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.60E+00	1.20E+00						0.97	(from gamma)					29.8
Gross Beta	5.60E+00	1.10E+00					J	4.13	1.62					111
Total Activity	1.27E+01	4.00E+00					J	2.24	1.18					63.7

Tonwanda Data Summary Tables

0107029-3		TMF-0037				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.00E-02	3.40E-01	-5.00E-02	2.70E-01	0.21	1800.0	U
Ra-226	1.40E+00	3.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.25E+00	2.30E-01												
Th-230	1.11E+00	2.00E-01												
Th-232	1.10E+00	2.00E-01												
U-234	9.80E-01	2.60E-01												
U-235	1.90E-01	1.00E-01						8.00E-02	3.40E-01	-1.80E-01	3.20E-01	0.56	520	U
U-238	9.20E-01	2.50E-01												
<b>Total U Alpha</b>	<b>2.09E+00</b>	<b>3.74E-01</b>												
<b>Alpha Sum</b>	<b>6.32E+00</b>	<b>1.90E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.20E-01	2.50E-01						6.00E-01	1.20E+00	7.30E-01	9.60E-01	0.08	19.5	U
Pa-234m (Assumed from U-238)	9.20E-01	2.50E-01						-1.10E+00	9.90E+00	8.40E+00	8.90E+00	0.71	260	U
K-40	1.84E+01	3.80E+00	2.10E+01	3.80E+00	0.48	13.2								
Ra-228	6.30E-01	2.40E-01	6.80E-01	2.00E-01	0.16	7.63								
Pa-231	-7.00E-01	2.00E+00	2.00E-01	2.00E+00	0.32	360	U							
<b>Beta Sum</b>	<b>2.08E+01</b>	<b>3.83E+00</b>						<b>1.84E+01</b>	<b>1.07E+01</b>	<b>3.08E+01</b>	<b>9.73E+00</b>			
<b>Total Activity Sum</b>	<b>2.71E+01</b>	<b>4.28E+00</b>						<b>2.48E+01</b>	<b>1.08E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.60E+00	1.10E+00						0.33	(from gamma)			12.1		
Gross Beta	4.16E+00	8.50E-01					J	4.24	1.33			133		
Total Activity	1.01E+01	4.00E+00					J	2.90	1.27			91.4		

Tonwanda Data Summary Tables

Analyses	TMF-0038				FROM GAMMA								Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)			
Am-241							-1.90E-01	3.10E-01					U
Ra-226	1.01E+00	2.70E-01											
Np-237													
Pu-238													
Pu-239													
Th-228	8.40E-01	1.70E-01											
Th-230	8.70E-01	1.60E-01											
Th-232	7.90E-01	1.50E-01											
U-234	6.20E-01	1.80E-01											
U-235	9.00E-02	6.00E-02					-3.10E-01	4.00E-01					U
U-238	7.30E-01	2.00E-01											
<b>Total U Alpha</b>	<b>1.44E+00</b>	<b>2.76E-01</b>											
<b>Alpha Sum</b>	<b>4.50E+00</b>	<b>2.04E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01					1.20E+00	1.00E+00					
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01					1.00E+00	1.40E+01					U
K-40	1.78E+01	3.80E+00											
Ra-228	7.20E-01	2.90E-01											
Pa-231	-5.00E-01	2.20E+00											U
<b>Beta Sum</b>	<b>1.99E+01</b>	<b>3.83E+00</b>					<b>2.07E+01</b>	<b>1.45E+01</b>					
<b>Total Activity Sum</b>	<b>2.44E+01</b>	<b>4.34E+00</b>					<b>2.52E+01</b>	<b>1.47E+01</b>					
<b>DER (sums to gross)</b>													
Gross Alpha	7.70E+00	1.40E+00					1.29	(from gamma)					52.5
Gross Beta	6.00E+00	1.10E+00				J	3.49	1.00					107
Total Activity	9.70E+00	3.90E+00				J	2.52	1.02					86.3

Tonwanda Data Summary Tables

0107029-5		TMF-0039				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.00E-02	1.10E-01					U
Ra-226	1.22E+00	2.80E-01	1.27E+00	2.70E-01	0.13	4.02								
Np-237														
Pu-238														
Pu-239														
Th-228	1.11E+00	1.90E-01	1.30E+00	2.20E-01	0.65	15.8								
Th-230	1.03E+00	1.70E-01	1.11E+00	1.90E-01	0.31	7.48								
Th-232	1.04E+00	1.70E-01	1.17E+00	2.00E-01	0.50	11.8								
U-234	8.70E-01	2.30E-01												
U-235	2.90E-02	3.80E-02					U	1.20E-01	3.40E-01					U
U-238	9.50E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.85E+00</b>	<b>3.35E-01</b>												
<b>Alpha Sum</b>	<b>5.53E+00</b>	<b>1.88E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.50E-01	2.40E-01						6.40E-01	6.60E-01					
Pa-234m (Assumed from U-238)	9.50E-01	2.40E-01						1.00E+00	1.40E+01					U
K-40	1.99E+01	4.40E+00												
Ra-228	9.40E-01	3.50E-01												
Pa-231	-8.00E-01	2.00E+00					U							
<b>Beta Sum</b>	<b>2.26E+01</b>	<b>4.43E+00</b>						<b>2.24E+01</b>	<b>1.47E+01</b>					
<b>Total Activity Sum</b>	<b>2.82E+01</b>	<b>4.81E+00</b>						<b>2.79E+01</b>	<b>1.48E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.50E+00	1.30E+00						0.86	(from gamma)					30.3
Gross Beta	6.20E+00	1.10E+00					J	3.60	1.10					114
Total Activity	1.22E+01	4.10E+00					J	2.53	1.02					79.1



Tonwanda Data Summary Tables

0107029-6		TMF-0040				FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								1.30E-01	1.10E-01						
Ra-226	7.80E-01	2.20E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	9.60E-01	1.70E-01													
Th-230	7.30E-01	1.30E-01													
Th-232	8.30E-01	1.40E-01													
U-234	9.00E-01	2.30E-01	8.80E-01	2.30E-01	0.06	2.25									
U-235	3.10E-02	3.60E-02	5.20E-02	4.80E-02	0.35	50.6		3.00E-02	2.60E-01					U	
U-238	8.40E-01	2.20E-01	9.70E-01	2.40E-01	0.40	14.4									
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.20E-01</b>	<b>1.90E+00</b>	<b>3.36E-01</b>											
<b>Alpha Sum</b>	<b>4.35E+00</b>	<b>1.43E+00</b>	<b>1.90E+00</b>	<b>3.36E-01</b>											
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	8.40E-01	2.20E-01	9.70E-01	2.40E-01	0.40	14.4		1.24E+00	7.80E-01						
Pa-234m (Assumed from U-238)	8.40E-01	2.20E-01	9.70E-01	2.40E-01	0.40	14.4		5.00E+00	1.10E+01					U	
K-40	2.08E+01	4.30E+00													
Ra-228	7.70E-01	2.60E-01													
Pa-231	-8.00E-01	1.50E+00													
<b>Beta Sum</b>	<b>2.32E+01</b>	<b>4.32E+00</b>	<b>1.94E+00</b>	<b>3.39E-01</b>				<b>2.77E+01</b>	<b>1.18E+01</b>						
<b>Total Activity Sum</b>	<b>2.75E+01</b>	<b>4.55E+00</b>	<b>3.84E+00</b>	<b>4.77E-01</b>				<b>3.21E+01</b>	<b>1.19E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.10E+00	1.00E+00						0.43	(from gamma)			15.9			
Gross Beta	4.49E+00	9.20E-01						4.22	1.96			135			
Total Activity	9.60E+00	3.90E+00						2.99	1.79			96.5			

Tonwanda Data Summary Tables

0107029-7		TMF-0015				FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								5.00E-02	1.70E-01	-1.00E-01	3.50E-01	<b>0.39</b>	<b>600.0</b>	U	
Ra-226	9.10E-01	2.20E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	9.80E-01	2.00E-01													
Th-230	9.50E-01	1.80E-01													
Th-232	1.00E+00	1.90E-01													
U-234	8.30E-01	2.20E-01													
U-235	7.20E-02	5.80E-02						-1.10E-01	2.70E-01	2.30E-01	3.30E-01	<b>0.80</b>	<b>567</b>	U	
U-238	7.60E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>3.10E-01</b>													
<b>Alpha Sum</b>	<b>4.78E+00</b>	<b>1.27E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.60E-01	2.10E-01						8.20E-01	6.70E-01	1.20E+00	1.00E+00	<b>0.32</b>	<b>37.6</b>		
Pa-234m (Assumed from U-238)	7.60E-01	2.10E-01						-1.40E+00	8.20E+00	0.00E+00	1.10E+01	<b>0.10</b>	<b>200</b>	U	
K-40	1.96E+01	3.60E+00	1.92E+01	3.90E+00	<b>0.08</b>	<b>2.06</b>									
Ra-228	8.20E-01	2.20E-01	8.10E-01	2.70E-01	<b>0.03</b>	<b>1.23</b>									
Pa-231	-8.00E-01	1.30E+00	0.00E+00	1.80E+00	<b>0.36</b>	<b>200</b>	U								
<b>Beta Sum</b>	<b>2.18E+01</b>	<b>3.62E+00</b>						<b>1.97E+01</b>	<b>8.98E+00</b>	<b>2.12E+01</b>	<b>1.17E+01</b>				
<b>Total Activity Sum</b>	<b>2.66E+01</b>	<b>3.84E+00</b>						<b>2.45E+01</b>	<b>9.07E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.80E+00	1.10E+00						<b>0.60</b>	(from gamma)			<b>19.2</b>			
Gross Beta	5.00E+00	9.30E-01						<b>4.50</b>	<b>1.63</b>			<b>125</b>			
Total Activity	9.00E+00	3.90E+00						<b>3.22</b>	<b>1.57</b>			<b>99.0</b>			

Tonwanda Data Summary Tables

0107029-8		TMF-0016				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.70E-01	5.30E-01					U
Ra-226	9.10E-01	2.80E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.30E-01	1.90E-01												
Th-230	8.40E-01	1.60E-01												
Th-232	8.60E-01	1.60E-01												
U-234	7.50E-01	2.10E-01												
U-235	1.09E-01	7.30E-02						-6.00E-02	3.20E-01					U
U-238	7.70E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.63E+00</b>	<b>3.06E-01</b>												
<b>Alpha Sum</b>	<b>3.82E+00</b>	<b>1.78E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.70E-01	2.10E-01						6.00E-01	1.20E+00					U
Pa-234m (Assumed from U-238)	7.70E-01	2.10E-01						9.00E+00	1.20E+01					U
K-40	2.05E+01	4.30E+00												
Ra-228	8.40E-01	3.20E-01												
Pa-231	-1.50E+00	1.90E+00												U
<b>Beta Sum</b>	<b>2.27E+01</b>	<b>4.33E+00</b>						<b>3.08E+01</b>	<b>1.28E+01</b>					
<b>Total Activity Sum</b>	<b>2.65E+01</b>	<b>4.68E+00</b>						<b>3.46E+01</b>	<b>1.29E+01</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.10E+00	1.00E+00						<b>0.63</b>	<b>(from gamma)</b>					<b>28.7</b>
Gross Beta	4.60E+00	9.10E-01					J	<b>4.09</b>	<b>2.04</b>					<b>133</b>
Total Activity	1.13E+01	4.00E+00					J	<b>2.47</b>	<b>1.72</b>					<b>80.5</b>

Tonwanda Data Summary Tables

0107029-9		TMF-0007				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-8.00E-02	3.40E-01					U
Ra-226	1.08E+00	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.20E-01	1.90E-01												
Th-230	9.30E-01	1.80E-01												
Th-232	9.30E-01	1.80E-01												
U-234	1.15E+00	3.10E-01												
U-235	5.90E-02	6.00E-02						-2.40E-01	4.20E-01					U
U-238	9.70E-01	2.70E-01												
<b>Total U Alpha</b>	<b>2.18E+00</b>	<b>4.15E-01</b>												
<b>Alpha Sum</b>	<b>2.26E+00</b>	<b>2.41E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.70E-01	2.70E-01						6.00E-01	1.30E+00					U
Pa-234m (Assumed from U-238)	9.70E-01	2.70E-01						-1.00E+00	1.40E+01					U
K-40	2.23E+01	4.50E+00												
Ra-228	8.00E-01	2.80E-01												
Pa-231	-4.20E+00	2.60E+00												
<b>Beta Sum</b>	<b>2.45E+01</b>	<b>4.54E+00</b>												
<b>Total Activity Sum</b>	<b>2.68E+01</b>	<b>5.14E+00</b>												
UJ														
								<b>2.22E+01</b>	<b>1.48E+01</b>					
								<b>2.45E+01</b>	<b>1.50E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.30E+00	1.30E+00						1.84	(from gamma)			105		
Gross Beta	7.10E+00	1.20E+00					J	3.72	1.02			110		
Total Activity	1.18E+01	4.10E+00					J	2.28	0.82			77.7		

Tonwanda Data Summary Tables

0107029-10		TMF-0008				FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)
Am-241								-9.20E-02	9.30E-02			U	
Ra-226	9.50E-01	3.90E-01	7.40E-01	2.00E-01	0.48	24.9							
Np-237													
Pu-238													
Pu-239													
Th-228	8.90E-01	1.60E-01											
Th-230	8.10E-01	1.40E-01											
Th-232	8.40E-01	1.50E-01											
U-234	7.90E-01	2.10E-01											
U-235	4.80E-02	4.80E-02						-7.00E-02	2.70E-01			U	
U-238	7.30E-01	2.00E-01											
<b>Total U Alpha</b>	<b>1.57E+00</b>	<b>2.94E-01</b>											
<b>Alpha Sum</b>	<b>5.06E+00</b>	<b>1.08E+01</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01						1.05E+00	6.30E-01				
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01						-7.00E-01	1.90E+00			U	
K-40	1.65E+01	3.80E+00											
Ra-228	7.00E-01	3.40E-01											
Pa-231	0.00E+00	1.20E+01											
<b>Beta Sum</b>	<b>1.87E+01</b>	<b>4.09E+00</b>						<b>1.76E+01</b>	<b>4.54E+00</b>				
<b>Total Activity Sum</b>	<b>2.37E+01</b>	<b>1.16E+01</b>						<b>2.26E+01</b>	<b>1.17E+01</b>				
								<u>DER (sums to gross)</u>		<u>RPD (sums to gross)</u>			
Gross Alpha	5.90E+00	1.10E+00	6.20E+00	1.20E+00	0.18	4.96		0.08	(from gamma)	15.4			
Gross Beta	5.16E+00	9.60E-01	4.32E+00	8.80E-01	0.65	17.7	J	3.22	2.67	113			
Total Activity	1.22E+01	4.00E+00	8.50E+00	3.90E+00	0.66	35.7	J	0.94	0.84	64.1			

Tonwanda Data Summary Tables

0107029-11		TMF-0001				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								0.00E+00	1.10E-01					U
Ra-226	1.23E+00	2.70E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	6.70E-01	1.30E-01												
Th-230	7.00E-01	1.30E-01												
Th-232	6.60E-01	1.20E-01												
U-234	7.10E-01	2.10E-01												
U-235	7.80E-02	6.40E-02						1.30E-01	2.80E-01					U
U-238	9.80E-01	2.50E-01												
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.33E-01</b>												
<b>Alpha Sum</b>	<b>4.67E+00</b>	<b>1.69E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.80E-01	2.50E-01						1.10E+00	6.70E-01					
Pa-234m (Assumed from U-238)	9.80E-01	2.50E-01						-7.40E+00	9.80E+00					U
K-40	1.91E+01	4.10E+00												
Ra-228	6.90E-01	2.90E-01												
Pa-231	-4.00E-01	1.80E+00												
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>4.13E+00</b>												
<b>Total Activity Sum</b>	<b>2.64E+01</b>	<b>4.46E+00</b>												
U														
								<b>1.34E+01</b>	<b>1.07E+01</b>					
								<b>1.81E+01</b>	<b>1.08E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
								<b>1.14</b>	<b>(from gamma)</b>			<b>41.3</b>		
Gross Alpha	7.10E+00	1.30E+00						<b>4.08</b>	<b>0.85</b>			<b>133</b>		
Gross Beta	4.38E+00	9.70E-01						<b>2.98</b>	<b>0.82</b>			<b>101</b>		
Total Activity	8.70E+00	3.90E+00												

Tonwanda Data Summary Tables

0107029-12		TMF-0002				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.50E-01	1.60E-01					
Ra-226	4.20E-01	1.60E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.70E-01	1.70E-01												
Th-230	7.60E-01	1.30E-01												
Th-232	8.50E-01	1.50E-01												
U-234	7.80E-01	2.10E-01												
U-235	1.50E-01	8.50E-02						-8.00E-02	2.60E-01					U
U-238	6.40E-01	1.90E-01												
<b>Total U Alpha</b>	<b>1.57E+00</b>	<b>2.96E-01</b>												
<b>Alpha Sum</b>	<b>5.02E+00</b>	<b>1.16E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	6.40E-01	1.90E-01						3.10E-01	6.50E-01					U
Pa-234m (Assumed from U-238)	6.40E-01	1.90E-01						3.00E+00	6.80E+00					U
K-40	1.77E+01	3.30E+00												
Ra-228	7.00E-01	1.90E-01												
Pa-231	5.00E-01	1.20E+00												
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.32E+00</b>						<b>2.18E+01</b>	<b>7.59E+00</b>					
<b>Total Activity Sum</b>	<b>2.48E+01</b>	<b>3.52E+00</b>						<b>2.68E+01</b>	<b>7.68E+00</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.50E+00	1.20E+00						0.29	(from gamma)			9.13		
Gross Beta	5.30E+00	1.00E+00						J 4.17	2.15			115		
Total Activity	1.13E+01	4.00E+00						J 2.53	1.79			74.7		

Tonwanda Data Summary Tables

0107029-13		TMF-0009				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	1.20E-01					U
Ra-226	9.70E-01	2.70E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.80E-01	1.80E-01												
Th-230	7.80E-01	1.40E-01												
Th-232	7.60E-01	1.40E-01												
U-234	7.80E-01	2.30E-01												
U-235	6.10E-02	5.90E-02						-3.30E-01	3.80E-01					U
U-238	6.20E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.46E+00</b>	<b>3.10E-01</b>												
<b>Alpha Sum</b>	<b>5.13E+00</b>	<b>2.39E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	6.20E-01	2.00E-01						1.00E-01	1.00E+00					U
Pa-234m (Assumed from U-238)	6.20E-01	2.00E-01						3.00E+00	2.20E+01					U
K-40	1.67E+01	4.90E+00												
Ra-228	5.60E-01	5.90E-01												
Pa-231	2.00E-01	2.60E+00												
<b>Beta Sum</b>	<b>1.85E+01</b>	<b>4.95E+00</b>						<b>2.04E+01</b>	<b>2.26E+01</b>					
<b>Total Activity Sum</b>	<b>2.37E+01</b>	<b>5.50E+00</b>						<b>2.55E+01</b>	<b>2.27E+01</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.60E+00	1.10E+00						<b>0.18</b>	<b>(from gamma)</b>					<b>8.74</b>
Gross Beta	4.93E+00	9.80E-01					J	<b>2.69</b>	<b>0.68</b>					<b>116</b>
Total Activity	1.01E+01	4.00E+00					J	<b>1.99</b>	<b>0.67</b>					<b>80.3</b>



Tonwanda Data Summary Tables

0107029-14		TMF-0010				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	1.20E-01					U
Ra-226	8.90E-01	3.40E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.50E-01	1.40E-01												
Th-230	7.70E-01	1.40E-01												
Th-232	7.80E-01	1.40E-01												
U-234	8.50E-01	2.30E-01												
U-235	3.60E-02	4.30E-02						2.30E-01	4.10E-01					U
U-238	8.90E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.78E+00</b>	<b>3.35E-01</b>												
<b>Alpha Sum</b>	<b>5.42E+00</b>	<b>2.31E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.90E-01	2.40E-01						1.37E+00	7.70E-01					
Pa-234m (Assumed from U-238)	8.90E-01	2.40E-01						-1.40E+01	1.70E+01					U
K-40	1.57E+01	4.20E+00												
Ra-228	8.20E-01	3.80E-01												
Pa-231	5.00E-01	2.50E+00												
<b>Beta Sum</b>	<b>1.84E+01</b>	<b>4.24E+00</b>						<b>3.95E+00</b>	<b>1.75E+01</b>					
<b>Total Activity Sum</b>	<b>2.38E+01</b>	<b>4.83E+00</b>						<b>9.37E+00</b>	<b>1.77E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.50E+00	1.20E+00						0.42	(from gamma)			18.2		
Gross Beta	5.24E+00	9.70E-01						3.02	0.07			111		
Total Activity	9.60E+00	3.90E+00						2.28	0.01			84.9		

Tonwanda Data Summary Tables

0107029-15		TMF-9019				FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								-4.00E-02	3.20E-01	-1.00E-01	3.50E-01	0.13	85.7	U		
Ra-226	1.02E+00	2.80E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	7.80E-01	1.40E-01														
Th-230	7.80E-01	1.40E-01														
Th-232	7.70E-01	1.40E-01														
U-234	7.50E-01	2.10E-01														
U-235	6.60E-02	5.50E-02						3.80E-01	3.80E-01	2.30E-01	3.30E-01	0.30	49.2			
U-238	7.20E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.54E+00</b>	<b>2.95E-01</b>														
<b>Alpha Sum</b>	<b>3.81E+00</b>	<b>3.01E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.20E-01	2.00E-01						5.00E-01	1.00E+00	1.20E+00	1.00E+00	0.49	82.4	U		
Pa-234m (Assumed from U-238)	7.20E-01	2.00E-01						6.00E+00	1.20E+01	0.00E+00	1.10E+01	0.37	200	U		
K-40	1.57E+01	3.40E+00	1.92E+01	3.90E+00	0.68	20.1										
Ra-228	6.20E-01	2.50E-01	8.10E-01	2.70E-01	0.52	26.6										
Pa-231	-1.20E+00	3.30E+00														
<b>Beta Sum</b>	<b>1.76E+01</b>	<b>3.44E+00</b>						<b>2.27E+01</b>	<b>1.25E+01</b>	<b>2.12E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.14E+01</b>	<b>4.57E+00</b>						<b>2.65E+01</b>	<b>1.29E+01</b>							
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	4.73E+00	9.90E-01						0.29	(from gamma)		21.6					
Gross Beta	4.23E+00	8.70E-01					J	3.77	1.47		123					
Total Activity	5.60E+00	3.80E+00					J	2.66	1.56		117					

Tonwanda Data Summary Tables

0107029-16		TMF-9020				FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								-8.00E-02	1.10E-01					U		
Ra-226	8.10E-01	2.50E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	8.90E-01	1.50E-01														
Th-230	8.50E-01	1.40E-01														
Th-232	8.20E-01	1.40E-01														
U-234	9.10E-01	2.30E-01														
U-235	9.50E-02	6.40E-02						-2.20E-01	4.00E-01					U		
U-238	8.40E-01	2.20E-01														
<b>Total U Alpha</b>	<b>1.85E+00</b>	<b>3.25E-01</b>														
<b>Alpha Sum</b>	<b>6.12E+00</b>	<b>3.36E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	8.40E-01	2.20E-01						6.30E-01	6.70E-01							
Pa-234m (Assumed from U-238)	8.40E-01	2.20E-01						-7.00E+00	2.10E+01					U		
K-40	1.59E+01	4.50E+00														
Ra-228	8.70E-01	3.70E-01														
Pa-231	1.00E+00	3.70E+00														
<b>Beta Sum</b>	<b>1.86E+01</b>	<b>4.55E+00</b>						<b>1.05E+01</b>	<b>2.15E+01</b>							
<b>Total Activity Sum</b>	<b>2.47E+01</b>	<b>5.66E+00</b>						<b>1.66E+01</b>	<b>2.18E+01</b>							
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	5.20E+00	1.10E+00						0.26	(from gamma)			16.2				
Gross Beta	5.13E+00	9.80E-01						J 2.89	0.25			113				
Total Activity	9.40E+00	3.90E+00						J 2.22	0.33			89.7				

Tonwanda Data Summary Tables

0107029-17		TMF-0017				FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								-3.00E-02	1.20E-01					U		
Ra-226	8.20E-01	2.20E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	9.60E-01	1.70E-01														
Th-230	8.80E-01	1.60E-01														
Th-232	8.20E-01	1.50E-01														
U-234	7.50E-01	2.00E-01														
U-235	9.60E-02	6.40E-02						4.00E-02	3.60E-01					U		
U-238	7.70E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>2.90E-01</b>														
<b>Alpha Sum</b>	<b>3.75E+00</b>	<b>2.38E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.70E-01	2.00E-01						8.00E-01	1.20E+00					U		
Pa-234m (Assumed from U-238)	7.70E-01	2.00E-01						6.00E+00	1.30E+01					U		
K-40	2.12E+01	5.30E+00														
Ra-228	7.80E-01	4.10E-01														
Pa-231	-1.50E+00	2.60E+00														
<b>Beta Sum</b>	<b>2.33E+01</b>	<b>5.33E+00</b>						<b>2.86E+01</b>	<b>1.41E+01</b>							
<b>Total Activity Sum</b>	<b>2.71E+01</b>	<b>5.84E+00</b>						<b>3.23E+01</b>	<b>1.43E+01</b>							
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	4.40E+00	1.00E+00						0.25	(from gamma)			16.1				
Gross Beta	3.41E+00	8.30E-01						J 3.69	1.78			149				
Total Activity	8.70E+00	3.90E+00						J 2.62	1.60			103				

Tonwanda Data Summary Tables

0107029-18		TMF-0018				FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)
Am-241								1.80E-01	5.40E-01			U	
Ra-226	9.20E-01	2.20E-01											
Np-237													
Pu-238													
Pu-239													
Th-228	9.70E-01	1.60E-01											
Th-230	8.90E-01	1.50E-01											
Th-232	9.20E-01	1.50E-01											
U-234	9.60E-01	2.40E-01											
U-235	1.67E+00	8.50E-02						-2.50E-01	3.60E-01			U	
U-238	9.40E-01	2.30E-01											
<b>Total U Alpha</b>	<b>3.57E+00</b>	<b>3.43E-01</b>											
<b>Alpha Sum</b>	<b>5.74E+00</b>	<b>1.95E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	9.40E-01	2.30E-01						1.00E+00	1.30E+00			U	
Pa-234m (Assumed from U-238)	9.40E-01	2.30E-01						-2.00E+00	1.30E+01			U	
K-40	1.73E+01	3.80E+00											
Ra-228	5.40E-01	2.90E-01											
Pa-231	-1.70E+00	2.10E+00											
<b>Beta Sum</b>	<b>1.95E+01</b>	<b>3.83E+00</b>						<b>1.66E+01</b>	<b>1.36E+01</b>				
<b>Total Activity Sum</b>	<b>2.53E+01</b>	<b>4.30E+00</b>						<b>2.24E+01</b>	<b>1.38E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	4.81E+00	9.60E-01						0.43	(from gamma)			17.6	
Gross Beta	4.18E+00	8.30E-01						J 3.91	0.91			129	
Total Activity	1.19E+01	4.00E+00						J 2.27	0.73			71.9	

Tonwanda Data Summary Tables

0107029-19		TMF-0027				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.00E-02	2.80E-01					U
Ra-226	8.90E-01	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.30E-01	1.70E-01												
Th-230	7.80E-01	1.40E-01												
Th-232	8.50E-01	1.50E-01												
U-234	7.20E-01	2.00E-01												
U-235	1.35E-01	8.00E-02						-2.10E-01	3.10E-01					U
U-238	8.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.72E+00</b>	<b>3.15E-01</b>												
<b>Alpha Sum</b>	<b>4.18E+00</b>	<b>2.21E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01						1.20E+00	1.00E+00					
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01						7.40E+00	7.90E+00					
K-40	1.80E+01	3.40E+00												
Ra-228	7.90E-01	2.00E-01												
Pa-231	-1.10E+00	2.40E+00												U
<b>Beta Sum</b>	<b>2.04E+01</b>	<b>3.43E+00</b>						<b>2.73E+01</b>	<b>8.67E+00</b>					
<b>Total Activity Sum</b>	<b>2.46E+01</b>	<b>4.08E+00</b>						<b>3.14E+01</b>	<b>8.94E+00</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.60E+00	1.10E+00						<b>0.58</b>	<b>(from gamma)</b>					<b>29.2</b>
Gross Beta	4.26E+00	9.10E-01					J	<b>4.54</b>	<b>2.64</b>					<b>131</b>
Total Activity	6.80E+00	3.90E+00					J	<b>3.14</b>	<b>2.52</b>					<b>113</b>

Tonwanda Data Summary Tables

0107029-20		TMF-0028				FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								2.50E-01	3.50E-01					U		
Ra-226	1.18E+00	2.80E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	8.00E-01	1.50E-01														
Th-230	8.60E-01	1.50E-01														
Th-232	8.70E-01	1.60E-01														
U-234	7.40E-01	2.00E-01														
U-235	8.90E-02	6.60E-02						7.00E-02	3.20E-01					U		
U-238	8.00E-01	2.10E-01														
<b>Total U Alpha</b>	<b>1.63E+00</b>	<b>2.97E-01</b>														
<b>Alpha Sum</b>	<b>5.16E+00</b>	<b>1.61E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	8.00E-01	2.10E-01						6.00E-02	8.50E-01					U		
Pa-234m (Assumed from U-238)	8.00E-01	2.10E-01						1.00E+00	1.10E+01					U		
K-40	1.71E+01	3.60E+00														
Ra-228	7.70E-01	2.40E-01														
Pa-231	-2.00E-01	1.70E+00														
<b>Beta Sum</b>	<b>1.94E+01</b>	<b>3.63E+00</b>						<b>1.89E+01</b>	<b>1.16E+01</b>							
<b>Total Activity Sum</b>	<b>2.46E+01</b>	<b>3.97E+00</b>						<b>2.41E+01</b>	<b>1.17E+01</b>							
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	4.02E+00	9.10E-01						<b>0.62</b>	<b>(from gamma)</b>					<b>24.8</b>		
Gross Beta	4.37E+00	8.70E-01					J	<b>4.04</b>	<b>1.25</b>					<b>127</b>		
Total Activity	9.60E+00	3.90E+00					J	<b>2.70</b>	<b>1.17</b>					<b>87.7</b>		

## Radiological Analytical Data Verification Comments on Data for SDG 0107030

This sample delivery group (SDG) contained twenty (20) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 6, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0041	0107030-1
TMF-0042	0107030-2
TMF-0053	0107030-3
TMF-0054	0107030-4
TMF-0055	0107030-5
TMF-0056	0107030-6
TMF-0057	0107030-7
TMF-0058	0107030-8
TMF-0061	0107030-9
TMF-0062	0107030-10
TMF-0067	0107030-11
TMF-0068	0107030-12
TMF-0069	0107030-13
TMF-0070	0107030-14
TMF-0073	0107030-15
TMF-0074	0107030-16
TMF-0075	0107030-17
TMF-0076	0107030-18
TMF-0079	0107030-19
TMF-0080	0107030-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:



$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was reported by the laboratory in the EQ-1 and EQ-02 equipment rinsate blanks. However,  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for equipment rinsate sample # EQ-1. All associated sample results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). There was  $^{137}\text{Cs}$  activity reported for sample TMF-0055. The reported  $^{137}\text{Cs}$  result is greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification of  $^{137}\text{Cs}$  results in the sample is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits for the gamma spectrometry analysis.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

## Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Results for natural  $^{40}\text{K}$  were also reported for all samples. There was  $^{137}\text{Cs}$  activity reported for sample TMF-0055 at an activity concentration of  $(7.8\text{E-}02 \pm 4.4\text{E-}02)$ . There were no incidents of identified radionuclides being excluded from the laboratory reports.

In addition,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples. The  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{232}\text{Th}$  and  $^{238}\text{U}$  series. These reported radionuclides may be due to near or total equilibrium with  $^{232}\text{Th}$  and  $^{238}\text{U}$ . The presence of  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  in the stated concentration is not out of the question for these samples considering the amount of  $^{232}\text{Th}$  and  $^{238}\text{U}$  present. **Inclusion of  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is recommended for information purposes only since any modeling will assume equilibrium with parent  $^{232}\text{Th}$  and  $^{238}\text{U}$ .**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtraction was indicated for the  $^{231}\text{Pa}$  result for sample TMF-0061  $(-2.5 \pm 1.9)$ . **It is recommended that the  $^{231}\text{Pa}$  result for sample TMF-0061 be qualified as estimated (J).** No other problems were observed for the gamma spectrometry analyses.

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was an indication of blank contamination for  $^{230}\text{Th}$  results in method blank. Also there was an indication of blank contamination for  $^{234}\text{U}$  result in method blank associated with sample TMF-0075. All associated samples results less than 5 times the blank value for  $^{230}\text{Th}$  and  $^{234}\text{U}$  analyses should be qualified as estimated (J). For sample TMF-0075 the  $^{234}\text{U}$  results is greater than 5 times the  $^{234}\text{U}$  concentrations identified in the method blank. No qualification of  $^{234}\text{U}$  results for sample TMF-0075 is necessary. However, for all samples except sample TMF-0079, the  $^{230}\text{Th}$  results are less than 5 times the  $^{230}\text{Th}$  concentrations identified in the method blank. **Therefore, it is recommended that  $^{230}\text{Th}$  results for samples TMF-0041, TMF-0042, TMF-0053, TMF-0054, TMF-0055, TMF-0056, TMF-0057, TMF-0058, TMF-0061, TMF-0062, TMF-0067, TMF-0068, TMF-0069, TMF-0070, TMF-0073, TMF-0074, TMF-0075, TMF-0076 and TMF-0080 be qualified as estimated (J).**

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis. There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5

times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No further qualification of the alpha isotopic results is necessary.

#### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

#### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 16.48% for all samples for the alpha analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty. No qualification of is required.

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium.

### **3.0 $^{226}\text{Ra}$ ANALYSES**

#### Method Blank:

There is no indication of blank contamination either in the method blank sample for the  $^{226}\text{Ra}$  analysis.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the  $^{226}\text{Ra}$  analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

#### Duplicate Analysis:

One of the two duplicate DERs (1.69) is outside acceptable limits for the  $^{226}\text{Ra}$  analysis. The RPD (72.7%) was also outside acceptable limits. **Therefore it is recommended that the  $^{226}\text{Ra}$  results for all samples be qualified as estimated (J).**

Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

#### **4.0 GROSS ALPHA AND BETA ANALYSIS**

Method Blank:

There was no indication of blank contamination in the method blank for the gross alpha/beta analyses.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING

### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses. Therefore, no qualification is necessary.

### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis.

### Duplicate Analysis:

The total activity analysis duplicate DER is within acceptable limits.

### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

### Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC. **It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs (1.32, 1.46) for gross alpha to sum of alpha activities for samples TMF-0055 and TMF-0061 respectively are outside the acceptable limits as well as the RPD values (52.7%, 74.6%), indicating that the gross alpha analyses for these samples do not agree with the sum of the alpha emitters within a 99% confidence level. The gross alpha results for sample TMF-0055 and TMF-0061 were greater than sum of the alpha emitters. This may be due to heterogeneity or missing activity as analyzed for by individual analysis. Since the gross alpha analysis is an estimated value, no qualification of the gross alpha result for these samples is necessary.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.72 to 4.86) for all samples are outside the acceptable limits as well as the RPD (93.2% to 131%) values. The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the sample preparation as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the sum of the alpha and beta emitters, the DERs for samples TMF-0041 (2.79), TMF-0042 (3.57), TMF-0054 (2.57), TMF-0055 (2.19), TMF-0056 (3.16), TMF-0057 (2.30), TMF-0058 (2.57), TMF-0061 (1.73), TMF-0062 (2.98), TMF-0067 (3.11), TMF-0068 (2.94), TMF-0069 (2.00), TMF-0074 (2.11), TMF-0075 (1.8), TMF-0076 (2.41), TMF-0079 (1.99), and TMF-0080 (2.99) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (93.5%, 116%, 81.3%, 66.3%, 90%, 95.9%, 59.2%, 105%, 107%, 84.5%, 63.9%, 71.3%, 57.6%, 69%, 60.2% and 84.8% respectively) are also outside acceptable limits. Samples TMF-0041, TMF-0042, TMF-0054, TMF-0055, TMF-0056, TMF-0057, TMF-0058, TMF-0061, TMF-0062, TMF-0067, TMF-0068, TMF-0069, TMF-0074, TMF-0075, TMF-0076, TMF-0079, and TMF-0080 have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 2.6 to 4. This is most likely due to a negative bias in the total activity results due to the sample preparation as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

$^{228}\text{Ac}$  Gamma and  $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.

**Tonawanda Data Summary Tables**

0107030-1	TMF-0041						FROM GAMMA						
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Val	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val
				Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)			
Am-241							-1.90E-01	2.30E-01	-1.80E-01	5.00E-01	<b>0.02</b>	<b>5.41</b>	U
Ra-226	9.60E-01	2.50E-01				J							
Np-237													
Pu-238													
Pu-239													
Th-228	7.00E-01	1.50E-01											
Th-230	6.30E-01	1.40E-01				J							
Th-232	6.90E-01	1.50E-01											
U-234	8.70E-01	2.30E-01											
U-235	5.30E-02	5.00E-02					-1.00E-02	2.70E-01	6.00E-02	3.30E-01	<b>0.16</b>	<b>280</b>	U
U-238	7.90E-01	2.10E-01											
<b>Total U Alpha</b>	<b>1.71E+00</b>	<b>3.15E-01</b>											
<b>Alpha Sum</b>	<b>4.06E+00</b>	<b>1.86E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	7.90E-01	2.10E-01					5.20E-01	7.40E-01	8.00E-01	9.80E-01	<b>0.23</b>	<b>42.4</b>	U
Pa-234m (Assumed from U-238)	7.90E-01	2.10E-01					3.10E+00	6.70E+00	-1.60E+00	9.50E+00	<b>0.40</b>	<b>627</b>	U
K-40	1.88E+01	3.40E+00	1.54E+01	3.20E+00	<b>0.73</b>	<b>19.9</b>							
Ra-228	7.30E-01	1.90E-01	9.00E-01	2.50E-01	<b>0.54</b>	<b>20.9</b>							
Pa-231	-7.00E-01	2.00E+00	-1.10E+00	1.80E+00	<b>0.15</b>	<b>44.4</b>							U
<b>Beta Sum</b>	<b>2.10E+01</b>	<b>3.43E+00</b>					<b>2.31E+01</b>	<b>7.56E+00</b>	<b>1.54E+01</b>	<b>1.01E+01</b>			
<b>Total Activity Sum</b>	<b>2.51E+01</b>	<b>3.90E+00</b>					<b>2.71E+01</b>	<b>7.78E+00</b>					
							<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.23E+00	1.00E+00	4.93E+00	9.80E-01	<b>0.21</b>	<b>5.91</b>	<b>0.55</b>	<b>(from gamma)</b>		<b>25.1</b>			
Gross Beta	4.68E+00	8.70E-01	4.78E+00	9.00E-01	<b>0.08</b>	<b>2.11</b>	<b>4.62</b>	<b>2.42</b>		<b>127</b>			
Total Activity	9.10E+00	4.20E+00	8.80E+00	4.20E+00	<b>0.05</b>	<b>3.35</b>	<b>2.79</b>	<b>2.04</b>		<b>93.5</b>			



Tonawanda Data Summary Tables

0107030-2			TMF-0042				FROM GAMMA								
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								8.00E-02	4.70E-01						U
Ra-226	1.10E+00	2.50E-01													J
Np-237															
Pu-238															
Pu-239															
Th-228	9.10E-01	2.00E-01	1.01E+00	2.10E-01	0.34	10.4									
Th-230	7.80E-01	1.70E-01	8.40E-01	1.70E-01	0.25	7.41	J								
Th-232	9.30E-01	1.90E-01	8.70E-01	1.80E-01	0.23	6.67									
U-234	9.20E-01	2.20E-01													
U-235	8.90E-02	5.90E-02						-8.00E-02	3.20E-01						U
U-238	8.40E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.85E+00</b>	<b>3.10E-01</b>													
<b>Alpha Sum</b>	<b>6.20E+00</b>	<b>1.53E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	8.40E-01	2.10E-01						6.00E-01	1.00E+00						U
Pa-234m (Assumed from U-238)	8.40E-01	2.10E-01						4.70E+00	8.30E+00						U
K-40	1.99E+01	3.90E+00													
Ra-228	7.00E-01	2.60E-01													
Pa-231	7.00E-01	1.60E+00													U
<b>Beta Sum</b>	<b>2.24E+01</b>	<b>3.92E+00</b>						<b>2.60E+01</b>	<b>9.23E+00</b>						
<b>Total Activity Sum</b>	<b>2.86E+01</b>	<b>4.21E+00</b>						<b>3.22E+01</b>	<b>9.36E+00</b>						
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>			
Gross Alpha	5.04E+00	9.70E-01						<b>0.64</b>	<b>(from gamma)</b>			<b>20.6</b>			
Gross Beta	4.56E+00	8.70E-01					J	<b>4.43</b>	<b>2.31</b>			<b>132</b>			
Total Activity	7.60E+00	4.10E+00					J	<b>3.57</b>	<b>2.41</b>			<b>116</b>			

Tonawanda Data Summary Tables

0107030-3	TMF-0053				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								1.00E-02	1.10E-01					U
Ra-226	7.80E-01	2.20E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.70E-01	1.70E-01												
Th-230	9.40E-01	1.90E-01					J							
Th-232	6.30E-01	1.40E-01												
U-234	8.10E-01	2.10E-01												
U-235	1.05E-01	6.70E-02						0.00E+00	3.30E-01					U
U-238	9.20E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.84E+00</b>	<b>3.19E-01</b>												
<b>Alpha Sum</b>	<b>4.95E+00</b>	<b>1.86E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.20E-01	2.30E-01						7.50E-01	9.00E-01					
Pa-234m (Assumed from U-238)	9.20E-01	2.30E-01						0.00E+00	1.20E+01					U
K-40	1.20E+01	3.20E+00												
Ra-228	5.90E-01	3.00E-01												
Pa-231	1.00E-01	2.00E+00					U							
<b>Beta Sum</b>	<b>1.44E+01</b>	<b>3.24E+00</b>						<b>1.34E+01</b>	<b>1.25E+01</b>					
<b>Total Activity Sum</b>	<b>1.94E+01</b>	<b>3.74E+00</b>						<b>1.83E+01</b>	<b>1.26E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.10E+00	1.30E+00						<b>0.95</b>	<b>(from gamma)</b>			<b>35.8</b>		
Gross Beta	5.26E+00	9.70E-01					J	<b>2.72</b>	<b>0.65</b>			<b>93.2</b>		
Total Activity	1.82E+01	5.80E+00					J	<b>0.17</b>	<b>0.01</b>			<b>6.32</b>		

Tonawanda Data Summary Tables

0107030-4	TMF-0054				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								6.60E-02	9.60E-02					U
Ra-226	1.09E+00	2.30E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.50E-01	2.20E-01												
Th-230	8.40E-01	1.80E-01					J							
Th-232	8.50E-01	1.80E-01												
U-234	8.10E-01	3.10E-01												
U-235	1.50E-01	1.20E-01						1.80E-01	2.60E-01					U
U-238	9.20E-01	3.30E-01												
<b>Total U Alpha</b>	<b>1.88E+00</b>	<b>4.68E-01</b>												
<b>Alpha Sum</b>	<b>5.16E+00</b>	<b>1.32E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.20E-01	3.30E-01						1.46E+00	9.30E-01					
Pa-234m (Assumed from U-238)	9.20E-01	3.30E-01						1.70E+00	8.40E+00					U
K-40	1.87E+01	3.80E+00												
Ra-228	6.70E-01	2.10E-01												
Pa-231	-5.00E-01	1.30E+00												
<b>Beta Sum</b>	<b>2.12E+01</b>	<b>3.84E+00</b>						<b>2.25E+01</b>	<b>9.27E+00</b>					
<b>Total Activity Sum</b>	<b>2.63E+01</b>	<b>4.06E+00</b>						<b>2.76E+01</b>	<b>9.36E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.40E+00	1.00E+00						<b>0.14</b>	<b>(from gamma)</b>			<b>4.55</b>		
Gross Beta	4.92E+00	9.20E-01					J	<b>4.11</b>	<b>1.88</b>			<b>125</b>		
Total Activity	1.11E+01	4.30E+00					J	<b>2.57</b>	<b>1.60</b>			<b>81.3</b>		

Tonawanda Data Summary Tables

0107030-5	TMF-0055						FROM GAMMA								
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
				Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-1.30E-01	1.70E-01	7.00E-02	2.50E-01	0.66	667	U
Ra-226	8.70E-01	3.40E-01						J							
Np-237															
Pu-238															
Pu-239															
Th-228	1.19E+00	2.50E-01													
Th-230	9.40E-01	2.00E-01						J							
Th-232	8.60E-01	1.90E-01													
U-234	8.00E-01	2.30E-01	8.10E-01	2.20E-01	0.03	1.24									
U-235	8.00E-02	6.60E-02	1.08E-01	7.00E-02	0.29	29.8	5.00E-02	2.70E-01	1.70E-01	2.90E-01	0.30	109	U		
U-238	9.00E-01	2.50E-01	9.40E-01	2.40E-01	0.12	4.35									
<b>Total U Alpha</b>	<b>1.78E+00</b>	<b>3.46E-01</b>	<b>1.86E+00</b>	<b>3.33E-01</b>											
<b>Alpha Sum</b>	<b>4.02E+00</b>	<b>1.82E+00</b>	<b>-4.82E-01</b>	<b>1.83E+00</b>											
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Cs-137	7.80E-02	4.40E-02	8.90E-02	5.50E-02	0.16	13.2									
Th-234 (Assumed from U-238)	9.00E-01	2.50E-01	9.40E-01	2.40E-01	0.12	4.35	1.12E+00	9.20E-01	-2.00E-02	6.30E-01	1.02	207			
Pa-234m (Assumed from U-238)	9.00E-01	2.50E-01	9.40E-01	2.40E-01	0.12	4.35	-2.30E+00	7.60E+00	9.00E-01	7.10E+00	0.31	457	U		
K-40	2.04E+01	3.70E+00	2.00E+01	3.60E+00	0.08	1.98									
Ra-228	8.00E-01	2.10E-01	8.60E-01	2.20E-01	0.20	7.23									
Pa-231	-1.80E+00	1.90E+00	-2.60E+00	2.00E+00	0.29	36.4									
<b>Beta Sum</b>	<b>2.29E+01</b>	<b>3.73E+00</b>	<b>2.25E+01</b>	<b>3.63E+00</b>					<b>1.99E+01</b>	<b>8.51E+00</b>	<b>2.15E+01</b>	<b>7.99E+00</b>			
<b>Total Activity Sum</b>	<b>2.69E+01</b>	<b>4.15E+00</b>	<b>2.20E+01</b>	<b>4.07E+00</b>					<b>2.39E+01</b>	<b>8.70E+00</b>	<b>2.10E+01</b>	<b>8.20E+00</b>			
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.90E+00	1.20E+00							<b>1.32</b>	<b>(from gamma)</b>	<b>52.7</b>				
Gross Beta	5.90E+00	1.00E+00					J	<b>4.39</b>	<b>1.63</b>	<b>118</b>					
Total Activity	1.35E+01	4.50E+00					J	<b>2.19</b>	<b>1.06</b>	<b>66.3</b>					

Tonawanda Data Summary Tables

Analyses	TMF-0056							FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-4.00E-02	4.70E-01					U
Ra-226	9.00E-01	2.20E-01	4.20E-01	1.80E-01	1.69	72.7	J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.70E-01	2.10E-01	7.90E-01	1.80E-01	0.65	20.5								
Th-230	8.30E-01	1.80E-01	9.10E-01	1.80E-01	0.31	9.20	J							
Th-232	8.70E-01	1.80E-01	9.40E-01	1.90E-01	0.27	7.73								
U-234	9.50E-01	2.40E-01												
U-235	1.25E-01	7.50E-02						7.00E-02	3.10E-01					U
U-238	1.01E+00	2.50E-01												
<b>Total U Alpha</b>	<b>2.09E+00</b>	<b>3.55E-01</b>												
<b>Alpha Sum</b>	<b>6.29E+00</b>	<b>1.88E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	1.01E+00	2.50E-01						9.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	1.01E+00	2.50E-01						2.00E+00	1.00E+01					U
K-40	1.80E+01	3.90E+00												
Ra-228	6.00E-01	2.60E-01												
Pa-231	7.00E-01	2.00E+00												
<b>Beta Sum</b>	<b>2.07E+01</b>	<b>3.93E+00</b>						<b>2.16E+01</b>	<b>1.08E+01</b>					
<b>Total Activity Sum</b>	<b>2.70E+01</b>	<b>4.36E+00</b>						<b>2.79E+01</b>	<b>1.10E+01</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	4.37E+00	9.70E-01						<b>0.91</b>	<b>(from gamma)</b>			<b>35.9</b>		
Gross Beta	4.05E+00	8.50E-01					J	<b>4.14</b>	<b>1.62</b>			<b>135</b>		
Total Activity	8.10E+00	4.10E+00					J	<b>3.16</b>	<b>1.69</b>			<b>108</b>		

Tonawanda Data Summary Tables

0107030-7	TMF-0057				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								-1.00E-02	2.90E-01					U
Ra-226	4.80E-01	1.70E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.80E-01	1.80E-01												
Th-230	7.50E-01	1.60E-01					J							
Th-232	6.80E-01	1.50E-01												
U-234	6.70E-01	1.90E-01												
U-235	7.50E-02	5.70E-02						1.00E-02	2.70E-01					U
U-238	6.30E-01	1.80E-01												
<b>Total U Alpha</b>	<b>1.38E+00</b>	<b>2.68E-01</b>												
<b>Alpha Sum</b>	<b>2.99E+00</b>	<b>1.42E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	6.30E-01	1.80E-01						7.10E-01	7.10E-01					
Pa-234m (Assumed from U-238)	6.30E-01	1.80E-01						6.20E+00	7.90E+00					U
K-40	1.52E+01	3.20E+00												
Ra-228	7.30E-01	2.30E-01												
Pa-231	-1.20E+00	1.50E+00												U
<b>Beta Sum</b>	<b>1.70E+01</b>	<b>3.22E+00</b>						<b>2.27E+01</b>	<b>8.56E+00</b>					
<b>Total Activity Sum</b>	<b>2.00E+01</b>	<b>3.52E+00</b>						<b>2.57E+01</b>	<b>8.67E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.86E+00	9.60E-01						<b>1.10</b>	<b>(from gamma)</b>			<b>47.8</b>		
Gross Beta	4.34E+00	8.50E-01					J	<b>3.81</b>	<b>2.13</b>			<b>119</b>		
Total Activity	7.60E+00	4.10E+00					J	<b>2.30</b>	<b>1.88</b>			<b>90.0</b>		

Tonawanda Data Summary Tables

0107030-8	TMF-0058				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								1.20E-01	4.80E-01					U
Ra-226	9.20E-01	2.50E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.10E-01	2.00E-01												
Th-230	7.40E-01	1.70E-01					J							
Th-232	7.50E-01	1.70E-01												
U-234	8.90E-01	2.40E-01												
U-235	6.10E-02	5.50E-02						4.00E-02	3.10E-01					U
U-238	8.20E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.37E-01</b>												
<b>Alpha Sum</b>	<b>4.90E+00</b>	<b>1.70E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.20E-01	2.30E-01						1.40E+00	1.00E+00					
Pa-234m (Assumed from U-238)	8.20E-01	2.30E-01						-6.00E+00	1.10E+01					U
K-40	1.59E+01	3.60E+00												
Ra-228	6.00E-01	2.40E-01												
Pa-231	-1.00E-01	1.80E+00												U
<b>Beta Sum</b>	<b>1.81E+01</b>	<b>3.63E+00</b>						<b>1.19E+01</b>	<b>1.16E+01</b>					
<b>Total Activity Sum</b>	<b>2.30E+01</b>	<b>4.01E+00</b>						<b>1.68E+01</b>	<b>1.17E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.63E+00	9.20E-01						<b>0.14</b>	<b>(from gamma)</b>			<b>5.69</b>		
Gross Beta	4.31E+00	8.40E-01					J	<b>3.71</b>	<b>0.65</b>			<b>123</b>		
Total Activity	8.10E+00	4.20E+00					J	<b>2.57</b>	<b>0.70</b>			<b>95.9</b>		

Tonawanda Data Summary Tables

0107030-9	TMF-0061				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								1.60E-01	3.10E-01					U
Ra-226	8.60E-01	2.40E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.30E-01	1.60E-01												
Th-230	7.70E-01	1.50E-01					J							
Th-232	7.80E-01	1.50E-01												
U-234	8.00E-01	2.10E-01												
U-235	1.27E-01	7.70E-02						-1.40E-01	2.70E-01					U
U-238	7.40E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.67E+00</b>	<b>3.00E-01</b>												
<b>Alpha Sum</b>	<b>2.56E+00</b>	<b>1.77E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.40E-01	2.00E-01						9.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	7.40E-01	2.00E-01						-2.00E+00	9.20E+00					U
K-40	1.78E+01	3.60E+00												
Ra-228	7.50E-01	2.60E-01												
Pa-231	-2.50E+00	1.90E+00												
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.63E+00</b>						<b>1.72E+01</b>	<b>9.95E+00</b>					
<b>Total Activity Sum</b>	<b>2.23E+01</b>	<b>4.04E+00</b>						<b>1.97E+01</b>	<b>1.01E+01</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	5.60E+00	1.10E+00						<b>1.46</b>	<b>(from gamma)</b>			<b>74.6</b>		
Gross Beta	4.94E+00	9.20E-01					J	<b>3.95</b>	<b>1.22</b>			<b>120</b>		
Total Activity	1.21E+01	4.30E+00					J	<b>1.73</b>	<b>0.69</b>			<b>59.2</b>		



Tonawanda Data Summary Tables

Analyses	TMF-0062				FROM GAMMA				Val Q	DER	RPD	Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate					
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)					
Am-241					4.00E-03	8.30E-02						U	
Ra-226	1.23E+00	2.70E-01											J
Np-237													
Pu-238													
Pu-239													
Th-228	8.20E-01	1.80E-01											
Th-230	6.70E-01	1.50E-01											J
Th-232	8.20E-01	1.70E-01											
U-234	7.40E-01	2.00E-01	7.50E-01	2.10E-01	<b>0.03</b>	<b>1.34</b>							
U-235	9.60E-02	6.50E-02	8.70E-02	6.20E-02	<b>0.10</b>	<b>9.84</b>	1.50E-01	2.80E-01					U
U-238	1.00E+00	2.40E-01	8.10E-01	2.20E-01	<b>0.58</b>	<b>21.0</b>							
<b>Total U Alpha</b>	<b>1.84E+00</b>	<b>3.19E-01</b>	<b>1.65E+00</b>	<b>3.10E-01</b>									
<b>Alpha Sum</b>	<b>4.48E+00</b>	<b>1.36E+00</b>	<b>1.65E+00</b>	<b>3.10E-01</b>									
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
Tc-99													
Th-234 (Assumed from U-238)	1.00E+00	2.40E-01	8.10E-01	2.20E-01	<b>0.58</b>	<b>21.0</b>	5.60E-01	6.40E-01					
Pa-234m (Assumed from U-238)	1.00E+00	2.40E-01	8.10E-01	2.20E-01	<b>0.58</b>	<b>21.0</b>	0.00E+00	1.10E+01					U
K-40	1.80E+01	3.90E+00											
Ra-228	8.20E-01	2.70E-01											
Pa-231	-1.00E+00	1.40E+00											U
<b>Beta Sum</b>	<b>2.07E+01</b>	<b>3.93E+00</b>	<b>1.62E+00</b>	<b>3.11E-01</b>			<b>1.93E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.52E+01</b>	<b>4.16E+00</b>	<b>3.27E+00</b>	<b>4.39E-01</b>			<b>2.37E+01</b>	<b>1.18E+01</b>					
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	4.47E+00	9.50E-01					<b>0.00</b>	<b>(from gamma)</b>		<b>0.13</b>			
Gross Beta	4.47E+00	8.90E-01					<b>4.03</b>	<b>1.26</b>		<b>129</b>			
Total Activity	7.80E+00	4.10E+00					<b>2.98</b>	<b>1.28</b>		<b>105</b>			

Tonawanda Data Summary Tables

Analyses	TMF-0067							FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.00E-02	1.10E-01					U
Ra-226	7.80E-01	2.10E-01	8.50E-01	2.20E-01	0.23	8.59	J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.70E-01	2.00E-01												
Th-230	9.10E-01	2.00E-01					J							
Th-232	8.50E-01	1.90E-01												
U-234	7.50E-01	2.10E-01												
U-235	4.70E-02	4.80E-02						1.20E-01	2.80E-01					U
U-238	8.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>3.15E-01</b>												
<b>Alpha Sum</b>	<b>5.25E+00</b>	<b>1.44E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01						8.40E-01	6.30E-01					
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01						2.90E+00	9.60E+00					U
K-40	1.85E+01	3.90E+00												
Ra-228	9.30E-01	2.90E-01												
Pa-231	2.00E-01	1.50E+00					U							
<b>Beta Sum</b>	<b>2.12E+01</b>	<b>3.93E+00</b>						<b>2.32E+01</b>	<b>1.04E+01</b>					
<b>Total Activity Sum</b>	<b>2.64E+01</b>	<b>4.19E+00</b>						<b>2.84E+01</b>	<b>1.05E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.10E+00	1.10E+00	5.40E+00	1.00E+00	0.47	12.2		0.47	(from gamma)			15.0		
Gross Beta	4.82E+00	9.10E-01	4.25E+00	8.50E-01	0.46	12.6	J	4.06	1.76			126		
Total Activity	8.00E+00	4.20E+00	7.60E+00	4.20E+00	0.07	5.13	J	3.11	1.81			107		

Tonawanda Data Summary Tables

0107030-12		TMF-0068				FROM GAMMA						
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	FROM GAMMA		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.20E-01	1.70E-01			U
Ra-226	1.03E+00	2.30E-01					J					
Np-237												
Pu-238												
Pu-239												
Th-228	9.40E-01	2.00E-01										
Th-230	9.20E-01	1.80E-01					J					
Th-232	8.90E-01	1.80E-01										
U-234	9.20E-01	2.50E-01										
U-235	8.30E-02	6.60E-02						-1.20E-01	2.60E-01			U
U-238	8.30E-01	2.30E-01										
<b>Total U Alpha</b>	<b>1.83E+00</b>	<b>3.46E-01</b>										
<b>Alpha Sum</b>	<b>6.15E+00</b>	<b>1.79E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	8.30E-01	2.30E-01						1.20E-01	7.20E-01			U
Pa-234m (Assumed from U-238)	8.30E-01	2.30E-01						5.30E+00	7.60E+00			U
K-40	2.18E+01	3.90E+00										
Ra-228	8.50E-01	2.10E-01										
Pa-231	6.00E-01	1.90E+00					U					
<b>Beta Sum</b>	<b>2.44E+01</b>	<b>3.93E+00</b>						<b>2.81E+01</b>	<b>8.58E+00</b>			
<b>Total Activity Sum</b>	<b>3.05E+01</b>	<b>4.31E+00</b>						<b>3.43E+01</b>	<b>8.76E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.70E+00	1.20E+00						<b>0.25</b>	<b>(from gamma)</b>			<b>8.51</b>
Gross Beta	5.10E+00	1.00E+00					J	<b>4.76</b>	<b>2.67</b>			<b>131</b>
Total Activity	1.24E+01	4.40E+00					J	<b>2.94</b>	<b>2.23</b>			<b>84.5</b>

Tonawanda Data Summary Tables

0107030-13	TMF-0069				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								7.00E-02	2.60E-01					U
Ra-226	7.70E-01	2.20E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.10E-01	1.80E-01												
Th-230	9.80E-01	2.10E-01					J							
Th-232	7.40E-01	1.70E-01												
U-234	9.40E-01	2.40E-01												
U-235	1.01E-01	6.70E-02						3.00E-02	2.70E-01					U
U-238	9.70E-01	2.40E-01												
<b>Total U Alpha</b>	<b>2.01E+00</b>	<b>3.46E-01</b>												
<b>Alpha Sum</b>	<b>5.30E+00</b>	<b>1.28E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.70E-01	2.40E-01						1.17E+00	7.50E-01					
Pa-234m (Assumed from U-238)	9.70E-01	2.40E-01						1.20E+00	6.60E+00					U
K-40	1.49E+01	2.80E+00												
Ra-228	7.30E-01	1.90E-01												
Pa-231	1.00E-01	1.30E+00												U
<b>Beta Sum</b>	<b>1.76E+01</b>	<b>2.83E+00</b>						<b>1.80E+01</b>	<b>7.21E+00</b>					
<b>Total Activity Sum</b>	<b>2.29E+01</b>	<b>3.11E+00</b>						<b>2.33E+01</b>	<b>7.33E+00</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	4.50E+00	1.10E+00						<b>0.47</b>	<b>(from gamma)</b>			<b>16.3</b>		
Gross Beta	3.93E+00	8.10E-01					J	<b>4.64</b>	<b>1.94</b>			<b>127</b>		
Total Activity	1.18E+01	4.60E+00					J	<b>2.00</b>	<b>1.33</b>			<b>63.9</b>		

Tonawanda Data Summary Tables

0107030-14		TMF-0070				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.70E-01	3.20E-01	-6.00E-02	1.10E-01	<b>0.33</b>	<b>95.7</b>	U
Ra-226	7.10E-01	1.80E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	5.70E-01	1.60E-01												
Th-230	7.30E-01	1.60E-01					J							
Th-232	5.40E-01	1.30E-01												
U-234	7.80E-01	2.40E-01												
U-235	8.90E-02	7.30E-02						-1.50E-01	4.30E-01	-2.70E-01	4.00E-01	<b>0.20</b>	<b>57.1</b>	U
U-238	7.50E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>3.40E-01</b>												
<b>Alpha Sum</b>	<b>2.82E+00</b>	<b>2.03E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.50E-01	2.30E-01						3.00E-01	1.20E+00	4.50E-01	7.80E-01	<b>0.10</b>	<b>40.0</b>	U
Pa-234m (Assumed from U-238)	7.50E-01	2.30E-01						8.00E+00	1.40E+01	1.30E+01	2.20E+01	<b>0.19</b>	<b>47.6</b>	U
K-40	1.12E+01	2.80E+00	1.02E+01	3.60E+00	<b>0.22</b>	<b>9.35</b>								
Ra-228	4.10E-01	2.30E-01	5.90E-01	5.20E-01	<b>0.32</b>	<b>36.0</b>								
Pa-231	-1.50E+00	2.20E+00	-9.00E-01	2.80E+00	<b>0.17</b>	<b>50.0</b>	U							
<b>Beta Sum</b>	<b>1.29E+01</b>	<b>2.84E+00</b>						<b>1.97E+01</b>	<b>1.43E+01</b>	<b>2.41E+01</b>	<b>2.23E+01</b>			
<b>Total Activity Sum</b>	<b>1.57E+01</b>	<b>3.49E+00</b>						<b>2.25E+01</b>	<b>1.45E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.60E+00	1.30E+00					J	<b>1.15</b>	<b>(from gamma)</b>		<b>66.1</b>			
Gross Beta	3.41E+00	8.90E-01					J	<b>3.20</b>	<b>1.14</b>		<b>117</b>			
Total Activity	1.20E+01	4.60E+00					J	<b>0.65</b>	<b>0.69</b>		<b>27.0</b>			

Tonawanda Data Summary Tables

0107030-15	TMF-0073				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								2.70E-01	4.90E-01					U
Ra-226	7.30E-01	3.00E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.90E-01	1.90E-01												
Th-230	7.80E-01	1.70E-01					J							
Th-232	7.60E-01	1.70E-01												
U-234	7.30E-01	2.20E-01												
U-235	6.90E-02	6.30E-02						3.00E-02	3.00E-01					U
U-238	5.90E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.39E+00</b>	<b>3.04E-01</b>												
<b>Alpha Sum</b>	<b>3.02E+00</b>	<b>1.88E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	5.90E-01	2.00E-01						4.90E-01	7.50E-01					U
Pa-234m (Assumed from U-238)	5.90E-01	2.00E-01						0.00E+00	8.40E+00					U
K-40	1.64E+01	3.40E+00												
Ra-228	5.90E-01	2.20E-01												
Pa-231	-1.70E+00	2.00E+00					U							
<b>Beta Sum</b>	<b>1.80E+01</b>	<b>3.43E+00</b>						<b>1.73E+01</b>	<b>9.10E+00</b>					
<b>Total Activity Sum</b>	<b>2.10E+01</b>	<b>3.91E+00</b>						<b>2.03E+01</b>	<b>9.29E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.70E+00	1.10E+00						<b>0.77</b>	<b>(from gamma)</b>			<b>43.6</b>		
Gross Beta	5.20E+00	1.00E+00					J	<b>3.58</b>	<b>1.32</b>			<b>110</b>		
Total Activity	1.44E+01	4.60E+00					J	<b>1.09</b>	<b>0.57</b>			<b>37.2</b>		

Tonawanda Data Summary Tables

0107030-16	TMF-0074				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								2.00E-02	3.00E-01					U
Ra-226	8.40E-01	2.10E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.50E-01	2.00E-01												
Th-230	1.01E+00	2.10E-01					J							
Th-232	1.05E+00	2.10E-01												
U-234	1.03E+00	2.80E-01												
U-235	7.10E-02	6.50E-02						-7.00E-02	3.00E-01					U
U-238	1.06E+00	2.90E-01												
<b>Total U Alpha</b>	<b>2.16E+00</b>	<b>4.08E-01</b>												
<b>Alpha Sum</b>	<b>4.47E+00</b>	<b>1.72E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	1.06E+00	2.90E-01						1.09E+00	8.90E-01					
Pa-234m (Assumed from U-238)	1.06E+00	2.90E-01						5.20E+00	8.30E+00					U
K-40	1.58E+01	3.30E+00												
Ra-228	7.70E-01	2.40E-01												
Pa-231	-1.60E+00	1.80E+00												U
<b>Beta Sum</b>	<b>1.85E+01</b>	<b>3.34E+00</b>						<b>2.27E+01</b>	<b>8.98E+00</b>					
<b>Total Activity Sum</b>	<b>2.30E+01</b>	<b>3.76E+00</b>						<b>2.71E+01</b>	<b>9.15E+00</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	6.20E+00	1.20E+00						<b>0.82</b>	<b>(from gamma)</b>			<b>32.4</b>		
Gross Beta	4.93E+00	9.40E-01					J	<b>3.91</b>	<b>1.96</b>			<b>116</b>		
Total Activity	1.09E+01	4.30E+00					J	<b>2.11</b>	<b>1.61</b>			<b>71.3</b>		

Tonawanda Data Summary Tables

Analyses	TMF-0075				FROM GAMMA				Val Q	DER	RPD	Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate				
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)				
Am-241					3.00E-02	1.00E-01						U
Ra-226	1.01E+00	2.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.00E+00	2.20E-01										
Th-230	9.90E-01	2.00E-01										
Th-232	7.90E-01	1.70E-01										
U-234	8.80E-01	2.40E-01	9.20E-01	2.40E-01	<b>0.12</b>	<b>4.44</b>						
U-235	1.21E-01	7.80E-02	1.07E-01	7.20E-02	<b>0.13</b>	<b>12.3</b>	3.00E-02	3.30E-01				U
U-238	9.90E-01	2.60E-01	1.05E+00	2.60E-01	<b>0.16</b>	<b>5.88</b>						
<b>Total U Alpha</b>	<b>1.99E+00</b>	<b>3.62E-01</b>	<b>2.08E+00</b>	<b>3.61E-01</b>								
<b>Alpha Sum</b>	<b>5.78E+00</b>	<b>1.80E+00</b>	<b>2.08E+00</b>	<b>3.61E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	9.90E-01	2.60E-01	1.05E+00	2.60E-01	<b>0.16</b>	<b>5.88</b>	1.40E+00	7.40E-01				
Pa-234m (Assumed from U-238)	9.90E-01	2.60E-01	1.05E+00	2.60E-01	<b>0.16</b>	<b>5.88</b>	6.70E+00	9.70E+00				U
K-40	1.61E+01	3.80E+00										
Ra-228	7.30E-01	2.80E-01										
Pa-231	0.00E+00	1.90E+00										
<b>Beta Sum</b>	<b>1.88E+01</b>	<b>3.83E+00</b>	<b>2.10E+00</b>	<b>3.68E-01</b>			<b>2.49E+01</b>	<b>1.05E+01</b>				
<b>Total Activity Sum</b>	<b>2.46E+01</b>	<b>4.24E+00</b>	<b>4.18E+00</b>	<b>5.15E-01</b>			<b>3.07E+01</b>	<b>1.06E+01</b>				
							<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>	
Gross Alpha	6.10E+00	1.20E+00					<b>0.15</b>	<b>(from gamma)</b>			<b>5.37</b>	
Gross Beta	4.89E+00	9.50E-01					<b>3.52</b>	<b>1.91</b>			<b>117</b>	
Total Activity	1.36E+01	4.40E+00					<b>1.80</b>	<b>1.49</b>			<b>57.6</b>	



Tonawanda Data Summary Tables

Analyses	TMF-0076				FROM GAMMA				Val Q	DER	RPD	Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate				
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)				
Am-241					1.40E-01	5.90E-01						U
Ra-226	8.50E-01	2.10E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.20E+00	2.30E-01										
Th-230	9.30E-01	1.90E-01										
Th-232	1.05E+00	2.10E-01										
U-234	9.50E-01	2.40E-01										
U-235	8.50E-02	6.20E-02			1.70E-01	3.60E-01						U
U-238	1.03E+00	2.50E-01										
<b>Total U Alpha</b>	<b>2.07E+00</b>	<b>3.52E-01</b>										
<b>Alpha Sum</b>	<b>6.37E+00</b>	<b>1.80E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	1.03E+00	2.50E-01			8.00E-01	1.10E+00						U
Pa-234m (Assumed from U-238)	1.03E+00	2.50E-01			1.00E+01	1.20E+01						
K-40	2.12E+01	4.50E+00										
Ra-228	1.15E+00	3.60E-01										
Pa-231	3.00E-01	1.90E+00										
<b>Beta Sum</b>	<b>2.44E+01</b>	<b>4.53E+00</b>			<b>3.32E+01</b>	<b>1.29E+01</b>						
<b>Total Activity Sum</b>	<b>3.08E+01</b>	<b>4.88E+00</b>			<b>3.96E+01</b>	<b>1.30E+01</b>						
					<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>				
Gross Alpha	7.50E+00	1.30E+00			<b>0.51</b>	<b>(from gamma)</b>					<b>16.4</b>	
Gross Beta	6.20E+00	1.10E+00			<b>3.91</b>	<b>2.09</b>					<b>119</b>	
Total Activity	1.50E+01	4.40E+00			<b>2.41</b>	<b>1.79</b>					<b>69.0</b>	

Tonawanda Data Summary Tables

0107030-19		TMF-0079				FROM GAMMA						
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.00E-02	1.10E-01			U
Ra-226	1.11E+00	2.50E-01					J					
Np-237												
Pu-238												
Pu-239												
Th-228	1.29E+00	2.70E-01										
Th-230	1.23E+00	2.50E-01										
Th-232	9.90E-01	2.10E-01										
U-234	9.60E-01	2.40E-01										
U-235	1.13E-01	7.20E-02						-4.00E-02	2.80E-01			U
U-238	9.90E-01	2.50E-01										
<b>Total U Alpha</b>	<b>2.06E+00</b>	<b>3.54E-01</b>										
<b>Alpha Sum</b>	<b>5.87E+00</b>	<b>1.81E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	9.90E-01	2.50E-01						1.30E+00	8.10E-01			
Pa-234m (Assumed from U-238)	9.90E-01	2.50E-01						1.00E+00	9.00E+00			U
K-40	1.85E+01	4.00E+00										
Ra-228	9.20E-01	3.40E-01										
Pa-231	-9.00E-01	1.90E+00										
<b>Beta Sum</b>	<b>2.13E+01</b>	<b>4.04E+00</b>						<b>2.16E+01</b>	<b>9.89E+00</b>			
<b>Total Activity Sum</b>	<b>2.72E+01</b>	<b>4.43E+00</b>						<b>2.75E+01</b>	<b>1.01E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	7.50E+00	1.30E+00						<b>0.73</b>	<b>(from gamma)</b>			<b>24.3</b>
Gross Beta	5.80E+00	1.10E+00					J	<b>3.70</b>	<b>1.59</b>			<b>114</b>
Total Activity	1.46E+01	4.50E+00					J	<b>1.99</b>	<b>1.17</b>			<b>60.2</b>

Tonawanda Data Summary Tables

0107030-20	TMF-0080				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								1.30E-01	1.60E-01					U
Ra-226	8.40E-01	2.20E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.60E-01	2.00E-01												
Th-230	8.60E-01	1.80E-01					J							
Th-232	8.30E-01	1.80E-01												
U-234	1.00E+00	2.70E-01												
U-235	9.50E-02	7.20E-02						4.00E-02	2.70E-01					U
U-238	9.70E-01	2.60E-01												
<b>Total U Alpha</b>	<b>2.07E+00</b>	<b>3.82E-01</b>												
<b>Alpha Sum</b>	<b>6.37E+00</b>	<b>1.29E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.70E-01	2.60E-01						8.40E-01	7.10E-01					
Pa-234m (Assumed from U-238)	9.70E-01	2.60E-01						9.00E-01	6.90E+00					U
K-40	1.94E+01	3.50E+00												
Ra-228	8.70E-01	2.20E-01												
Pa-231	9.00E-01	1.30E+00												U
<b>Beta Sum</b>	<b>2.23E+01</b>	<b>3.53E+00</b>						<b>2.21E+01</b>	<b>7.77E+00</b>					
<b>Total Activity Sum</b>	<b>2.87E+01</b>	<b>3.76E+00</b>						<b>2.85E+01</b>	<b>7.88E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.90E+00	1.20E+00						<b>0.30</b>	<b>(from gamma)</b>			<b>8.07</b>		
Gross Beta	4.62E+00	8.90E-01					J	<b>4.86</b>	<b>2.24</b>			<b>131</b>		
Total Activity	1.16E+01	4.30E+00					J	<b>2.99</b>	<b>1.88</b>			<b>84.8</b>		

## Radiological Analytical Data Verification Comments on Data for SDG 0107095

This sample delivery group (SDG) contained twenty (20) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 13, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0131	0107095-1
TMF-0132	0107095-2
TMF-0121	0107095-3
TMF-0122	0107095-4
TMF-0127	0107095-5
TMF-0128	0107095-6
TMF-0175	0107095-7
TMF-0176	0107095-8
TMF-0178	0107095-9
TMF-0179	0107095-10
TMF-0181	0107095-11
TMF-0182	0107095-12
TMF-0187	0107095-13
TMF-0188	0107095-14
TMF-0184	0107095-15
TMF-0185	0107095-16
TMF-9199	0107095-17
TMF-9200	0107095-18
TMF-0166	0107095-19
TMF-0167	0107095-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## **1.0 GAMMA SPECTROMETRY ANALYSIS**

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was reported by the laboratory in the EQ-1 and EQ-02 equipment rinsate blanks. However,  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for equipment rinsate sample # EQ-1. All associated sample results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). There was  $^{137}\text{Cs}$  activity reported for samples TMF-0121, TMF-0127, TMF-0181 and TMF-0187. The reported  $^{137}\text{Cs}$  results were greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification of  $^{137}\text{Cs}$  results in the sample is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits for the gamma spectrometry analysis.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Results for natural  $^{40}\text{K}$  were also reported for all samples. There was  $^{137}\text{Cs}$  activity reported for samples TMF-0121 ( $1.44\text{E-}01\pm 9.20\text{E-}02$ ), TMF-0127 ( $7.6\text{E-}02\pm 8.8\text{E-}02$ ), TMF-0181 ( $1.37\text{E-}01\pm 9.40\text{E-}02$ ), and TMF-0187 ( $2.30\text{E-}01\pm 1.20\text{E-}01$ ). There were no incidents of identified radionuclides being excluded from the laboratory reports.

In addition,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples. The  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near or total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . The presence of  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the stated concentration is not out of the question for these samples considering the amount of  $^{232}\text{Th}$  and  $^{238}\text{U}$  present. **Inclusion of  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is recommended for information purposes only since any modeling will assume equilibrium with parent  $^{232}\text{Th}$  and  $^{238}\text{U}$ .**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtraction was indicated for the  $^{231}\text{Pa}$  result for sample TMF-0127. **It is recommended that the  $^{231}\text{Pa}$  result for sample TMF-0127 be qualified as estimated (J).** No other problems were observed for the gamma spectrometry analyses.

## **2.0 ALPHA SPECTROMETRY**

### Method Blank:

There was an indication of blank contamination for  $^{230}\text{Th}$  results in method blank. All associated samples results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). For all samples the  $^{230}\text{Th}$  results are greater than 5 times the  $^{230}\text{Th}$  concentrations identified in the method blank. No qualification of  $^{230}\text{Th}$  results for sample is necessary.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis. There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No further qualification of the alpha isotopic results is necessary.

#### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

#### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 20.99% for all samples for the alpha analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty. No qualification of is required.

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium.

### **3.0 <sup>226</sup>Ra ANALYSES**

#### Method Blank:

There is no indication of blank contamination either in the method blank sample for the <sup>226</sup>Ra analysis.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the <sup>226</sup>Ra analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the <sup>226</sup>Ra analysis were within acceptable limits.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate <sup>226</sup>Ra analysis.

#### Chemical Recoveries:

The sample-specific chemical recoveries for the <sup>226</sup>Ra analysis were within acceptable limits.

#### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

#### 4.0 GROSS ALPHA AND BETA ANALYSIS

##### Method Blank:

There was no indication of blank contamination in the method blank for the gross alpha/beta analyses.

##### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

##### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

##### Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

##### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

#### 5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING

##### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses.



#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

#### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis.

#### Duplicate Analysis:

The total activity analysis duplicate DER is within acceptable limits.

#### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

#### Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC. **It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

#### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

#### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities are within acceptable limits indicating that the gross alpha analyses agree with the sum of the alpha emitters within a 99% confidence level.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . DERs for samples TMF-0131 (4.51), TMF-0132 (4.21), TMF-0121 (3.65), TMF-0122 (4.36), TMF-0127 (3.49), TMF-0128 (4.06), TMF-0176 (4.37), TMF-0178 (3.48), TMF-0179 (3.56), TMF-0181 (2.75), TMF-0182 (4.48), TMF-0187 (3.29), TMF-0188 (3.72), TMF-0184 (4.39), TMF-9199 (3.00), TMF-9200 (4.27), TMF-0166 (3.18), and TMF-0167 (4.16) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (123%, 128%, 124%, 115%, 113%, 124%, 120%, 113%, 116%, 104%, 123%, 97.8%, 113%, 123%, 127%, 108%, and 123% respectively) are also outside acceptable limits. The gross beta results are about 3-4 times smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the sample preparation as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the sum of the alpha and beta emitters, the DERs for samples TMF-0131 (3.45), TMF-0132 (3.79), TMF-0121 (2.54), TMF-0122 (2.76), TMF-0127 (2.01), TMF-0128 (2.95), TMF-0176 (3.46), TMF-0178 (1.42), TMF-0179 (2.48), TMF-0182 (3.51), TMF-0188 (3.13), TMF-0184 (3.04), TMF-9199 (1.88), TMF-9200 (2.68), TMF-0166 (2.02), and TMF-0167 (3.09) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (106%, 132%, 87.4%, 82.5%, 75.9%, 107%, 103%, 50.6%, 96.4%, 102%, 108%, 102%, 81.7%, 89.9%, 74.8%, and 103% respectively) are also outside acceptable limits. Samples TMF-0131, TMF-0132, TMF-0121, TMF-0122, TMF-0127, TMF-0128, TMF-0176, TMF-0178, TMF-0179, TMF-0182, TMF-0188, TMF-0184, TMF-9199, TMF-9200, TMF-0166, and TMF-0167 have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 1.9 to 4.5. This is most likely due to a negative bias in the total activity results due to sample preparation as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.

**Tonawanda Data Summary Tables**

Analyses	TMF-0131				FROM GAMMA							Val			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-8.00E-02	2.60E-01	6.00E-02	3.40E-01	0.33	1400	U	
Ra-226	8.90E-01	2.40E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.13E+00	1.90E-01	1.05E+00	1.90E-01	0.30	7.34									
Th-230	1.04E+00	1.70E-01	9.60E-01	1.70E-01	0.33	8.00									
Th-232	9.90E-01	1.60E-01	8.70E-01	1.60E-01	0.53	12.9									
U-234	9.70E-01	2.40E-01													
U-235	6.30E-02	5.20E-02					2.40E-01	2.90E-01	1.00E-02	3.40E-01		0.51	184		
U-238	1.00E+00	2.40E-01													
<b>Total U Alpha</b>	<b>2.03E+00</b>	<b>3.43E-01</b>													
<b>Alpha Sum</b>	<b>6.80E+00</b>	<b>1.45E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.70E+01	3.20E+00	1.51E+01	3.30E+00	0.41	11.8									
Th-234 (Assumed from U-238)	1.00E+00	2.40E-01					1.68E+00	9.90E-01	1.20E+00	1.10E+00		0.32	33.3		
Pa-234m (Assumed from U-238)	1.00E+00	2.40E-01					8.40E+00	7.80E+00	8.00E+00	1.10E+01		0.03	4.88		
Ac-227															
Ra-228	7.50E-01	2.10E-01	8.90E-01	2.60E-01	0.42	17.1									
Pa-231	8.00E-01	1.50E+00	-1.40E+00	2.70E+00	0.71	733								U	
<b>Beta Sum</b>	<b>1.98E+01</b>	<b>3.23E+00</b>					<b>2.79E+01</b>	<b>8.49E+00</b>	<b>2.50E+01</b>	<b>1.15E+01</b>					
<b>Total Activity Sum</b>	<b>2.66E+01</b>	<b>3.54E+00</b>					<b>3.47E+01</b>	<b>8.62E+00</b>							
							<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>				
Gross Alpha	6.20E+00	1.10E+00					0.33	(from gamma)				9.27			
Gross Beta	4.74E+00	8.80E-01					4.51	2.72				123		J	
Total Activity	8.20E+00	4.00E+00					3.45	2.79				106		J	

Tonawanda Data Summary Tables

Analyses	TMF-0132				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-1.80E-01	3.30E-01			U
Ra-226	1.10E+00	4.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.00E-01	1.60E-01										
Th-230	8.10E-01	1.50E-01										
Th-232	9.40E-01	1.60E-01										
U-234	7.90E-01	2.00E-01										
U-235	9.40E-02	6.10E-02						1.00E-02	3.10E-01			U
U-238	9.00E-01	2.20E-01										
<b>Total U Alpha</b>	<b>1.78E+00</b>	<b>3.04E-01</b>										
<b>Alpha Sum</b>	<b>5.08E+00</b>	<b>1.82E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.98E+01	4.00E+00										
Th-234 (Assumed from U-238)	9.00E-01	2.20E-01						7.90E-01	8.40E-01			
Pa-234m (Assumed from U-238)	9.00E-01	2.20E-01						4.40E+00	1.00E+01			U
Ac-227												
Ra-228	8.10E-01	2.80E-01										
Pa-231	-5.00E-01	1.90E+00										U
<b>Beta Sum</b>	<b>2.24E+01</b>	<b>4.03E+00</b>						<b>2.57E+01</b>	<b>1.08E+01</b>			
<b>Total Activity Sum</b>	<b>2.74E+01</b>	<b>4.42E+00</b>						<b>3.08E+01</b>	<b>1.10E+01</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	6.20E+00	1.20E+00						<b>0.51</b>	<b>(from gamma)</b>			<b>19.8</b>
Gross Beta	4.94E+00	9.20E-01					J	<b>4.21</b>	<b>1.92</b>			<b>128</b>
Total Activity	5.60E+00	3.70E+00					J	<b>3.79</b>	<b>2.18</b>			<b>132</b>

Tonawanda Data Summary Tables

Analyses	TMF-0121				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								5.00E-02	1.20E-01			U
Ra-226	1.22E+00	2.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.03E+00	1.80E-01										
Th-230	1.10E+00	1.80E-01										
Th-232	1.14E+00	1.90E-01										
U-234	1.08E+00	2.90E-01										
U-235	7.50E-02	6.70E-02						-1.30E-01	3.50E-01			U
U-238	9.90E-01	2.80E-01										
<b>Total U Alpha</b>	<b>2.15E+00</b>	<b>4.09E-01</b>										
<b>Alpha Sum</b>	<b>5.83E+00</b>	<b>2.06E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
K-40	1.90E+01	4.50E+00										
Cs-137	1.44E-01	9.20E-02										
Th-234 (Assumed from U-238)	9.90E-01	2.80E-01						1.11E+00	8.80E-01			
Pa-234m (Assumed from U-238)	9.90E-01	2.80E-01						2.00E+00	1.30E+01			U
Ac-227												
Ra-228	9.70E-01	4.10E-01										
Pa-231	-9.00E-01	2.20E+00										U
<b>Beta Sum</b>	<b>2.20E+01</b>	<b>4.54E+00</b>						<b>2.31E+01</b>	<b>1.38E+01</b>			
<b>Total Activity Sum</b>	<b>2.78E+01</b>	<b>4.99E+00</b>						<b>2.89E+01</b>	<b>1.39E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.90E+00	1.10E+00	5.46E+00	9.10E-01	<b>1.01</b>	<b>23.3</b>		<b>0.46</b>	<b>(from gamma)</b>		<b>16.9</b>	
Gross Beta	5.12E+00	8.10E-01	4.65E+00	7.60E-01	<b>0.42</b>	<b>9.62</b>	J	<b>3.65</b>	<b>1.30</b>		<b>124</b>	
Total Activity	1.09E+01	4.40E+00	9.10E+00	4.20E+00	<b>0.30</b>	<b>18.0</b>	J	<b>2.54</b>	<b>1.23</b>		<b>87.4</b>	

Tonawanda Data Summary Tables

Analyses	TMF-0122					FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)	
Am-241								-4.00E-02	1.60E-01			U
Ra-226	6.80E-01	1.90E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	8.40E-01	1.60E-01										
Th-230	8.10E-01	1.50E-01										
Th-232	8.40E-01	1.50E-01										
U-234	7.40E-01	2.20E-01	8.00E-01	2.10E-01	0.20	7.79						
U-235	1.20E-01	8.10E-02	1.01E-01	6.80E-02	0.18	17.2		-4.00E-02	2.60E-01			U
U-238	7.80E-01	2.30E-01	9.10E-01	2.30E-01	0.40	15.4						
<b>Total U Alpha</b>	<b>1.64E+00</b>	<b>3.28E-01</b>	<b>1.81E+00</b>	<b>3.19E-01</b>								
<b>Alpha Sum</b>	<b>4.45E+00</b>	<b>1.18E+00</b>	<b>1.81E+00</b>	<b>3.19E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.77E+01	3.20E+00										
Th-234 (Assumed from U-238)	7.80E-01	2.30E-01	9.10E-01	2.30E-01	0.40	15.4		1.14E+00	8.60E-01			
Pa-234m (Assumed from U-238)	7.80E-01	2.30E-01	9.10E-01	2.30E-01	0.40	15.4		1.00E-01	7.30E+00			U
Ac-227												
Ra-228	8.60E-01	2.10E-01										
Pa-231	-4.00E-01	1.20E+00										U
<b>Beta Sum</b>	<b>2.01E+01</b>	<b>3.23E+00</b>	<b>1.82E+00</b>	<b>3.25E-01</b>				<b>1.98E+01</b>	<b>8.02E+00</b>			
<b>Total Activity Sum</b>	<b>2.45E+01</b>	<b>3.43E+00</b>	<b>3.63E+00</b>	<b>4.55E-01</b>				<b>2.42E+01</b>	<b>8.11E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.50E+00	1.10E+00						0.65	(from gamma)			21.1
Gross Beta	5.39E+00	9.70E-01					J	4.36	1.78			115
Total Activity	1.02E+01	3.90E+00					J	2.76	1.56			82.5

**Tonawanda Data Summary Tables**

Analyses	TMF-0127				FROM GAMMA							Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								3.00E-02	1.30E-01	1.40E-01	2.90E-01	0.35	129	U	
Ra-226	1.01E+00	2.30E-01	1.00E+00	3.00E-01	0.03	1.00									
Np-237															
Pu-238															
Pu-239															
Th-228	9.60E-01	1.70E-01	1.04E+00	1.90E-01	0.31	8.00									
Th-230	9.60E-01	1.60E-01	8.90E-01	1.60E-01	0.31	7.57									
Th-232	9.60E-01	1.60E-01	1.06E+00	1.80E-01	0.42	9.90									
U-234	7.50E-01	2.30E-01													
U-235	5.50E-02	5.60E-02						-2.20E-01	3.00E-01	-9.00E-02	3.20E-01	0.30	83.9	U	
U-238	9.00E-01	2.50E-01													
<b>Total U Alpha</b>	<b>1.71E+00</b>	<b>3.44E-01</b>													
<b>Alpha Sum</b>	<b>3.35E+00</b>	<b>1.78E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
K-40	1.56E+01	3.60E+00	1.53E+01	2.90E+00	0.06	1.94									
Cs-137	7.60E-02	8.80E-02	1.21E-01	6.40E-02	0.41	45.7									
Th-234 (Assumed from U-238)	9.00E-01	2.50E-01						1.03E+00	8.80E-01	7.00E-01	1.00E+00	0.25	38.2		
Pa-234m (Assumed from U-238)	9.00E-01	2.50E-01						1.00E+00	1.10E+01	4.60E+00	8.10E+00	0.26	129	U	
Ac-227															
Ra-228	8.30E-01	3.00E-01	7.10E-01	2.10E-01	0.33	15.6									
Pa-231	-2.50E+00	1.90E+00	-1.60E+00	2.40E+00	0.29	43.9	UJ								
<b>Beta Sum</b>	<b>1.80E+01</b>	<b>3.64E+00</b>						<b>1.82E+01</b>	<b>1.16E+01</b>	<b>2.12E+01</b>	<b>8.67E+00</b>				
<b>Total Activity Sum</b>	<b>2.14E+01</b>	<b>4.05E+00</b>						<b>2.16E+01</b>	<b>1.17E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.70E+00	1.10E+00						1.60	(from gamma)			66.8			
Gross Beta	5.00E+00	8.00E-01					J	3.49	1.14			113			
Total Activity	9.60E+00	4.20E+00					J	2.01	0.96			75.9			

\*\*NOTE: Cs-137 original sample results were not listed on the Form 1, however they were listed on the QC form with the duplicate results



Tonawanda Data Summary Tables

Analyses	TMF-0128				FROM GAMMA						Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD	
Am-241								4.60E-01	4.80E-01				
Ra-226	8.00E-01	2.50E-01											
Np-237													
Pu-238													
Pu-239													
Th-228	8.00E-01	1.60E-01											
Th-230	7.70E-01	1.50E-01											
Th-232	8.00E-01	1.50E-01											
U-234	8.20E-01	2.10E-01											
U-235	7.30E-02	5.50E-02						-1.40E-01	3.20E-01				U
U-238	8.80E-01	2.20E-01											
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.09E-01</b>											
<b>Alpha Sum</b>	<b>3.86E+00</b>	<b>1.86E+00</b>											
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
K-40	1.74E+01	3.60E+00											
Th-234 (Assumed from U-238)	8.80E-01	2.20E-01						6.60E-01	9.80E-01				U
Pa-234m (Assumed from U-238)	8.80E-01	2.20E-01						5.20E+00	9.20E+00				U
Ac-227													
Ra-228	7.70E-01	2.30E-01											
Pa-231	-1.20E+00	2.00E+00											U
<b>Beta Sum</b>	<b>1.98E+01</b>	<b>3.63E+00</b>						<b>2.39E+01</b>	<b>9.93E+00</b>				
<b>Total Activity Sum</b>	<b>2.36E+01</b>	<b>4.08E+00</b>						<b>2.77E+01</b>	<b>1.01E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	5.90E+00	1.10E+00	5.50E+00	1.10E+00	<b>0.26</b>	<b>7.02</b>		<b>0.94</b>	<b>(from gamma)</b>	<b>41.7</b>			
Gross Beta	4.61E+00	9.10E-01	5.07E+00	9.30E-01	<b>0.35</b>	<b>9.50</b>	J	<b>4.06</b>	<b>1.93</b>	<b>124</b>			
Total Activity	7.20E+00	3.80E+00	9.20E+00	3.80E+00	<b>0.37</b>	<b>24.4</b>	J	<b>2.95</b>	<b>1.90</b>	<b>107</b>			

Tonawanda Data Summary Tables

Analyses	TMF-0175				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								-6.80E-02	8.30E-02			U
Ra-226	5.00E-01	2.10E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	2.70E-01	1.20E-01										
Th-230	5.00E-01	1.20E-01										
Th-232	2.27E-01	7.10E-02										
U-234	4.90E-01	1.60E-01										
U-235	5.90E-02	5.30E-02						-2.80E-01	2.50E-01			U
U-238	3.90E-01	1.50E-01										
<b>Total U Alpha</b>	<b>9.39E-01</b>	<b>2.26E-01</b>										
<b>Alpha Sum</b>	<b>2.80E+00</b>	<b>1.40E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	4.60E+00	1.80E+00										
Th-234 (Assumed from U-238)	3.90E-01	1.50E-01						3.00E-01	4.80E-01			U
Pa-234m (Assumed from U-238)	3.90E-01	1.50E-01						5.40E+00	8.60E+00			U
Ac-227												
Ra-228	3.80E-01	2.80E-01										
Pa-231	4.00E-01	1.50E+00										U
<b>Beta Sum</b>	<b>5.81E+00</b>	<b>1.84E+00</b>						<b>1.07E+01</b>	<b>8.81E+00</b>			
<b>Total Activity Sum</b>	<b>8.60E+00</b>	<b>2.31E+00</b>						<b>1.35E+01</b>	<b>8.92E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	2.90E+00	1.30E+00						<b>0.05</b>	<b>(from gamma)</b>			<b>3.65</b>
Gross Beta	3.00E+00	1.60E+00					J	<b>1.15</b>	<b>0.86</b>			<b>63.8</b>
Total Activity	1.14E+01	4.70E+00					J	<b>0.53</b>	<b>0.21</b>			<b>28.0</b>

Tonawanda Data Summary Tables

Analyses	TMF-0176				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	DER		RPD
Am-241								1.20E-01	1.60E-01			U
Ra-226	9.50E-01	2.60E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.80E-01	2.10E-01										
Th-230	1.02E+00	2.00E-01										
Th-232	1.10E+00	2.10E-01										
U-234	7.00E-01	2.00E-01										
U-235	5.60E-02	5.20E-02						-1.00E-02	2.60E-01			U
U-238	7.60E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.52E+00</b>	<b>2.95E-01</b>										
<b>Alpha Sum</b>	<b>5.48E+00</b>	<b>1.20E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.95E+01	3.60E+00										
Th-234 (Assumed from U-238)	7.60E-01	2.10E-01						4.00E-02	5.00E-01			U
Pa-234m (Assumed from U-238)	7.60E-01	2.10E-01						2.80E+00	7.00E+00			U
Ac-227												
Ra-228	8.30E-01	2.10E-01										
Pa-231	-1.00E-01	1.20E+00										U
<b>Beta Sum</b>	<b>2.18E+01</b>	<b>3.62E+00</b>						<b>2.32E+01</b>	<b>7.89E+00</b>			
<b>Total Activity Sum</b>	<b>2.73E+01</b>	<b>3.82E+00</b>						<b>2.86E+01</b>	<b>7.98E+00</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	5.80E+00	1.10E+00						<b>0.20</b>	<b>(from gamma)</b>			<b>5.75</b>
Gross Beta	5.44E+00	9.80E-01					J	<b>4.37</b>	<b>2.23</b>			<b>120</b>
Total Activity	8.70E+00	3.80E+00					J	<b>3.46</b>	<b>2.25</b>			<b>103</b>

Tonawanda Data Summary Tables

Analyses	TMF-0178					FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)	
Am-241								7.00E-02	1.20E-01			U
Ra-226	8.20E-01	2.10E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.60E-01	1.80E-01										
Th-230	1.02E+00	1.80E-01										
Th-232	8.50E-01	1.50E-01										
U-234	7.10E-01	2.10E-01	9.20E-01	2.30E-01	0.67	25.8						
U-235	1.20E-02	3.50E-02	9.60E-02	6.60E-02	1.12	156	U	3.20E-01	3.00E-01			
U-238	1.09E+00	2.70E-01	8.50E-01	2.20E-01	0.69	24.7						
<b>Total U Alpha</b>	<b>1.81E+00</b>	<b>3.44E-01</b>	<b>1.87E+00</b>	<b>3.25E-01</b>								
<b>Alpha Sum</b>	<b>4.83E+00</b>	<b>1.78E+00</b>	<b>1.87E+00</b>	<b>3.25E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.18E+01	2.90E+00										
Th-234 (Assumed from U-238)	1.09E+00	2.70E-01	8.50E-01	2.20E-01	0.69	24.7		8.50E-01	7.40E-01			
Pa-234m (Assumed from U-238)	1.09E+00	2.70E-01	8.50E-01	2.20E-01	0.69	24.7		3.60E+00	9.80E+00			U
Ac-227												
Ra-228	7.20E-01	2.70E-01										
Pa-231	-7.00E-01	1.90E+00					U					
<b>Beta Sum</b>	<b>1.46E+01</b>	<b>2.95E+00</b>	<b>1.70E+00</b>	<b>3.11E-01</b>				<b>1.69E+01</b>	<b>1.03E+01</b>			
<b>Total Activity Sum</b>	<b>1.94E+01</b>	<b>3.44E+00</b>	<b>3.57E+00</b>	<b>4.50E-01</b>				<b>2.17E+01</b>	<b>1.04E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.58E+00	9.30E-01						0.37	(from gamma)			14.4
Gross Beta	4.09E+00	7.00E-01					J	3.48	1.25			113
Total Activity	1.16E+01	4.30E+00					J	1.42	0.90			50.6

Tonawanda Data Summary Tables

Analyses	TMF-0179				FROM GAMMA							Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)	
Am-241								3.60E-01	5.30E-01			U
Ra-226	6.60E-01	2.00E-01	8.90E-01	2.30E-01	0.75	29.7						
Np-237												
Pu-238												
Pu-239												
Th-228	7.60E-01	1.60E-01										
Th-230	8.30E-01	1.50E-01										
Th-232	8.30E-01	1.50E-01										
U-234	6.10E-01	1.80E-01										
U-235	5.00E-03	2.30E-02					U	0.00E+00	2.90E-01			U
U-238	7.80E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.40E+00</b>	<b>2.78E-01</b>										
<b>Alpha Sum</b>	<b>3.76E+00</b>	<b>1.59E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.36E+01	3.10E+00										
Th-234 (Assumed from U-238)	7.80E-01	2.10E-01						7.00E-01	1.00E+00			U
Pa-234m (Assumed from U-238)	7.80E-01	2.10E-01						-2.00E+00	1.20E+01			U
Ac-227												
Ra-228	6.40E-01	2.70E-01										
Pa-231	-8.00E-01	1.70E+00					U					
<b>Beta Sum</b>	<b>1.57E+01</b>	<b>3.13E+00</b>						<b>1.28E+01</b>	<b>1.24E+01</b>			
<b>Total Activity Sum</b>	<b>1.95E+01</b>	<b>3.51E+00</b>						<b>1.66E+01</b>	<b>1.25E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	4.51E+00	9.60E-01						<b>0.41</b>	<b>(from gamma)</b>			<b>18.3</b>
Gross Beta	4.16E+00	8.40E-01					J	<b>3.56</b>	<b>0.70</b>			<b>116</b>
Total Activity	6.80E+00	3.70E+00					J	<b>2.48</b>	<b>0.75</b>			<b>96.4</b>

Tonawanda Data Summary Tables

Analyses	TMF-0181				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					9.00E-02	1.10E-01					U
Ra-226	3.70E-01	1.80E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	5.80E-01	1.30E-01									
Th-230	7.00E-01	1.30E-01									
Th-232	4.70E-01	1.00E-01									
U-234	5.30E-01	1.70E-01									
U-235	8.70E-02	6.40E-02			-2.30E-01	3.20E-01					U
U-238	5.80E-01	1.80E-01									
<b>Total U Alpha</b>	<b>1.20E+00</b>	<b>2.56E-01</b>									
<b>Alpha Sum</b>	<b>3.32E+00</b>	<b>1.75E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
K-40	1.22E+01	3.30E+00									
Cs-137	1.37E-01	9.40E-02									
Th-234 (Assumed from U-238)	5.80E-01	1.80E-01			5.60E-01	6.50E-01					
Pa-234m (Assumed from U-238)	5.80E-01	1.80E-01			-5.00E+00	1.30E+01					U
Ac-227											
Ra-228	4.30E-01	3.10E-01									
Pa-231	0.00E+00	1.90E+00									U
<b>Beta Sum</b>	<b>1.39E+01</b>	<b>3.33E+00</b>			<b>8.33E+00</b>	<b>1.34E+01</b>					
<b>Total Activity Sum</b>	<b>1.72E+01</b>	<b>3.77E+00</b>			<b>1.16E+01</b>	<b>1.35E+01</b>					
					<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	5.20E+00	1.10E+00			<b>0.91</b>	<b>(from gamma)</b>				<b>44.2</b>	
Gross Beta	4.38E+00	9.50E-01			<b>2.75</b>	<b>0.29</b>				<b>104</b>	
Total Activity	1.28E+01	6.30E+00			<b>0.61</b>	<b>0.08</b>				<b>29.6</b>	

Tonawanda Data Summary Tables

Analyses	TMF-0182				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-4.00E-02	2.60E-01			U
Ra-226	6.50E-01	2.80E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.04E+00	1.80E-01										
Th-230	9.70E-01	1.70E-01										
Th-232	1.08E+00	1.80E-01										
U-234	6.60E-01	1.90E-01										
U-235	4.80E-02	4.90E-02						5.00E-02	2.60E-01			U
U-238	7.60E-01	2.10E-01										
<b>Total U Alpha</b>	<b>1.47E+00</b>	<b>2.87E-01</b>										
<b>Alpha Sum</b>	<b>5.93E+00</b>	<b>1.36E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	2.02E+01	3.70E+00										
Th-234 (Assumed from U-238)	7.60E-01	2.10E-01						1.16E+00	9.70E-01			
Pa-234m (Assumed from U-238)	7.60E-01	2.10E-01						-1.20E+00	7.20E+00			U
Ac-227												
Ra-228	8.40E-01	2.20E-01										
Pa-231	8.00E-01	1.40E+00										U
<b>Beta Sum</b>	<b>2.27E+01</b>	<b>3.72E+00</b>						<b>2.11E+01</b>	<b>8.16E+00</b>			
<b>Total Activity Sum</b>	<b>2.86E+01</b>	<b>3.96E+00</b>						<b>2.70E+01</b>	<b>8.27E+00</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	6.00E+00	1.10E+00						<b>0.04</b>	<b>(from gamma)</b>			<b>1.21</b>
Gross Beta	5.43E+00	9.70E-01					J	<b>4.48</b>	<b>1.91</b>			<b>123</b>
Total Activity	9.30E+00	3.80E+00					J	<b>3.51</b>	<b>1.95</b>			<b>102</b>

Tonawanda Data Summary Tables

Analyses	TMF-0187				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					-8.00E-02	1.30E-01					U
Ra-226	1.48E+00	2.90E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	1.15E+00	2.00E-01									
Th-230	1.36E+00	2.20E-01									
Th-232	1.01E+00	1.70E-01									
U-234	1.19E+00	2.90E-01									
U-235	7.90E-02	6.50E-02			2.10E-01	3.30E-01					U
U-238	1.05E+00	2.70E-01									
<b>Total U Alpha</b>	<b>2.32E+00</b>	<b>4.02E-01</b>									
<b>Alpha Sum</b>	<b>6.78E+00</b>	<b>1.73E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
K-40	1.56E+01	3.60E+00									
Cs-137	2.30E-01	1.20E-01									
Th-234 (Assumed from U-238)	1.05E+00	2.70E-01			7.40E-01	6.80E-01					
Pa-234m (Assumed from U-238)	1.05E+00	2.70E-01			0.00E+00	1.40E+01					U
Ac-227											
Ra-228	1.08E+00	3.60E-01									
Pa-231	-6.00E-01	1.80E+00									U
<b>Beta Sum</b>	<b>1.89E+01</b>	<b>3.65E+00</b>			<b>1.76E+01</b>	<b>1.45E+01</b>					
<b>Total Activity Sum</b>	<b>2.57E+01</b>	<b>4.04E+00</b>			<b>2.44E+01</b>	<b>1.46E+01</b>					
					<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	7.70E+00	1.30E+00			0.43	(from gamma)			12.7		
Gross Beta	6.50E+00	1.00E+00			J 3.29	0.76			97.8		
Total Activity	1.86E+01	5.10E+00			J 1.09	0.37			32.1		



Tonawanda Data Summary Tables

0107095-14	TMF-0188				FROM GAMMA							Val		
	Result	Uncertainty	Duplicate Result	Duplicate Uncertainty	DER	RPD	Val Q	Result	Uncertainty	Duplicate Result	Duplicate Uncertainty		DER	RPD
Analyses	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)				(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)			
Am-241								1.70E-01	3.50E-01					U
Ra-226	8.50E-01	2.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	1.80E-01												
Th-230	9.90E-01	1.70E-01												
Th-232	7.80E-01	1.40E-01												
U-234	6.50E-01	2.00E-01												
U-235	2.90E-02	4.30E-02					U	3.80E-01	3.00E-01					
U-238	7.00E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.38E+00</b>	<b>2.93E-01</b>												
<b>Alpha Sum</b>	<b>4.76E+00</b>	<b>1.60E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.80E+01	3.70E+00												
Th-234 (Assumed from U-238)	7.00E-01	2.10E-01						7.30E-01	7.70E-01					
Pa-234m (Assumed from U-238)	7.00E-01	2.10E-01						6.60E+00	7.80E+00					
Ac-227														
Ra-228	6.80E-01	2.50E-01												
Pa-231	-2.00E-01	1.70E+00					U							
<b>Beta Sum</b>	<b>2.01E+01</b>	<b>3.73E+00</b>						<b>2.60E+01</b>	<b>8.67E+00</b>					
<b>Total Activity Sum</b>	<b>2.48E+01</b>	<b>4.05E+00</b>						<b>3.07E+01</b>	<b>8.82E+00</b>					
<b>DER (sums to gross)</b>														
Gross Alpha	4.60E+00	1.10E+00						<b>0.08</b>	<b>(from gamma)</b>			<b>3.40</b>		
Gross Beta	5.60E+00	1.10E+00					J	<b>3.72</b>	<b>2.33</b>			<b>113</b>		
Total Activity	7.40E+00	3.80E+00					J	<b>3.13</b>	<b>2.43</b>			<b>108</b>		

Tonawanda Data Summary Tables

Analyses	TMF-0184				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241							1.00E-02	1.80E-01				U
Ra-226	1.01E+00	4.40E-01	8.10E-01	2.30E-01	0.40	22						
Np-237												
Pu-238												
Pu-239												
Th-228	8.60E-01	1.60E-01										
Th-230	8.70E-01	1.50E-01										
Th-232	8.50E-01	1.40E-01										
U-234	8.30E-01	2.50E-01										
U-235	1.32E-01	9.00E-02					1.50E-01	2.90E-01				U
U-238	8.10E-01	2.40E-01										
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.58E-01</b>										
<b>Alpha Sum</b>	<b>4.82E+00</b>	<b>1.41E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.74E+01	3.30E+00										
Th-234 (Assumed from U-238)	8.10E-01	2.40E-01					6.20E-01	7.80E-01				U
Pa-234m (Assumed from U-238)	8.10E-01	2.40E-01					-6.00E+00	8.70E+00				U
Ac-227												
Ra-228	7.20E-01	2.10E-01										
Pa-231	-6.00E-01	1.40E+00										U
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.33E+00</b>					<b>1.27E+01</b>	<b>9.34E+00</b>				
<b>Total Activity Sum</b>	<b>2.45E+01</b>	<b>3.61E+00</b>					<b>1.75E+01</b>	<b>9.45E+00</b>				
<b>DER (sums to gross)</b>												
Gross Alpha	4.87E+00	9.10E-01					<b>0.03</b>	<b>(from gamma)</b>			<b>0.99</b>	
Gross Beta	4.66E+00	7.90E-01					<b>4.39</b>	<b>0.85</b>			<b>123</b>	
Total Activity	7.90E+00	4.10E+00					<b>3.04</b>	<b>0.93</b>			<b>102</b>	

Tonawanda Data Summary Tables

Analyses	TMF-0185				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-8.00E-02	2.10E-01			U
Ra-226	5.10E-01	1.70E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.40E-01	1.10E-01										
Th-230	5.80E-01	1.40E-01										
Th-232	1.62E-01	6.20E-02										
U-234	6.30E-01	2.00E-01										
U-235	4.60E-02	5.00E-02						-5.00E-02	2.50E-01			U
U-238	5.40E-01	1.80E-01										
<b>Total U Alpha</b>	<b>1.22E+00</b>	<b>2.74E-01</b>										
<b>Alpha Sum</b>	<b>1.89E+00</b>	<b>1.06E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	2.55E+00	9.00E-01										
Th-234 (Assumed from U-238)	5.40E-01	1.80E-01						2.80E-01	7.50E-01			U
Pa-234m (Assumed from U-238)	5.40E-01	1.80E-01						2.00E-01	5.80E+00			U
Ac-227												
Ra-228	1.40E-01	1.50E-01										
Pa-231	-8.00E-01	1.10E+00										U
<b>Beta Sum</b>	<b>3.67E+00</b>	<b>9.56E-01</b>						<b>3.07E+00</b>	<b>5.92E+00</b>			
<b>Total Activity Sum</b>	<b>5.56E+00</b>	<b>1.43E+00</b>						<b>4.96E+00</b>	<b>6.01E+00</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	5.20E+00	1.80E+00						1.59	(from gamma)			93.5
Gross Beta	2.40E+00	1.70E+00					J	0.65	0.11			41.9
Total Activity	7.10E+00	3.80E+00					J	0.38	0.30			24.3

**Tonawanda Data Summary Tables**

Analyses	TMF-9199				FROM GAMMA							Val			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241							1.00E-02	1.30E-01	9.00E-02	1.20E-01	0.45	160	U		
Ra-226	5.80E-01	2.30E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	7.80E-01	1.80E-01													
Th-230	9.20E-01	1.80E-01													
Th-232	8.10E-01	1.60E-01													
U-234	1.00E+00	2.60E-01													
U-235	8.80E-02	6.70E-02					7.00E-02	4.50E-01	-4.00E-02	4.50E-01	0.17	733	U		
U-238	9.00E-01	2.40E-01													
<b>Total U Alpha</b>	<b>1.99E+00</b>	<b>3.60E-01</b>													
<b>Alpha Sum</b>	<b>2.38E+00</b>	<b>3.19E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	2.29E+01	6.30E+00	1.94E+01	5.10E+00	0.43	16.5									
Th-234 (Assumed from U-238)	9.00E-01	2.40E-01					-2.00E-01	1.10E+00	7.00E-01	1.00E+00	0.61	360	U		
Pa-234m (Assumed from U-238)	9.00E-01	2.40E-01					1.90E+01	2.10E+01	-1.50E+01	1.70E+01	1.26	1700			
Ac-227															
Ra-228	4.40E-01	6.30E-01	5.00E-01	5.30E-01	0.07	12.8							U		
Pa-231	-3.00E+00	3.50E+00	-9.00E-01	2.50E+00	0.49	108							U		
<b>Beta Sum</b>	<b>2.48E+01</b>	<b>6.35E+00</b>					<b>4.18E+01</b>	<b>2.20E+01</b>	<b>5.49E+00</b>	<b>1.78E+01</b>					
<b>Total Activity Sum</b>	<b>2.72E+01</b>	<b>7.11E+00</b>					<b>4.42E+01</b>	<b>2.22E+01</b>							
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>					
Gross Alpha	6.90E+00	1.30E+00					1.31	(from gamma)			97.5				
Gross Beta	5.50E+00	1.00E+00					3.00	1.65			127				
Total Activity	1.14E+01	4.40E+00					1.88	1.45			81.7				

Tonawanda Data Summary Tables

Analyses	TMF-9200				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					-1.60E-01	2.50E-01					U
Ra-226	4.70E-01	2.20E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	8.90E-01	1.80E-01									
Th-230	8.10E-01	1.60E-01									
Th-232	8.20E-01	1.60E-01									
U-234	7.40E-01	2.00E-01									
U-235	8.10E-02	6.20E-02			1.40E-01	2.30E-01					U
U-238	8.50E-01	2.20E-01									
<b>Total U Alpha</b>	<b>1.67E+00</b>	<b>3.04E-01</b>									
<b>Alpha Sum</b>	<b>3.04E+00</b>	<b>1.95E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
K-40	1.88E+01	3.40E+00									
Th-234 (Assumed from U-238)	8.50E-01	2.20E-01			1.54E+00	8.10E-01					
Pa-234m (Assumed from U-238)	8.50E-01	2.20E-01			-8.00E-01	7.20E+00					U
Ac-227											
Ra-228	6.50E-01	1.80E-01									
Pa-231	-1.80E+00	2.10E+00									U
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>3.43E+00</b>			<b>2.00E+01</b>	<b>8.01E+00</b>					
<b>Total Activity Sum</b>	<b>2.40E+01</b>	<b>3.94E+00</b>			<b>2.30E+01</b>	<b>8.24E+00</b>					
					<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	6.50E+00	1.30E+00			1.48	(from gamma)		72.5			
Gross Beta	5.70E+00	1.00E+00			4.27	1.77		114			
Total Activity	9.10E+00	3.90E+00			2.68	1.53		89.9			

Tonawanda Data Summary Tables

Analyses	TMF-0166				FROM GAMMA						Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)			
Am-241					1.00E-02	1.00E-01					U
Ra-226	9.70E-01	2.30E-01									
Np-237											
Pu-238											
Pu-239											
Th-228	9.60E-01	1.80E-01									
Th-230	8.70E-01	1.60E-01									
Th-232	7.60E-01	1.40E-01									
U-234	9.60E-01	2.60E-01									
U-235	5.00E-02	5.10E-02			-1.00E-02	2.90E-01					U
U-238	7.00E-01	2.10E-01									
<b>Total U Alpha</b>	<b>1.71E+00</b>	<b>3.38E-01</b>									
<b>Alpha Sum</b>	<b>3.74E+00</b>	<b>1.69E+00</b>									
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
K-40	1.63E+01	3.80E+00									
Th-234 (Assumed from U-238)	7.00E-01	2.10E-01			9.30E-01	7.10E-01					
Pa-234m (Assumed from U-238)	7.00E-01	2.10E-01			3.00E+00	1.20E+01					U
Ac-227											
Ra-228	5.00E-01	3.20E-01									
Pa-231	-1.70E+00	1.80E+00									U
<b>Beta Sum</b>	<b>1.80E+01</b>	<b>3.83E+00</b>			<b>2.05E+01</b>	<b>1.26E+01</b>					
<b>Total Activity Sum</b>	<b>2.17E+01</b>	<b>4.19E+00</b>			<b>2.43E+01</b>	<b>1.27E+01</b>					
					<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	6.50E+00	1.20E+00			1.33	(from gamma)			53.9		
Gross Beta	5.40E+00	1.00E+00			3.18	1.20			108		
Total Activity	9.90E+00	4.10E+00			2.02	1.07			74.8		

Tonawanda Data Summary Tables

Analyses	TMF-0167				FROM GAMMA							Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)	
Am-241								-1.30E-01	5.00E-01			U
Ra-226	7.20E-01	2.00E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.70E-01	1.70E-01										
Th-230	8.30E-01	1.40E-01										
Th-232	9.80E-01	1.60E-01										
U-234	7.90E-01	2.20E-01										
U-235	1.10E-02	2.40E-02				U		-8.00E-02	3.40E-01			U
U-238	9.50E-01	2.50E-01										
<b>Total U Alpha</b>	<b>1.75E+00</b>	<b>3.34E-01</b>										
<b>Alpha Sum</b>	<b>4.35E+00</b>	<b>1.86E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.89E+01	3.80E+00										
Th-234 (Assumed from U-238)	9.50E-01	2.50E-01						3.80E-01	7.70E-01			U
Pa-234m (Assumed from U-238)	9.50E-01	2.50E-01						-9.00E-01	8.50E+00			U
Ac-227												
Ra-228	9.30E-01	2.60E-01										
Pa-231	-1.00E+00	2.00E+00				U						
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>3.83E+00</b>						<b>1.92E+01</b>	<b>9.35E+00</b>			
<b>Total Activity Sum</b>	<b>2.60E+01</b>	<b>4.26E+00</b>						<b>2.35E+01</b>	<b>9.53E+00</b>			
<b>DER (sums to gross)</b>												
Gross Alpha	5.80E+00	1.10E+00						<b>0.67</b>	<b>(from gamma)</b>			<b>28.5</b>
Gross Beta	5.19E+00	9.50E-01				J		<b>4.16</b>	<b>1.49</b>			<b>123</b>
Total Activity	8.30E+00	3.80E+00				J		<b>3.09</b>	<b>1.49</b>			<b>103</b>

## Radiological Analytical Data Verification Comments on Data for SDG 0107096

This sample delivery group (SDG) contained twenty individual soil samples from the Tonawanda Landfill FUSRAP Site for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] were  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry,  $^{228}\text{Ac}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ , and any radioisotopes detected above the decision level (DL) by gamma spectrometry;  $^{226}\text{Ra}$  by radon emanation; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation were requested for all samples. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics, Inc. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data; therefore, the gross alpha/beta analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0133	0107096-1
TMF-0134	0107096-2
TMF-0135	0107096-3
TMF-0136	0107096-4
TMF-0137	0107096-5
TMF-0138	0107096-6
TMF-0129	0107096-7
TMF-0130	0107965-8
TMF-9139	0107096-9
TMF-9140	0107096-10
TMF-0151	0107096-11
TMF-0152	0107096-12
TMF-0154	0107096-13
TMF-0155	0107096-14
TMF-0157	0107096-15
TMF-0158	0107096-16
TMF-0160	0107096-17
TMF-0161	0107096-18
TMF-0163	0107096-19
TMF-0164	0107096-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:



$$DER = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was an indication of blank contamination in one of the method blanks for  $^{234m}\text{Pa}$ . All associated sample results less than 5 times the blank value for  $^{234m}\text{Pa}$  analyses should be qualified as estimated (J). **Therefore, it is recommended that the  $^{234m}\text{Pa}$  results for samples TMF-0133, TMF-0133 (laboratory duplicate), TMF-0135, TMF-0136, TMF-0137, TMF-0129, TMF-9139, TMF-9140, TMF-0151, TMF-0154, TMF-0157, TMF-0160, and TMF-0163 be qualified as estimated (J).**

### Equipment Rinsate Sample:

There was no indication of contamination of the equipment rinsate blank for gamma spectrometry analyses.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ac}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported for in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{137}\text{Cs}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ ,  $^{228}\text{Ra}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples.

The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. Results for fission product  $^{137}\text{Cs}$  were reported for two samples. **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is not recommended since any modeling would assume equilibrium with  $^{235/238}\text{U}$  or  $^{232}\text{Th}$ .**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{231}\text{Pa}$  result for samples TMF-0130 and TMF-0155 and the  $^{235}\text{U}$  result for sample TMF-0160 (laboratory duplicate). **Therefore, it is recommended that the  $^{231}\text{Pa}$  result for samples TMF-0130 and TMF-0155 and the  $^{235}\text{U}$  result for sample TMF-0160 (laboratory duplicate) be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination in the  $^{234/235/238}\text{U}$  alpha spectrometry analyses. There was an indication of blank contamination in the method blank for  $^{230}\text{Th}$ . All associated sample results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples have results that are greater than 5 times the blank value for the  $^{230}\text{Th}$  analyses. No qualification is required.

### Equipment Rinsate Sample:

There was an indication of  $^{228}\text{Th}$  and  $^{230}\text{Th}$  contamination of equipment rinsate blank contamination for alpha spectrometry analyses. All associated sample results less than 5 times the blank value for  $^{228}\text{Th}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples had  $^{228}\text{Th}$  and  $^{230}\text{Th}$  results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

#### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 30.07% for all samples for the Th and U alpha spectrometry analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty for the Th and U alpha spectrometry analyses.

#### Spectral Analysis:

Spectral interferences were observed in the alpha spectra all samples except TML-0129 and TML-0130 for isotopic thorium. The spectral interference observed is from the tailing of a higher energy peak into a lower energy peak. In each case and in the matrix blank sample, the isotopic thorium analyses, the tracer peaks for  $^{229}\text{Th}$  tails into the  $^{230}\text{Th}$  peak region. The measured blank activity is below the MDC (1.0 pCi/g). Only samples TMF-0135 and TMF-0160 have  $^{230}\text{Th}$  results greater than the required MDC. **Therefore, it is recommended that the  $^{230}\text{Th}$  results for samples TMF-0133, TMF-0133 (laboratory duplicate), TMF-0134, TMF-0135, TMF-0136, TMF-0137, TMF-0137 (laboratory duplicate), TMF-0138, TMF-130, TMF-9139, TMF-9140, TMF-0151, TMF-0152, TMF-0154, TMF-0155, TMF-0157, TMF-0158, TMF-0160, TMF-0163, and TMF-0164 be qualified as estimated (J).**

Several of the isotopic thorium alpha spectra show at least five extra peaks. These peaks are in the 5.8 MeV, 6.3 MeV, 6.7 MeV, 6.9 MeV, and 7.1 MeV regions. It is assumed that the peaks can be attributed to  $^{216}\text{Po}$ ,  $^{217}\text{At}$ ,  $^{225}\text{Ac}$  and  $^{221}\text{Fr}$ , which are progeny of  $^{228}\text{Th}$  and the  $^{229}\text{Th}$  tracer. There is no indication of interference with the quantitation of the isotopic thorium results. No further qualification of the isotopic thorium results is required.

### 3.0 $^{226}\text{Ra}$ ANALYSES

#### Method Blank:

There was an indication of blank contamination in the method blank for  $^{226}\text{Ra}$  analyses. All associated sample results less than 5 times the blank value for  $^{226}\text{Ra}$  analyses should be qualified as estimated (J). Therefore, it is recommended that samples **TMF-0133, TMF-0136, TMF-0137, TMF-0138, TMF-0129, TMF-9139, TMF-9140, TMF-9140 (laboratory duplicate), TMF-0154, TMF-0155, TMF-0157, TMF-0161, TMF-0163, and TMF-0164 be qualified as estimated (J).**

#### Equipment Rinsate Sample:

There was no indication of  $^{226}\text{Ra}$  contamination of equipment rinsate blank contamination for the radon emanation analyses.

Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

Duplicate Analysis:

The duplicate DERs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/g for  $^{226}\text{Ra}$ .

#### **4.0 GROSS ALPHA AND BETA ANALYSIS**

Method Blank:

There was no indication of blank contamination in the gross alpha/beta analyses.

Equipment Rinsate Sample:

There was no indication of gross alpha or gross beta contamination of equipment rinsate blank.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs for the gross alpha/beta analyses are within acceptable limits.

Matrix Spike Sample Analysis:

The MSS result was within acceptable limits for both gross alpha and gross beta analyses.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting, which is not quantitative and does not include volatile radionuclides (e.g.,  $^3\text{H}$  and  $^{99}\text{Tc}$ ).**

Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. The for the gross alpha analyses for samples TMF-0152, TMF-0155, and TMF-0157 exceeded the required MDL. The MDLs for the gross beta analyses for samples TMF-0152, TMF-0154, TMF-0155, and TMF-157 also exceeded the required MDL. The maximum MDL is 1.2 pCi/g. Since the gross alpha/beta analyses are activity estimates, no qualification is required.

## **5.0 TOTAL ACTIVITY**

Method Blank:

There was no indication of blank contamination for the total activity analyses.

Equipment Rinsate Sample:

There was no indication of total activity contamination of equipment rinsate blank.

Laboratory Control Sample:

The percent recoveries for the reported LCSs are within acceptable limits for the total activity analysis.

Duplicate Analysis:

The total activity laboratory duplicate DER is within acceptable limits.

Matrix Spike Sample:

The MSS recovery was within acceptable limits for the total activity analysis.

Spectral Analysis:

Spectral plots of the total activity analyses were not included in the laboratory data package.

Method Detection Limit:

The required method detection limit (MDL) for the total activity analysis is 10 pCi/g. All samples met the required MDLs.

## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gamma agree within the uncertainties. No further qualification of the gamma spectrometry results is required.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DER for all samples indicates that the gross alpha analyses agree with the sum of the alpha emitters within a 99% confidence level.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (from 2.25 to 4.75) for all samples are greater than or equal to 1.29 indicating that the gross beta analyses are in agreement with the sum of the beta emitters within a 99% confidence level. The corresponding RPDs (from 101% to 142%) are also outside acceptable limits. The gross beta activity for all samples was smaller than the beta sum values by approximately a factor of 4. This difference may be indicative of a negative bias in the gross beta sample results. **Therefore, it is recommended that the gross beta results from all samples be qualified as estimated (J).**

### Total Activity to Sum of Alpha and Beta Emitters:

The DERs (2.36, 2.99, 2.82, 3.01, 1.61, 2.40, 2.92, 2.91, 3.53, 1.66, 2.99, 2.78, 2.06, 1.50, 3.72, 1.81, 3.25, and 3.69) for samples TMF-0133, TMF-0134, TMF-0135, TMF-0136, TMF-0137, TMF-0138, TMF-0129, TMF-0130, TMF-9139, TMF-9140, TMF-0152, TMF-0154, TML-0155, TMF-0157, TMF-0158, TMF-0160, TMF-0161, and TMF-0164 indicate that the total activity analysis does not agree with the sum of the alpha and beta emitters within a 99% confidence level. In addition, the corresponding RPDs (93.3%, 93.4%, 110%, 104%, 84.3%, 84.7%, 133%, 105%, 144%, 68%, 99.0%, 115%, 69.4%, 73.8%, 128%, 59.9%, 97.7%, and 107%) are also outside acceptable limits. The total activity results ranged from approximately a factor of 2 to 5 lower than the total activity sums. Again, this may be indicative of a negative bias in the total activity. **Therefore, it is recommended that the total activity results from samples TMF-0133, TMF-0134, TMF-0135, TMF-0136, TMF-0137, TMF-0138, TMF-0129, TMF-0130, TMF-9139, TMF-9140, TMF-0152, TMF-0154, TMF-0155, TMF-0157, TMF-0158, TMF-0160, TMF-0161, and TMF-0164 be qualified as estimated (J).**

$^{228}\text{Ra}$  Gamma to  $^{232}\text{Th}$  Alpha:

When comparing the  $^{228}\text{Ra}$  activity to  $^{232}\text{Th}$  activity, it was assumed that the radium and thorium were in equilibrium. The activities are all within the uncertainties of the measurements for all samples.

$^{231}\text{Pa}$  Gamma to  $^{235}\text{U}$  Alpha:

When comparing the  $^{231}\text{Pa}$  gamma activity and  $^{235}\text{U}$  alpha activity, it was assumed that the protactinium was in equilibrium. The  $^{231}\text{Pa}$  and  $^{235}\text{U}$  activities are within the measurement uncertainties for all samples except TMF-0130 and TMF-0155. Since the  $^{231}\text{Pa}$  gamma activity results for samples TMF-0130 and TMF-0155 were previously qualified for improper background subtraction, no further qualification is necessary.

Summary:

For all samples, there was agreement within the measurement uncertainties between the total activity results and the sum of the gross alpha and gross beta results. However, there appears to be a negative bias on the gross alpha/beta and total activity results. **Therefore, it is recommended that the individual analysis results be used.**

Tonwanda Data Summary Tables

0107096-1		TMF-0133					FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q		
															Am-241	
Ra-226	6.70E-01	2.70E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	7.70E-01	1.30E-01	8.20E-01	1.30E-01	0.27	6.29										
Th-230	8.00E-01	1.30E-01	8.00E-01	1.30E-01	0.00	0.00	J									
Th-232	7.10E-01	1.10E-01	7.50E-01	1.20E-01	0.25	5.48										
U-234	1.03E+00	2.50E-01														
U-235	1.49E-01	8.10E-02					-2.70E-01	5.20E-01	4.30E-01	5.80E-01	0.90	875	U			
U-238	8.70E-01	2.20E-01														
<b>Total U Alpha</b>	<b>2.05E+00</b>	<b>3.43E-01</b>														
<b>Alpha Sum</b>	<b>4.64E+00</b>	<b>2.39E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Cs-137	2.50E-01	1.20E-01	2.60E-01	1.70E-01	0.05	3.92										
Th-234 (Assumed from U-238)	8.70E-01	2.20E-01					6.00E-01	1.60E+00	1.30E+00	1.60E+00	0.31	73.7	U			
Pa-234m (Assumed from U-238)	8.70E-01	2.20E-01					-3.00E+00	1.80E+01	3.40E+01	2.60E+01	1.17	239	UJ			
K-40	1.44E+01	3.40E+00	1.07E+01	4.40E+00	0.67	29.5										
Ra-228	7.40E-01	3.60E-01	7.10E-01	5.30E-01	0.05	4.14										
Pa-231	-4.00E-01	2.60E+00	0.00E+00	3.30E+00	0.10	200	U									
<b>Beta Sum</b>	<b>1.71E+01</b>	<b>3.45E+00</b>					<b>1.29E+01</b>	<b>1.84E+01</b>	<b>4.70E+01</b>	<b>2.64E+01</b>						
<b>Total Activity Sum</b>	<b>2.17E+01</b>	<b>4.20E+00</b>					<b>1.76E+01</b>	<b>1.85E+01</b>								
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	4.20E+00	7.20E-01					0.18	(from gamma)			9.93					
Gross Beta	3.66E+00	6.20E-01					J	3.83	0.50			129				
Total Activity	7.90E+00	4.10E+00					J	2.36	0.51			93.3				



**Tonwanda Data Summary Tables**

<b>0107096-2</b>		<b>TMF-0134</b>					<b>FROM GAMMA</b>							
<b>Analyses</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Duplicate</b>		<b>DER</b>	<b>RPD</b>	<b>Val Q</b>	<b>Duplicate</b>		<b>Duplicate</b>		<b>DER</b>	<b>RPD</b>	<b>Val Q</b>
			<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>				<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>			
Am-241								7.00E-02	2.40E-01	2.10E-01	5.10E-01	<b>0.25</b>	<b>100</b>	U
Ra-226	1.08E+00	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.80E-01	1.70E-01												
Th-230	8.80E-01	1.50E-01					J							
Th-232	1.08E+00	1.80E-01												
U-234	8.50E-01	2.20E-01	7.90E-01	2.10E-01	<b>0.20</b>	<b>7.32</b>								
U-235	1.54E-01	8.30E-02	6.20E-02	5.50E-02	<b>0.92</b>	<b>85.2</b>		3.00E-02	2.80E-01	1.00E-01	3.00E-01	<b>0.17</b>	<b>108</b>	U
U-238	7.50E-01	2.00E-01	8.30E-01	2.10E-01	<b>0.28</b>	<b>10.1</b>								
<b>Total U Alpha</b>	<b>1.75E+00</b>	<b>3.09E-01</b>	<b>1.68E+00</b>	<b>3.02E-01</b>										
<b>Alpha Sum</b>	<b>4.33E+00</b>	<b>1.95E+00</b>	<b>2.04E+00</b>	<b>1.38E+00</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.50E-01	2.00E-01	8.30E-01	2.10E-01	<b>0.28</b>	<b>10.1</b>		1.60E+00	9.30E-01	5.00E-01	1.10E+00	<b>0.76</b>	<b>105</b>	
Pa-234m (Assumed from U-238)	7.50E-01	2.00E-01	8.30E-01	2.10E-01	<b>0.28</b>	<b>10.1</b>		6.80E+00	7.20E+00	0.00E+00	8.00E+00	<b>0.63</b>	<b>200</b>	
K-40	2.08E+01	3.70E+00	1.83E+01	3.70E+00	<b>0.48</b>	<b>12.8</b>								
Ra-228	8.10E-01	2.00E-01	7.90E-01	2.40E-01	<b>0.06</b>	<b>2.50</b>								
Pa-231	-1.60E+00	2.10E+00	4.00E-01	1.50E+00	<b>0.77</b>	<b>333</b>	U							
<b>Beta Sum</b>	<b>2.29E+01</b>	<b>3.72E+00</b>	<b>2.08E+01</b>	<b>3.72E+00</b>				<b>2.98E+01</b>	<b>8.15E+00</b>	<b>1.96E+01</b>	<b>8.89E+00</b>			
<b>Total Activity Sum</b>	<b>2.73E+01</b>	<b>4.21E+00</b>	<b>2.28E+01</b>	<b>3.97E+00</b>				<b>3.42E+01</b>	<b>8.39E+00</b>	<b>2.17E+01</b>	<b>8.99E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.20E+00	1.20E+00						<b>0.81</b>	<b>(from gamma)</b>		<b>35.4</b>			
Gross Beta	5.31E+00	9.60E-01					J	<b>4.58</b>	<b>2.98</b>		<b>125</b>			
Total Activity	9.90E+00	4.00E+00					J	<b>2.99</b>	<b>2.61</b>		<b>93.4</b>			

Tonwanda Data Summary Tables

0107096-3			TMF-0135		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-5.00E-02	1.50E-01					U
Ra-226	1.05E+00	2.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.27E+00	2.00E-01												
Th-230	1.14E+00	1.80E-01					J							
Th-232	1.20E+00	1.90E-01												
U-234	8.50E-01	2.20E-01												
U-235	1.76E-01	8.80E-02						7.00E-02	4.70E-01					U
U-238	7.20E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.75E+00</b>	<b>3.10E-01</b>												
<b>Alpha Sum</b>	<b>6.41E+00</b>	<b>2.48E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.20E-01	2.00E-01						1.20E+00	1.20E+00					
Pa-234m (Assumed from U-238)	7.20E-01	2.00E-01						-1.00E+01	2.80E+01					UJ
K-40	1.99E+01	5.40E+00												
Ra-228	7.40E-01	6.10E-01												
Pa-231	0.00E+00	2.70E+00					U							
<b>Beta Sum</b>	<b>2.21E+01</b>	<b>5.45E+00</b>						<b>1.18E+01</b>	<b>2.85E+01</b>					
<b>Total Activity Sum</b>	<b>2.85E+01</b>	<b>5.99E+00</b>						<b>1.82E+01</b>	<b>2.87E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.90E+00	1.10E+00						<b>0.18</b>	<b>(from gamma)</b>			<b>7.43</b>		
Gross Beta	4.62E+00	7.50E-01					J	<b>3.17</b>	<b>0.25</b>			<b>131</b>		
Total Activity	8.30E+00	3.90E+00					J	<b>2.82</b>	<b>0.34</b>			<b>110</b>		

Tonwanda Data Summary Tables

0107096-4			TMF-0136		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									9.00E-02	3.20E-01						U
Ra-226	6.80E-01	2.20E-01						J								
Np-237																
Pu-238																
Pu-239																
Th-228	8.60E-01	1.40E-01														
Th-230	7.40E-01	1.20E-01						J								
Th-232	8.20E-01	1.30E-01														
U-234	7.50E-01	2.20E-01														
U-235	1.15E-01	7.70E-02							-2.30E-01	4.10E-01						U
U-238	7.30E-01	2.10E-01														
<b>Total U Alpha</b>	<b>1.60E+00</b>	<b>3.14E-01</b>														
<b>Alpha Sum</b>	<b>4.52E+00</b>	<b>2.03E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.30E-01	2.10E-01							1.20E+00	1.10E+00						
Pa-234m (Assumed from U-238)	7.30E-01	2.10E-01							1.00E+01	1.30E+01						UJ
K-40	1.96E+01	4.00E+00														
Ra-228	6.80E-01	2.70E-01														
Pa-231	-2.00E-01	2.20E+00						U								
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>4.03E+00</b>							<b>3.15E+01</b>	<b>1.37E+01</b>						
<b>Total Activity Sum</b>	<b>2.62E+01</b>	<b>4.51E+00</b>							<b>3.60E+01</b>	<b>1.38E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.00E+00	1.00E+00	4.90E+00	9.80E-01	<b>0.07</b>	<b>2.02</b>			<b>0.21</b>	<b>(from gamma)</b>						<b>10.2</b>
Gross Beta	4.13E+00	8.40E-01	4.70E+00	8.90E-01	<b>0.47</b>	<b>12.9</b>	J		<b>4.27</b>	<b>2.00</b>						<b>136</b>
Total Activity	8.30E+00	3.90E+00	8.60E+00	3.90E+00	<b>0.05</b>	<b>3.55</b>	J		<b>3.01</b>	<b>1.93</b>						<b>104</b>

**Tonwanda Data Summary Tables**

0107096-5			TMF-0137		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q	
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									8.00E-02	1.50E-01						U
Ra-226	9.10E-01	2.20E-01	1.18E+00	2.80E-01	0.76	26	J									
Np-237																
Pu-238																
Pu-239																
Th-228	8.90E-01	1.30E-01	8.90E-01	1.40E-01	0.00	0.00										
Th-230	9.30E-01	1.40E-01	8.90E-01	1.30E-01	0.21	4.40	J									
Th-232	9.20E-01	1.30E-01	8.70E-01	1.30E-01	0.27	5.59										
U-234	8.40E-01	2.40E-01														
U-235	1.35E-01	8.70E-02							3.70E-01	5.80E-01						U
U-238	8.30E-01	2.40E-01														
<b>Total U Alpha</b>	<b>1.81E+00</b>	<b>3.50E-01</b>														
<b>Alpha Sum</b>	<b>4.56E+00</b>	<b>3.72E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	8.30E-01	2.40E-01							9.00E-01	1.40E+00						U
Pa-234m (Assumed from U-238)	8.30E-01	2.40E-01							1.20E+01	2.90E+01						UJ
K-40	1.43E+01	5.30E+00														
Ra-228	9.70E-01	7.60E-01														
Pa-231	-1.00E+00	4.10E+00														U
<b>Beta Sum</b>	<b>1.68E+01</b>	<b>5.39E+00</b>							<b>2.81E+01</b>	<b>2.95E+01</b>						
<b>Total Activity Sum</b>	<b>2.14E+01</b>	<b>6.55E+00</b>							<b>3.26E+01</b>	<b>2.98E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.08E+00	9.80E-01							<b>0.40</b>	<b>(from gamma)</b>						<b>28.7</b>
Gross Beta	4.51E+00	7.40E-01					J		<b>2.26</b>	<b>0.80</b>						<b>115</b>
Total Activity	8.70E+00	4.40E+00					J		<b>1.61</b>	<b>0.79</b>						<b>84.3</b>

Tonwanda Data Summary Tables

0107096-6		TMF-0138					FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								2.40E-01	5.00E-01					U
Ra-226	8.40E-01	2.30E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.50E-01	1.40E-01												
Th-230	8.60E-01	1.40E-01					J							
Th-232	8.30E-01	1.40E-01												
U-234	7.40E-01	2.00E-01	8.70E-01	2.40E-01	0.42	16.1								
U-235	1.19E-01	7.20E-02	1.04E-01	7.50E-02	0.14	13.5		-3.00E-02	3.20E-01					U
U-238	7.30E-01	2.00E-01	8.40E-01	2.40E-01	0.35	14.0								
<b>Total U Alpha</b>	<b>1.59E+00</b>	<b>2.92E-01</b>	<b>1.81E+00</b>	<b>3.48E-01</b>										
<b>Alpha Sum</b>	<b>4.07E+00</b>	<b>2.29E+00</b>	<b>1.81E+00</b>	<b>3.48E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01	8.40E-01	2.40E-01	0.35	14.0		1.20E+00	1.10E+00					
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01	8.40E-01	2.40E-01	0.35	14.0		2.40E+00	8.10E+00					U
K-40	1.75E+01	3.60E+00												
Ra-228	8.00E-01	2.20E-01												
Pa-231	-1.00E+00	2.50E+00					U							
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>3.63E+00</b>	<b>1.68E+00</b>	<b>3.39E-01</b>				<b>2.18E+01</b>	<b>8.94E+00</b>					
<b>Total Activity Sum</b>	<b>2.37E+01</b>	<b>4.29E+00</b>	<b>3.49E+00</b>	<b>4.86E-01</b>				<b>2.58E+01</b>	<b>9.23E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.00E+00	1.20E+00					J	0.75	(from gamma)				38.4	
Gross Beta	4.01E+00	8.40E-01					J	4.19					132	
Total Activity	9.60E+00	4.00E+00					J	2.40					84.7	

Tonwanda Data Summary Tables

0107096-7			TMF-0129		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-9.00E-02	1.30E-01					U
Ra-226	7.30E-01	2.00E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	1.13E+00	1.70E-01													
Th-230	9.60E-01	1.40E-01													
Th-232	9.50E-01	1.40E-01													
U-234	9.50E-01	2.40E-01													
U-235	1.25E-01	7.60E-02							2.10E-01	4.40E-01					U
U-238	9.90E-01	2.50E-01													
<b>Total U Alpha</b>	<b>2.07E+00</b>	<b>3.55E-01</b>													
<b>Alpha Sum</b>	<b>6.20E+00</b>	<b>2.39E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.90E-01	2.50E-01							4.00E-01	1.30E+00					U
Pa-234m (Assumed from U-238)	9.90E-01	2.50E-01							-1.00E+01	2.10E+01					UJ
K-40	1.64E+01	4.70E+00													
Ra-228	1.36E+00	6.70E-01													
Pa-231	4.00E-01	2.60E+00					U								
<b>Beta Sum</b>	<b>1.98E+01</b>	<b>4.77E+00</b>							<b>8.21E+00</b>	<b>2.16E+01</b>					
<b>Total Activity Sum</b>	<b>2.60E+01</b>	<b>5.34E+00</b>							<b>1.44E+01</b>	<b>2.17E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.79E+00	8.10E-01							<b>0.56</b>	<b>(from gamma)</b>					<b>25.6</b>
Gross Beta	4.18E+00	7.00E-01					J		<b>3.24</b>	<b>0.19</b>					<b>130</b>
Total Activity	6.50E+00	4.00E+00					J		<b>2.92</b>	<b>0.36</b>					<b>120</b>

Tonwanda Data Summary Tables

0107096-8			TMF-0130		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									8.00E-02	3.60E-01					U
Ra-226	8.90E-01	2.10E-01						J							
Np-237															
Pu-238															
Pu-239															
Th-228	9.10E-01	1.50E-01													
Th-230	7.50E-01	1.20E-01						J							
Th-232	8.10E-01	1.30E-01													
U-234	1.08E+00	2.70E-01													
U-235	2.20E-01	1.10E-01							3.20E-01	3.50E-01					
U-238	9.00E-01	2.40E-01													
<b>Total U Alpha</b>	<b>2.20E+00</b>	<b>3.78E-01</b>													
<b>Alpha Sum</b>	<b>3.13E+00</b>	<b>1.87E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.00E-01	2.40E-01							8.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	9.00E-01	2.40E-01							3.00E+00	1.00E+01					U
K-40	1.98E+01	4.10E+00													
Ra-228	9.10E-01	3.00E-01													
Pa-231	-2.70E+00	2.00E+00						UJ							
<b>Beta Sum</b>	<b>2.22E+01</b>	<b>4.13E+00</b>							<b>2.42E+01</b>	<b>1.09E+01</b>					
<b>Total Activity Sum</b>	<b>2.53E+01</b>	<b>4.53E+00</b>							<b>2.73E+01</b>	<b>1.10E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.13E+00	9.90E-01	5.70E+00	1.10E+00	<b>0.39</b>	<b>10.5</b>			<b>0.95</b>	<b>(from gamma)</b>				<b>48.4</b>	
Gross Beta	4.63E+00	8.80E-01	4.52E+00	8.70E-01	<b>0.09</b>	<b>2.40</b>	J		<b>4.16</b>	<b>1.79</b>				<b>131</b>	
Total Activity	7.90E+00	3.90E+00	8.60E+00	3.90E+00	<b>0.13</b>	<b>8.48</b>	J		<b>2.91</b>	<b>1.66</b>				<b>105</b>	

Tonwanda Data Summary Tables

0107096-9			TMF-9139		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-1.90E-01	3.90E-01					U
Ra-226	1.12E+00	2.40E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	9.70E-01	1.40E-01													
Th-230	9.30E-01	1.40E-01					J								
Th-232	9.20E-01	1.40E-01													
U-234	9.50E-01	2.50E-01													
U-235	1.44E-01	8.50E-02							-3.00E-01	5.10E-01					U
U-238	1.04E+00	2.60E-01													
<b>Total U Alpha</b>	<b>2.13E+00</b>	<b>3.71E-01</b>													
<b>Alpha Sum</b>	<b>4.45E+00</b>	<b>2.31E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	1.04E+00	2.60E-01							7.00E-01	1.20E+00					U
Pa-234m (Assumed from U-238)	1.04E+00	2.60E-01							9.00E+00	1.60E+01					UJ
K-40	1.85E+01	4.00E+00													
Ra-228	8.60E-01	4.40E-01													
Pa-231	-1.80E+00	2.50E+00					U								
<b>Beta Sum</b>	<b>2.12E+01</b>	<b>4.05E+00</b>							<b>2.88E+01</b>	<b>1.65E+01</b>					
<b>Total Activity Sum</b>	<b>2.57E+01</b>	<b>4.66E+00</b>							<b>3.33E+01</b>	<b>1.67E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.14E+00	7.30E-01							<b>0.13</b>	<b>(from gamma)</b>			<b>7.31</b>		
Gross Beta	3.59E+00	6.30E-01					J		<b>4.30</b>	<b>1.53</b>			<b>142</b>		
Total Activity	4.20E+00	3.90E+00					J		<b>3.53</b>	<b>1.70</b>			<b>144</b>		



**Tonwanda Data Summary Tables**

0107096-10			TMF-9140		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									1.00E-02	1.20E-01					U
Ra-226	9.60E-01	2.20E-01	9.20E-01	2.10E-01	0.13	4.26	J								
Np-237															
Pu-238															
Pu-239															
Th-228	9.30E-01	1.60E-01													
Th-230	8.10E-01	1.30E-01					J								
Th-232	8.10E-01	1.40E-01													
U-234	7.90E-01	2.10E-01													
U-235	1.86E-01	9.30E-02							0.00E+00	4.60E-01					U
U-238	9.40E-01	2.40E-01													
<b>Total U Alpha</b>	<b>1.92E+00</b>	<b>3.32E-01</b>													
<b>Alpha Sum</b>	<b>5.25E+00</b>	<b>2.30E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.40E-01	2.40E-01							1.10E+00	1.20E+00					
Pa-234m (Assumed from U-238)	9.40E-01	2.40E-01							3.00E+00	1.70E+01					UJ
K-40	1.26E+01	4.10E+00													
Ra-228	6.00E-01	6.10E-01													
Pa-231	-2.00E-01	2.50E+00					U								
<b>Beta Sum</b>	<b>1.51E+01</b>	<b>4.17E+00</b>							<b>1.73E+01</b>	<b>1.75E+01</b>					
<b>Total Activity Sum</b>	<b>2.03E+01</b>	<b>4.76E+00</b>							<b>2.25E+01</b>	<b>1.77E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.89E+00	9.90E-01							<b>0.14</b>	<b>(from gamma)</b>				<b>7.02</b>	
Gross Beta	4.54E+00	8.80E-01					J		<b>2.47</b>	<b>0.73</b>				<b>107</b>	
Total Activity	1.00E+01	4.00E+00					J		<b>1.66</b>	<b>0.69</b>				<b>68.0</b>	

Tonwanda Data Summary Tables

0107096-11			TMF-0151		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								3.00E-02	1.20E-01					U	
Ra-226	1.05E+00	3.00E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	8.00E-01	1.40E-01													
Th-230	8.60E-01	1.40E-01					J								
Th-232	7.60E-01	1.30E-01													
U-234	1.13E+00	2.70E-01													
U-235	4.30E-02	4.80E-02						-8.00E-02	4.20E-01					U	
U-238	7.50E-01	2.00E-01													
<b>Total U Alpha</b>	<b>1.92E+00</b>	<b>3.39E-01</b>													
<b>Alpha Sum</b>	<b>3.86E+00</b>	<b>2.40E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	7.50E-01	2.00E-01						9.00E-01	1.40E+00					U	
Pa-234m (Assumed from U-238)	7.50E-01	2.00E-01						7.00E+00	2.10E+01					UJ	
K-40	1.33E+01	4.10E+00													
Ra-228	6.70E-01	4.10E-01													
Pa-231	-1.70E+00	2.60E+00					U								
<b>Beta Sum</b>	<b>1.53E+01</b>	<b>4.14E+00</b>						<b>2.17E+01</b>	<b>2.14E+01</b>						
<b>Total Activity Sum</b>	<b>1.91E+01</b>	<b>4.78E+00</b>						<b>2.55E+01</b>	<b>2.16E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	4.95E+00	9.90E-01						<b>0.42</b>	<b>(from gamma)</b>				<b>24.7</b>		
Gross Beta	4.35E+00	8.60E-01					J	<b>2.58</b>	<b>0.81</b>				<b>111</b>		
Total Activity	1.46E+01	4.50E+00						<b>0.69</b>	<b>0.50</b>				<b>26.9</b>		

Tonwanda Data Summary Tables

0107096-12			TMF-0152		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								2.90E-02	9.60E-02					U
Ra-226	1.09E+00	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	1.60E-01												
Th-230	8.70E-01	1.40E-01					J							
Th-232	9.40E-01	1.50E-01												
U-234	8.10E-01	2.10E-01												
U-235	1.06E-01	6.60E-02						-6.00E-02	2.80E-01					U
U-238	8.20E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.74E+00</b>	<b>3.04E-01</b>												
<b>Alpha Sum</b>	<b>6.30E+00</b>	<b>1.60E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.20E-01	2.10E-01						4.90E-01	8.10E-01					U
Pa-234m (Assumed from U-238)	8.20E-01	2.10E-01						-1.00E+00	1.10E+01					U
K-40	1.74E+01	3.80E+00												
Ra-228	6.10E-01	2.40E-01												
Pa-231	8.00E-01	1.70E+00					U							
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.82E+00</b>						<b>1.76E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.60E+01</b>	<b>4.15E+00</b>						<b>2.39E+01</b>	<b>1.18E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.20E+00	1.00E+00						<b>0.58</b>	<b>(from gamma)</b>				<b>19.1</b>	
Gross Beta	4.50E+00	9.40E-01					J	<b>3.87</b>	<b>1.12</b>				<b>126</b>	
Total Activity	8.80E+00	4.00E+00					J	<b>2.99</b>	<b>1.21</b>				<b>99.0</b>	

Tonwanda Data Summary Tables

0107096-13			TMF-0154		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Duplicate		Duplicate		DER	RPD	Val	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									-2.30E-01	3.80E-01						U
Ra-226	9.90E-01	2.10E-01						J								
Np-237																
Pu-238																
Pu-239																
Th-228	7.00E-01	1.30E-01														
Th-230	8.00E-01	1.30E-01						J								
Th-232	7.60E-01	1.30E-01														
U-234	8.40E-01	2.20E-01														
U-235	1.00E-01	6.80E-02							-3.40E-01	4.50E-01						U
U-238	7.20E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>3.05E-01</b>														
<b>Alpha Sum</b>	<b>4.73E+00</b>	<b>2.38E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.20E-01	2.00E-01							3.00E-01	1.30E+00						U
Pa-234m (Assumed from U-238)	7.20E-01	2.00E-01							7.00E+00	1.50E+01						UJ
K-40	1.54E+01	3.50E+00														
Ra-228	7.30E-01	3.50E-01														
Pa-231	-2.00E-01	2.60E+00						U								
<b>Beta Sum</b>	<b>1.75E+01</b>	<b>3.54E+00</b>							<b>2.34E+01</b>	<b>1.55E+01</b>						
<b>Total Activity Sum</b>	<b>2.23E+01</b>	<b>4.27E+00</b>							<b>2.81E+01</b>	<b>1.56E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.00E+00	1.20E+00							<b>0.48</b>	<b>(from gamma)</b>						<b>23.7</b>
Gross Beta	4.57E+00	9.80E-01						J	<b>3.53</b>	<b>1.22</b>						<b>117</b>
Total Activity	6.00E+00	4.00E+00						J	<b>2.78</b>	<b>1.37</b>						<b>115</b>

Tonwanda Data Summary Tables

0107096-14			TMF-0155		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q	
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									3.00E-02	1.10E-01					U	
Ra-226	9.80E-01	2.60E-01					J									
Np-237																
Pu-238																
Pu-239																
Th-228	8.60E-01	1.40E-01														
Th-230	8.80E-01	1.40E-01					J									
Th-232	8.00E-01	1.30E-01														
U-234	9.10E-01	2.30E-01														
U-235	1.42E-01	8.20E-02							-2.00E-02	2.60E-01					U	
U-238	6.90E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.74E+00</b>	<b>3.16E-01</b>														
<b>Alpha Sum</b>	<b>3.73E+00</b>	<b>1.43E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	6.90E-01	2.00E-01							9.00E-01	7.90E-01						
Pa-234m (Assumed from U-238)	6.90E-01	2.00E-01							9.00E-01	9.40E+00					U	
K-40	1.73E+01	3.60E+00														
Ra-228	6.90E-01	2.70E-01														
Pa-231	-1.70E+00	1.50E+00					UJ									
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>3.63E+00</b>							<b>1.96E+01</b>	<b>1.01E+01</b>						
<b>Total Activity Sum</b>	<b>2.29E+01</b>	<b>3.90E+00</b>							<b>2.33E+01</b>	<b>1.02E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.00E+00	1.20E+00							1.21	(from gamma)					46.6	
Gross Beta	4.61E+00	9.70E-01					J		3.88	1.48					122	
Total Activity	1.11E+01	4.20E+00					J		2.06	1.11					69.4	

Tonwanda Data Summary Tables

0107096-15			TMF-0157		FROM GAMMA												
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)					
Am-241									2.00E-02	1.30E-01							U
Ra-226	7.40E-01	1.90E-01						J									
Np-237																	
Pu-238																	
Pu-239																	
Th-228	8.10E-01	1.40E-01															
Th-230	9.30E-01	1.50E-01						J									
Th-232	8.10E-01	1.30E-01															
U-234	8.80E-01	2.30E-01															
U-235	1.27E-01	7.80E-02							7.80E-01	5.90E-01							
U-238	1.00E+00	2.50E-01															
<b>Total U Alpha</b>	<b>2.01E+00</b>	<b>3.49E-01</b>															
<b>Alpha Sum</b>	<b>3.23E+00</b>	<b>2.83E+00</b>															
Total U by KPA																	
Total U by KPA																	
U-235 wt% (by alpha spect)																	
U-233 wt%																	
<b>Total U Alpha (Calc)</b>																	
Total Radiological Sr																	
Tc-99																	
Th-234 (Assumed from U-238)	1.00E+00	2.50E-01							1.30E+00	9.60E-01							
Pa-234m (Assumed from U-238)	1.00E+00	2.50E-01							2.00E+01	2.30E+01							J
K-40	1.39E+01	4.80E+00															
Ra-228	8.90E-01	7.40E-01															
Pa-231	-2.30E+00	3.10E+00						U									
<b>Beta Sum</b>	<b>1.65E+01</b>	<b>4.88E+00</b>							<b>3.58E+01</b>	<b>2.35E+01</b>							
<b>Total Activity Sum</b>	<b>1.97E+01</b>	<b>5.64E+00</b>							<b>3.90E+01</b>	<b>2.37E+01</b>							
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	6.70E+00	1.40E+00							<b>1.10</b>	<b>(from gamma)</b>							<b>70.0</b>
Gross Beta	5.30E+00	1.00E+00						J	<b>2.25</b>	<b>1.30</b>							<b>103</b>
Total Activity	9.10E+00	4.30E+00						J	<b>1.50</b>	<b>1.24</b>							<b>73.8</b>

Tonwanda Data Summary Tables

0107096-16			TMF-0158		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									1.50E-01	5.20E-01					U
Ra-226	1.26E+00	3.00E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	9.30E-01	1.80E-01													
Th-230	8.80E-01	1.60E-01					J								
Th-232	9.00E-01	1.60E-01													
U-234	9.60E-01	2.70E-01													
U-235	1.12E-01	8.60E-02							1.20E-01	3.20E-01					U
U-238	6.60E-01	2.20E-01													
<b>Total U Alpha</b>	<b>1.73E+00</b>	<b>3.59E-01</b>													
<b>Alpha Sum</b>	<b>6.42E+00</b>	<b>1.54E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	6.60E-01	2.20E-01							9.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	6.60E-01	2.20E-01							4.00E+00	1.10E+01					U
K-40	1.95E+01	4.10E+00													
Ra-228	7.30E-01	2.50E-01													
Pa-231	8.00E-01	1.60E+00					U								
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>4.12E+00</b>							<b>2.52E+01</b>	<b>1.18E+01</b>					
<b>Total Activity Sum</b>	<b>2.81E+01</b>	<b>4.40E+00</b>							<b>3.16E+01</b>	<b>1.19E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.50E+00	1.10E+00							<b>0.49</b>	<b>(from gamma)</b>				<b>15.5</b>	
Gross Beta	4.53E+00	8.90E-01					J		<b>4.06</b>	<b>1.75</b>				<b>131</b>	
Total Activity	6.20E+00	3.90E+00					J		<b>3.72</b>	<b>2.03</b>				<b>128</b>	

Tonwanda Data Summary Tables

0107096-17			TMF-0160				FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-4.00E-02	1.30E-01	1.00E-01	3.70E-01	0.36	467	U
Ra-226	1.64E+00	3.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	8.60E-01	1.30E-01												
Th-230	1.24E+00	1.80E-01					J							
Th-232	8.40E-01	1.30E-01												
U-234	1.14E+00	2.80E-01												
U-235	8.80E-02	6.80E-02					J	1.50E-01	4.10E-01	-5.40E-01	4.40E-01	1.15	354	U
U-238	1.21E+00	2.90E-01												
<b>Total U Alpha</b>	<b>2.44E+00</b>	<b>4.09E-01</b>												
<b>Alpha Sum</b>	<b>7.20E+00</b>	<b>2.24E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	1.21E+00	2.90E-01						1.80E-01	9.60E-01	6.00E-01	1.50E+00	0.24	108	U
Pa-234m (Assumed from U-238)	1.21E+00	2.90E-01						9.00E+00	1.70E+01	1.70E+01	1.50E+01	0.35	61.5	UJ
K-40	1.59E+01	4.50E+00	1.66E+01	3.70E+00	0.12	4.31								
Ra-228	8.10E-01	3.80E-01	8.20E-01	3.30E-01	0.02	1.23								
Pa-231	2.00E-01	2.40E+00	-8.00E-01	2.60E+00	0.28	333	U							
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>4.54E+00</b>						<b>2.59E+01</b>	<b>1.76E+01</b>	<b>3.49E+01</b>	<b>1.55E+01</b>			
<b>Total Activity Sum</b>	<b>2.64E+01</b>	<b>5.06E+00</b>						<b>3.31E+01</b>	<b>1.78E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	8.50E+00	1.40E+00						0.49	(from gamma)		16.6			
Gross Beta	6.10E+00	1.10E+00					J	2.79			103			
Total Activity	1.42E+01	4.40E+00					J	1.81	1.03		59.9			



Tonwanda Data Summary Tables

0107096-18			TMF-0161		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-9.00E-02	1.60E-01					U
Ra-226	9.00E-01	2.20E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	8.00E-01	1.40E-01													
Th-230	7.60E-01	1.30E-01													
Th-232	8.80E-01	1.40E-01													
U-234	8.00E-01	2.40E-01													
U-235	1.70E-01	1.00E-01							-3.00E-02	2.50E-01					U
U-238	9.90E-01	2.70E-01													
<b>Total U Alpha</b>	<b>1.96E+00</b>	<b>3.75E-01</b>													
<b>Alpha Sum</b>	<b>5.21E+00</b>	<b>1.19E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	9.90E-01	2.70E-01							4.70E-01	6.30E-01					U
Pa-234m (Assumed from U-238)	9.90E-01	2.70E-01							5.60E+00	7.20E+00					U
K-40	1.90E+01	3.40E+00													
Ra-228	5.80E-01	1.60E-01													
Pa-231	-1.00E-01	1.20E+00					U								
<b>Beta Sum</b>	<b>2.15E+01</b>	<b>3.43E+00</b>							<b>2.56E+01</b>	<b>7.99E+00</b>					
<b>Total Activity Sum</b>	<b>2.68E+01</b>	<b>3.63E+00</b>							<b>3.08E+01</b>	<b>8.08E+00</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.70E+00	1.20E+00							<b>0.29</b>	<b>(from gamma)</b>			<b>8.98</b>		
Gross Beta	4.66E+00	9.40E-01					J		<b>4.75</b>	<b>2.61</b>			<b>129</b>		
Total Activity	9.20E+00	4.00E+00					J		<b>3.25</b>	<b>2.40</b>			<b>97.7</b>		

Tonwanda Data Summary Tables

0107096-19			TMF-0163		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									-8.00E-02	1.30E-01						U
Ra-226	6.90E-01	1.80E-01					J									
Np-237																
Pu-238																
Pu-239																
Th-228	8.30E-01	1.40E-01														
Th-230	8.40E-01	1.40E-01					J									
Th-232	8.50E-01	1.40E-01														
U-234	9.30E-01	2.40E-01														
U-235	6.50E-02	5.60E-02							-1.70E-01	5.60E-01						U
U-238	7.30E-01	2.00E-01														
<b>Total U Alpha</b>	<b>1.73E+00</b>	<b>3.17E-01</b>														
<b>Alpha Sum</b>	<b>3.14E+00</b>	<b>2.82E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01							6.00E-01	1.20E+00						U
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01							0.00E+00	2.10E+01						UJ
K-40	1.31E+01	4.80E+00														
Ra-228	7.10E-01	7.10E-01														
Pa-231	-2.00E+00	3.10E+00					U									
<b>Beta Sum</b>	<b>1.50E+01</b>	<b>4.87E+00</b>							<b>1.42E+01</b>	<b>2.16E+01</b>						
<b>Total Activity Sum</b>	<b>1.82E+01</b>	<b>5.63E+00</b>							<b>1.73E+01</b>	<b>2.18E+01</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.30E+00	1.20E+00							<b>1.03</b>	<b>(from gamma)</b>						<b>67.1</b>
Gross Beta	4.92E+00	9.60E-01					J		<b>2.03</b>	<b>0.43</b>						<b>101</b>
Total Activity	1.27E+01	4.60E+00							<b>0.75</b>	<b>0.21</b>						<b>35.4</b>

Tonwanda Data Summary Tables

0107096-20			TMF-0164		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Duplicate		Duplicate		DER	RPD	Val	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)						
Am-241									-6.00E-02	2.30E-01						U
Ra-226	7.50E-01	1.80E-01						J								
Np-237																
Pu-238																
Pu-239																
Th-228	1.04E+00	1.60E-01														
Th-230	8.60E-01	1.30E-01						J								
Th-232	9.10E-01	1.40E-01														
U-234	7.90E-01	2.10E-01														
U-235	7.60E-02	5.80E-02							-8.00E-02	2.60E-01						U
U-238	8.40E-01	2.20E-01														
<b>Total U Alpha</b>	<b>1.71E+00</b>	<b>3.10E-01</b>														
<b>Alpha Sum</b>	<b>4.28E+00</b>	<b>1.76E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
Tc-99																
Th-234 (Assumed from U-238)	8.40E-01	2.20E-01							1.00E+00	9.40E-01						
Pa-234m (Assumed from U-238)	8.40E-01	2.20E-01							1.00E-01	6.70E+00						U
K-40	1.84E+01	3.30E+00														
Ra-228	7.70E-01	1.90E-01														
Pa-231	-1.10E+00	1.90E+00						U								
<b>Beta Sum</b>	<b>2.07E+01</b>	<b>3.33E+00</b>							<b>2.01E+01</b>	<b>7.53E+00</b>						
<b>Total Activity Sum</b>	<b>2.50E+01</b>	<b>3.77E+00</b>							<b>2.44E+01</b>	<b>7.74E+00</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	4.61E+00	9.80E-01							<b>0.17</b>	<b>(from gamma)</b>			<b>7.52</b>			
Gross Beta	4.78E+00	9.20E-01						J	<b>4.62</b>	<b>2.02</b>			<b>125</b>			
Total Activity	5.00E+00	3.90E+00						J	<b>3.69</b>	<b>2.24</b>			<b>133</b>			

## Radiological Analytical Data Verification Comments on Data for SDG 0107106

This sample delivery group (SDG) contained fifteen (15) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 14, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0190	0107106-1
TMF-0191	0107106-2
TMF-9196	0107106-3
TMF-9197	0107106-4
TMF-0272	0107106-5
TMF-0270	0107106-6
TMF-0271	0107106-7
TMF-0229	0107106-8
TMF-0228	0107106-9
TMF-0193	0107106-10
TMF-0282	0107106-11
TMF-0283	0107106-12
TMF-0284	0107106-13
TMF-0285	0107106-14
TMF-0194	0107106-15

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_S)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_S$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was observed in the EQ-1 and EQ-2 equipment rinsate blanks.  $^{137}\text{Cs}$  activity was observed in the equipment rinsate blank EQ-1, but it was not observed in all samples. However,  $^{137}\text{Cs}$  activity was reported by the laboratory in samples TMF-0271 and TMF-0283 as the  $^{137}\text{Cs}$  activity in the sample was higher than the required DL (1.65\*TPU). All associated samples results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J).  $^{137}\text{Cs}$  activity value observed in samples TMF-0271 and TMF-0283 were greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification on  $^{137}\text{Cs}$  results in those samples is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses except  $^{231}\text{Pa}$  (DER 1.30, RPD 1533%) result. **Therefore, it is recommended that  $^{231}\text{Pa}$  result for all samples qualified as estimated (J).**

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples. The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. Results for fission product  $^{137}\text{Cs}$  was reported for samples TMF-0271 and TMF-0283. **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is for information purposes only, since any modeling will assume equilibrium with parent  $^{238}\text{U}$  or  $^{232}\text{Th}$ .**

There were no incidents of identified radionuclides being excluded from the laboratory reports. The required method detection limit (MDL) for the gamma spectrometric analysis for target radionuclides is 1 pCi/g for  $^{241}\text{Am}$ . Sample TMF-0285  $^{241}\text{Am}$  result exceeded the required MDL indicating that the laboratory may not have met the project DQOs. No other problems were observed for the gamma spectrometry analyses.

## **2.0 ALPHA SPECTROMETRY**

### Method Blank:

There was an indication of blank contamination for  $^{230}\text{Th}$  analyses in the method blank. All associated sample results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). The  $^{230}\text{Th}$  analyses results for all samples were greater than 5 times the blank therefore, no qualification of  $^{230}\text{Th}$  analysis is necessary.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses. No qualification is required.

#### Sample-Specific Chemical Recovery:

The tracer recoveries are within acceptable limit. The tracer recoveries were greater than 14% for all samples for the alpha spectrometry analyses. The sample-specific percent recovery results of  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  for all samples have less than 10% uncertainty, except for  $^{228/230/232}\text{Th}$  result for sample TMF-9196 (10.79%). Therefore it is recommended that the  $^{228/230/232}\text{Th}$  results for sample TMF-9196 be qualified as estimated (J).

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  analysis.

#### Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 1.0 pCi/g for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$ .

### 3.0 $^{226}\text{Ra}$ ANALYSES

#### Method Blank:

There is no indication of blank contamination in the method blank sample for  $^{226}\text{Ra}$  analysis except for the method blank associated with sample TMF-0283. All associated samples result less than 5 times the blank value for  $^{226}\text{Ra}$  analyses should be qualified as estimated (J). The  $^{226}\text{Ra}$  result for sample TMF-0283 is less than 5 times the  $^{226}\text{Ra}$  concentration identified in the method blank. **Therefore, it is recommended that the  $^{226}\text{Ra}$  result for sample TMF-0283 qualified as estimated (J).**

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for  $^{226}\text{Ra}$  analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all  $^{226}\text{Ra}$  analyses.

#### Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis for all samples except samples TMF-0284 (237.37%) and TMF-0285 (127.05%) were within acceptable limits. However, results for samples TMF-0284 and TMF-0285 were calculated using 100% chemical recovery as directed by the SOW. This high recovery may be due to a matrix effect. **Therefore, it is recommended that the  $^{226}\text{Ra}$  results for samples TMF-0284 and TMF-0285 be qualified as estimated (J).**

#### Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

### 4.0 GROSS ALPHA AND BETA ANALYSIS

#### Method Blank:

There was no indication of blank contamination in method blank for the gross alpha/beta analyses.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

#### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

#### Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

#### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**



#### Quantitation and Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. The results for samples TMF-0190, TMF-9196, TMF-0270, TMF-0228, TMF-0103, TMF-0282, TMF-0282 (laboratory duplicate), TMF-0283, and TMF-0285 did not meet the required MDL limits of both gross alpha and gross beta analyses indicating that the laboratory may not have met the project DQOs for these samples.

### **5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING**

#### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses. Therefore, no qualification is necessary.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

#### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis by liquid scintillation counting.

#### Duplicate Analysis:

The total activity by LCS duplicate DER is within acceptable limits.

#### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

#### Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC.

**It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g., <sup>3</sup>H, <sup>99</sup>Tc, <sup>40</sup>K salts). Also, the laboratory used an 8M HNO<sub>3</sub> leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have**

been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.

## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities are within acceptable limits for all samples indicating that the gross alpha analyses for all samples agree with the sum of the alpha emitters within a 99% confidence level. No qualification of the gross alpha result is necessary.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (1.91 – 4.62) for all samples, except sample TMF-0285 (0.07), the sums of the beta emitters activity and gross beta activity are outside the acceptable limits as well as the RPD values (84.1% - 130%). The gross beta results are smaller than the sum of the beta emitters by an approximate factor ranging from 2.4 to 4.7 for all samples. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts or the sample preparation method, as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the total activity sum i.e., the sums of the beta emitters and the sum of alpha, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs for samples TMF-0191 (3.19), TMF-9197 (2.39), TMF-0272 (2.63), TMF-0270 (1.72), TMF-0271 (2.08), TMF-0229 (2.34), TMF-0193 (1.96), TMF-0282 (1.68), TMF-0283 (2.25), TMF-0284 (2.93), TMF-0285 (1.88) and TMF-0194 (2.28) are out side the acceptable limits as well as the RPD values TMF-0191 (106%), TMF-9197 (81.3%), TMF-0272 (88.1%), TMF-0270 (54.5%), TMF-0271 (56.6%), TMF-0229 (84.4%), TMF-0193 (83.4%), TMF-0282 (65.1%), TMF-0283 (62.3%), TMF-0284 (98.7%), TMF-0285 (24.3%) and TMF-0194 (72.1%). The total activity results for these samples are smaller than the sums of the alpha and beta emitters by an approximate factor ranging from 1.7

to 3.2. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides, radionuclide salts, and/or the sample preparation method as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

$^{228}\text{Ac}$  Gamma and  $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.

**Tonawanda Data Summary Tables**

Analyses	TMF-0190				FROM GAMMA							Val			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-5.00E-02	2.40E-01	1.00E-02	1.40E-01	0.22	300	U	
Ra-226	6.10E-01	2.30E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	3.30E-01	1.20E-01	2.40E-01	1.00E-01	0.58	31.6									
Th-230	6.10E-01	1.30E-01	6.20E-01	1.40E-01	0.05	1.63									
Th-232	3.11E-01	8.90E-02	3.51E-01	9.40E-02	0.31	12.1									
U-234	5.20E-01	1.80E-01													
U-235	5.10E-02	5.20E-02					1.00E-02	2.50E-01	-8.00E-02	2.50E-01		0.25	257	U	
U-238	5.60E-01	1.80E-01													
<b>Total U Alpha</b>	<b>1.13E+00</b>	<b>2.60E-01</b>													
<b>Alpha Sum</b>	<b>3.89E+00</b>	<b>1.24E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	6.60E+00	1.50E+00	6.20E+00	1.40E+00	0.19	6.25									
Th-234 (Assumed from U-238)	5.60E-01	1.80E-01					6.70E-01	7.50E-01	5.80E-01	7.30E-01		0.09	14.4		
Pa-234m (Assumed from U-238)	5.60E-01	1.80E-01					-1.00E+00	6.80E+00	1.70E+00	7.10E+00		0.27	771	U	
Ac-227															
Ra-228	2.30E-01	1.30E-01	2.50E-01	1.30E-01	0.11	8.33									
Pa-231	1.00E+00	1.30E+00	-1.30E+00	1.20E+00	1.30	1533									
<b>Beta Sum</b>	<b>8.07E+00</b>	<b>1.53E+00</b>					<b>6.62E+00</b>	<b>7.01E+00</b>	<b>8.57E+00</b>	<b>7.28E+00</b>					
<b>Total Activity Sum</b>	<b>1.20E+01</b>	<b>1.97E+00</b>					<b>1.05E+01</b>	<b>7.11E+00</b>							
<b>DER (sums to gross)</b>															
Gross Alpha	4.50E+00	1.10E+00					0.37	(from gamma)				14.5			
Gross Beta	3.17E+00	9.20E-01					2.74	0.49				87.2			
Total Activity	8.40E+00	4.00E+00					0.80	0.26				35.0			

Tonawanda Data Summary Tables

Analyses	TMF-0191				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-2.30E-01	4.70E-01			U
Ra-226	1.80E-01	1.40E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	9.80E-01	1.90E-01										
Th-230	7.60E-01	1.50E-01										
Th-232	8.10E-01	1.60E-01										
U-234	7.70E-01	2.10E-01	9.50E-01	2.50E-01	0.55	20.9						
U-235	1.24E-01	7.50E-02	1.33E-01	8.20E-02	0.08	7.00		-1.40E-01	3.50E-01			U
U-238	7.10E-01	2.00E-01	9.30E-01	2.50E-01	0.69	26.8						
<b>Total U Alpha</b>	<b>1.60E+00</b>	<b>3.00E-01</b>	<b>2.01E+00</b>	<b>3.63E-01</b>								
<b>Alpha Sum</b>	<b>4.78E+00</b>	<b>1.59E+00</b>	<b>2.01E+00</b>	<b>3.63E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.97E+01	4.00E+00										
Th-234 (Assumed from U-238)	7.10E-01	2.00E-01	9.30E-01	2.50E-01	0.69	26.8		6.00E-01	1.00E+00			U
Pa-234m (Assumed from U-238)	7.10E-01	2.00E-01	9.30E-01	2.50E-01	0.69	26.8		-1.70E+00	9.30E+00			U
Ac-227												
Ra-228	6.20E-01	2.10E-01										
Pa-231	5.00E-01	1.70E+00										
<b>Beta Sum</b>	<b>2.18E+01</b>	<b>4.02E+00</b>	<b>1.86E+00</b>	<b>3.54E-01</b>				<b>1.93E+01</b>	<b>1.02E+01</b>			
<b>Total Activity Sum</b>	<b>2.66E+01</b>	<b>4.32E+00</b>	<b>3.87E+00</b>	<b>5.07E-01</b>				<b>2.41E+01</b>	<b>1.03E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.10E+00	1.10E+00						<b>0.68</b>	<b>(from gamma)</b>			<b>24.2</b>
Gross Beta	5.35E+00	9.70E-01					J	<b>3.98</b>	<b>1.36</b>			<b>121</b>
Total Activity	8.20E+00	3.80E+00					J	<b>3.19</b>	<b>1.44</b>			<b>106</b>

Tonawanda Data Summary Tables

0107106-3			TMF-9196		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.60E-01	2.70E-01					U
Ra-226	7.00E-01	2.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	2.90E-01	1.80E-01												
Th-230	5.80E-01	1.60E-01												
Th-232	3.20E-01	1.10E-01												
U-234	5.90E-01	1.90E-01												
U-235	1.20E-01	8.00E-02						-1.10E-01	2.70E-01					U
U-238	5.20E-01	1.70E-01												
<b>Total U Alpha</b>	<b>1.23E+00</b>	<b>2.67E-01</b>												
<b>Alpha Sum</b>	<b>3.66E+00</b>	<b>1.33E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	6.70E+00	1.90E+00												
Th-234 (Assumed from U-238)	5.20E-01	1.70E-01						5.40E-01	8.80E-01					U
Pa-234m (Assumed from U-238)	5.20E-01	1.70E-01						3.40E+00	9.00E+00					U
Ac-227														
Ra-228	2.80E-01	2.40E-01												
Pa-231	6.00E-01	1.40E+00												
<b>Beta Sum</b>	<b>8.09E+00</b>	<b>1.94E+00</b>						<b>1.10E+01</b>	<b>9.25E+00</b>					
<b>Total Activity Sum</b>	<b>1.18E+01</b>	<b>2.35E+00</b>						<b>1.47E+01</b>	<b>9.34E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	3.80E+00	1.30E+00						<b>0.08</b>	<b>(from gamma)</b>			<b>3.8</b>		
Gross Beta	3.30E+00	1.60E+00					J	<b>1.91</b>	<b>0.82</b>			<b>84.1</b>		
Total Activity	8.20E+00	3.90E+00					J	<b>0.78</b>	<b>0.64</b>			<b>35.6</b>		

Tonawanda Data Summary Tables

0107106-4		TMF-9197				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.20E-02	9.60E-02					U
Ra-226	9.20E-01	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	8.60E-01	1.70E-01												
Th-230	9.20E-01	1.70E-01												
Th-232	6.90E-01	1.30E-01												
U-234	6.70E-01	1.90E-01												
U-235	6.10E-02	5.30E-02						1.90E-01	2.80E-01					U
U-238	7.30E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.46E+00</b>	<b>2.81E-01</b>												
<b>Alpha Sum</b>	<b>3.86E+00</b>	<b>1.51E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.75E+01	3.80E+00												
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01						1.12E+00	6.10E-01					
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01						0.00E+00	1.10E+01					U
Ac-227														
Ra-228	7.80E-01	2.90E-01												
Pa-231	-1.10E+00	1.60E+00												
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>3.83E+00</b>						<b>1.93E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.35E+01</b>	<b>4.11E+00</b>						<b>2.31E+01</b>	<b>1.18E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.30E+00	1.00E+00	7.10E+00	1.30E+00	<b>1.10</b>	<b>29.0</b>		<b>0.79</b>	<b>(from gamma)</b>			<b>31.4</b>		
Gross Beta	5.25E+00	9.60E-01	5.36E+00	9.70E-01	<b>0.08</b>	<b>2.07</b>	J	<b>3.64</b>	<b>1.20</b>			<b>116</b>		
Total Activity	9.90E+00	3.90E+00	7.50E+00	3.80E+00	<b>0.44</b>	<b>27.6</b>	J	<b>2.39</b>	<b>1.07</b>			<b>81.3</b>		

**Tonawanda Data Summary Tables**

<b>0107106-5</b>		<b>TMF-0272</b>				<b>FROM GAMMA</b>									
<b>Analyses</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Duplicate</b>		<b>DER</b>	<b>RPD</b>	<b>Val Q</b>	<b>Duplicate</b>		<b>Duplicate</b>		<b>DER</b>	<b>RPD</b>	<b>Val Q</b>	
			<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>				<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>				
Am-241								3.70E-02	9.60E-02	2.30E-01	4.90E-01	<b>0.39</b>	<b>145</b>	U	
Ra-226	6.60E-01	2.60E-01	9.50E-01	2.50E-01	<b>0.80</b>	<b>36</b>									
Np-237															
Pu-238															
Pu-239															
Th-228	1.02E+00	2.10E-01	8.40E-01	1.70E-01	<b>0.67</b>	<b>19.4</b>									
Th-230	9.20E-01	1.80E-01	7.70E-01	1.40E-01	<b>0.66</b>	<b>17.8</b>									
Th-232	9.60E-01	1.80E-01	7.90E-01	1.50E-01	<b>0.73</b>	<b>19.4</b>									
U-234	9.20E-01	2.30E-01													
U-235	1.36E-01	8.00E-02					7.00E-02	2.60E-01	-9.00E-02	3.20E-01		<b>0.39</b>	<b>1600</b>	U	
U-238	9.10E-01	2.30E-01													
<b>Total U Alpha</b>	<b>1.97E+00</b>	<b>3.35E-01</b>													
<b>Alpha Sum</b>	<b>5.62E+00</b>	<b>1.79E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.52E+01	3.30E+00	1.91E+01	3.80E+00	<b>0.77</b>	<b>22.7</b>									
Th-234 (Assumed from U-238)	9.10E-01	2.30E-01					1.20E+00	8.50E-01	1.20E+00	1.00E+00		<b>0.00</b>	<b>0.00</b>		
Pa-234m (Assumed from U-238)	9.10E-01	2.30E-01					9.80E+00	9.70E+00	0.00E+00	9.10E+00		<b>0.74</b>	<b>200</b>		
Ac-227															
Ra-228	7.70E-01	2.40E-01	6.00E-01	2.20E-01	<b>0.52</b>	<b>24.8</b>									
Pa-231	1.00E-01	1.90E+00	-5.00E-01	1.80E+00	<b>0.23</b>	<b>300</b>									
<b>Beta Sum</b>	<b>1.78E+01</b>	<b>3.33E+00</b>					<b>2.70E+01</b>	<b>1.03E+01</b>	<b>2.08E+01</b>	<b>9.92E+00</b>					
<b>Total Activity Sum</b>	<b>2.34E+01</b>	<b>3.78E+00</b>					<b>3.26E+01</b>	<b>1.04E+01</b>							
							<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>						
Gross Alpha	5.80E+00	1.10E+00					<b>0.09</b>	<b>(from gamma)</b>			<b>3.2</b>				
Gross Beta	5.57E+00	9.90E-01				J	<b>3.52</b>	<b>2.07</b>			<b>105</b>				
Total Activity	9.10E+00	3.90E+00				J	<b>2.63</b>	<b>2.11</b>			<b>88.1</b>				



Tonawanda Data Summary Tables

Analyses	TMF-0270				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								1.70E-01	2.90E-01			U
Ra-226	1.06E+00	2.70E-01										
Np-237												
Pu-238												
Pu-239												
Th-228	1.09E+00	2.10E-01										
Th-230	1.00E+00	1.90E-01										
Th-232	1.00E+00	1.90E-01										
U-234	1.08E+00	2.80E-01	9.90E-01	2.50E-01	0.24	8.70						
U-235	1.90E-01	1.00E-01	7.60E-02	6.20E-02	0.97	85.7		-4.00E-02	3.10E-01			U
U-238	1.05E+00	2.70E-01	8.70E-01	2.30E-01	0.51	18.8						
<b>Total U Alpha</b>	<b>2.32E+00</b>	<b>4.02E-01</b>	<b>1.94E+00</b>	<b>3.45E-01</b>								
<b>Alpha Sum</b>	<b>4.85E+00</b>	<b>2.33E+00</b>	<b>1.94E+00</b>	<b>3.45E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.56E+01	3.00E+00										
Th-234 (Assumed from U-238)	1.05E+00	2.70E-01	8.70E-01	2.30E-01	0.51	18.8		5.00E-01	5.80E-01			
Pa-234m (Assumed from U-238)	1.05E+00	2.70E-01	8.70E-01	2.30E-01	0.51	18.8		-1.00E+00	8.30E+00			U
Ac-227												
Ra-228	5.70E-01	1.70E-01										
Pa-231	-1.80E+00	2.50E+00										
<b>Beta Sum</b>	<b>1.81E+01</b>	<b>3.04E+00</b>	<b>1.74E+00</b>	<b>3.25E-01</b>				<b>1.55E+01</b>	<b>8.85E+00</b>			
<b>Total Activity Sum</b>	<b>2.29E+01</b>	<b>3.83E+00</b>	<b>3.68E+00</b>	<b>4.74E-01</b>				<b>2.03E+01</b>	<b>9.15E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.70E+00	1.40E+00						<b>0.68</b>	<b>(from gamma)</b>			<b>32.0</b>
Gross Beta	4.70E+00	1.10E+00					J	<b>4.13</b>	<b>1.21</b>			<b>117</b>
Total Activity	1.31E+01	4.20E+00					J	<b>1.72</b>	<b>0.72</b>			<b>54.5</b>

Tonawanda Data Summary Tables

0107106-7			TMF-0271		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.00E-02	1.70E-01					U
Ra-226	7.20E-01	2.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	6.90E-01	1.60E-01												
Th-230	6.60E-01	1.30E-01												
Th-232	7.20E-01	1.40E-01												
U-234	1.22E+00	3.00E-01												
U-235	5.00E-02	5.10E-02						-2.10E-01	2.80E-01					U
U-238	1.15E+00	2.90E-01												
<b>Total U Alpha</b>	<b>2.42E+00</b>	<b>4.20E-01</b>												
<b>Alpha Sum</b>	<b>5.12E+00</b>	<b>1.37E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Cs-137	1.46E-01	7.10E-02												
K-40	1.84E+01	3.50E+00												
Th-234 (Assumed from U-238)	1.15E+00	2.90E-01						8.10E-01	8.10E-01					
Pa-234m (Assumed from U-238)	1.15E+00	2.90E-01						2.10E+00	7.50E+00					U
Ac-227														
Ra-228	7.10E-01	2.10E-01												
Pa-231	-1.00E-01	1.40E+00												
<b>Beta Sum</b>	<b>2.15E+01</b>	<b>3.53E+00</b>						<b>2.22E+01</b>	<b>8.32E+00</b>					
<b>Total Activity Sum</b>	<b>2.67E+01</b>	<b>3.79E+00</b>						<b>2.73E+01</b>	<b>8.43E+00</b>					
UJ														
<b>DER (sums to gross)</b>														
Gross Alpha	3.69E+00	8.90E-01						<b>0.88</b>	<b>(from gamma)</b>				<b>32.5</b>	
Gross Beta	5.30E+00	9.60E-01					J	<b>4.43</b>	<b>2.01</b>				<b>121</b>	
Total Activity	1.49E+01	4.20E+00					J	<b>2.08</b>	<b>1.31</b>				<b>56.6</b>	

Tonawanda Data Summary Tables

Analyses	TMF-0229				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								-1.60E-01	5.50E-01			U
Ra-226	4.50E-01	3.40E-01					J					
Np-237												
Pu-238												
Pu-239												
Th-228	8.50E-01	2.00E-01										
Th-230	8.10E-01	1.70E-01										
Th-232	8.70E-01	1.80E-01										
U-234	7.80E-01	2.20E-01										
U-235	4.10E-02	5.00E-02					U	-3.00E-02	3.10E-01			U
U-238	8.80E-01	2.40E-01										
<b>Total U Alpha</b>	<b>1.70E+00</b>	<b>3.29E-01</b>										
<b>Alpha Sum</b>	<b>3.51E+00</b>	<b>2.15E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.75E+01	3.90E+00										
Th-234 (Assumed from U-238)	8.80E-01	2.40E-01						-4.00E-01	1.10E+00			U
Pa-234m (Assumed from U-238)	8.80E-01	2.40E-01						7.00E+00	1.30E+01			U
Ac-227												
Ra-228	7.70E-01	2.60E-01										
Pa-231	-1.30E+00	2.30E+00					UJ					
<b>Beta Sum</b>	<b>1.99E+01</b>	<b>3.93E+00</b>						<b>2.47E+01</b>	<b>1.36E+01</b>			
<b>Total Activity Sum</b>	<b>2.34E+01</b>	<b>4.48E+00</b>						<b>2.82E+01</b>	<b>1.38E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	5.08E+00	9.90E-01	5.40E+00	1.10E+00	<b>0.22</b>	<b>6.11</b>		<b>0.66</b>	<b>(from gamma)</b>			<b>36.5</b>
Gross Beta	4.49E+00	8.70E-01	4.80E+00	9.10E-01	<b>0.25</b>	<b>6.67</b>	J	<b>3.82</b>	<b>1.48</b>			<b>126</b>
Total Activity	9.50E+00	3.90E+00	9.90E+00	3.90E+00	<b>0.07</b>	<b>4.12</b>	J	<b>2.34</b>	<b>1.31</b>			<b>84.4</b>

Tonawanda Data Summary Tables

Analyses	TMF-0228				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								-1.40E-01	2.90E-01					U
Ra-226	7.40E-01	2.10E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	4.90E-01	1.80E-01												
Th-230	6.80E-01	1.60E-01												
Th-232	4.40E-01	1.20E-01												
U-234	8.40E-01	2.50E-01												
U-235	1.01E-01	7.80E-02						2.80E-01	2.80E-01					
U-238	8.00E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.74E+00</b>	<b>3.55E-01</b>												
<b>Alpha Sum</b>	<b>3.37E+00</b>	<b>1.52E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	8.80E+00	2.20E+00												
Th-234 (Assumed from U-238)	8.00E-01	2.40E-01						5.50E-01	8.10E-01					U
Pa-234m (Assumed from U-238)	8.00E-01	2.40E-01						3.70E+00	8.90E+00					U
Ac-227														
Ra-228	4.30E-01	2.10E-01												
Pa-231	-8.00E-01	1.60E+00												
<b>Beta Sum</b>	<b>1.07E+01</b>	<b>2.24E+00</b>						<b>1.34E+01</b>	<b>9.21E+00</b>					
<b>Total Activity Sum</b>	<b>1.41E+01</b>	<b>2.71E+00</b>						<b>1.68E+01</b>	<b>9.33E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	3.40E+00	1.00E+00						<b>0.02</b>	<b>(from gamma)</b>			<b>0.9</b>		
Gross Beta	2.54E+00	9.40E-01					J	<b>3.37</b>	<b>1.17</b>			<b>123</b>		
Total Activity	9.20E+00	3.90E+00					J	<b>1.03</b>	<b>0.75</b>			<b>42.1</b>		

Tonawanda Data Summary Tables

0107106-10		TMF-0193				FROM GAMMA						Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241							4.00E-03	8.40E-02						U
Ra-226	6.70E-01	2.10E-01	7.20E-01	2.00E-01	0.17	7								
Np-237														
Pu-238														
Pu-239														
Th-228	4.40E-01	1.60E-01												
Th-230	7.40E-01	1.60E-01												
Th-232	3.70E-01	1.00E-01												
U-234	6.90E-01	2.10E-01												
U-235	9.00E-03	2.70E-02					U	1.30E-01	2.30E-01					U
U-238	7.30E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.43E+00</b>	<b>3.05E-01</b>												
<b>Alpha Sum</b>	<b>4.37E+00</b>	<b>1.34E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	9.30E+00	2.30E+00												
Th-234 (Assumed from U-238)	7.30E-01	2.20E-01					5.60E-01	5.20E-01						
Pa-234m (Assumed from U-238)	7.30E-01	2.20E-01					-2.00E+00	7.90E+00						U
Ac-227														
Ra-228	5.80E-01	2.40E-01												
Pa-231	8.00E-01	1.40E+00												
<b>Beta Sum</b>	<b>1.14E+01</b>	<b>2.34E+00</b>						<b>8.54E+00</b>	<b>8.25E+00</b>					
<b>Total Activity Sum</b>	<b>1.58E+01</b>	<b>2.69E+00</b>						<b>1.29E+01</b>	<b>8.36E+00</b>					
								<b>DER (sums to gross)</b>					<b>RPD (sums to gross)</b>	
Gross Alpha	3.80E+00	1.00E+00						<b>0.34</b>	<b>(from gamma)</b>				<b>13.93</b>	
Gross Beta	2.94E+00	9.30E-01					J	<b>3.37</b>	<b>0.67</b>				<b>118</b>	
Total Activity	6.50E+00	3.90E+00					J	<b>1.96</b>	<b>0.69</b>				<b>83.4</b>	

**Tonawanda Data Summary Tables**

Analyses	TMF-0282				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.60E-01	2.60E-01	8.00E-03	9.50E-02	0.61	221	U
Ra-226	5.00E-01	1.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	5.90E-01	1.40E-01	5.00E-01	1.50E-01	0.44	16.5								
Th-230	6.20E-01	1.30E-01	6.90E-01	1.50E-01	0.35	10.7								
Th-232	4.60E-01	1.10E-01	5.80E-01	1.40E-01	0.67	23.1								
U-234	8.90E-01	2.60E-01												
U-235	4.50E-02	5.40E-02						0.00E+00	2.80E-01	-8.00E-02	2.90E-01	0.20	200	U
U-238	9.80E-01	2.80E-01												
<b>Total U Alpha</b>	<b>1.92E+00</b>	<b>3.86E-01</b>												
<b>Alpha Sum</b>	<b>3.37E+00</b>	<b>1.35E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.07E+01	2.10E+00	1.07E+01	2.80E+00	0.00	0.00								
Th-234 (Assumed from U-238)	9.80E-01	2.80E-01						6.00E-02	8.00E-01	5.60E-01	7.10E-01	0.47	161	U
Pa-234m (Assumed from U-238)	9.80E-01	2.80E-01						-5.00E+00	7.90E+00	1.30E+00	7.70E+00	0.57	341	U
Ac-227														
Ra-228	5.80E-01	1.90E-01	3.80E-01	2.50E-01	0.64	41.7								
Pa-231	-8.00E-01	1.40E+00	-6.00E-01	1.60E+00	0.09	28.6	UJ							
<b>Beta Sum</b>	<b>1.31E+01</b>	<b>2.15E+00</b>						<b>6.24E+00</b>	<b>8.22E+00</b>	<b>1.29E+01</b>	<b>8.23E+00</b>			
<b>Total Activity Sum</b>	<b>1.65E+01</b>	<b>2.54E+00</b>						<b>9.61E+00</b>	<b>8.33E+00</b>					
<b>DER (sums to gross)</b>														
Gross Alpha	4.50E+00	1.10E+00	3.10E+00	1.10E+00	0.90	36.8		<b>0.65</b>	<b>(from gamma)</b>			<b>28.9</b>		
Gross Beta	2.81E+00	9.30E-01	2.90E+00	1.00E+00	0.07	3.15	J	<b>4.41</b>	<b>0.42</b>			<b>130</b>		
Total Activity	8.40E+00	4.10E+00					J	<b>1.68</b>	<b>0.13</b>			<b>65.1</b>		

Tonawanda Data Summary Tables

0107106-12			TMF-0283		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	1.60E-01					UJ
Ra-226	9.80E-01	2.30E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.50E-01	1.60E-01												
Th-230	1.06E+00	1.90E-01												
Th-232	6.50E-01	1.30E-01												
U-234	1.46E+00	3.40E-01												
U-235	7.90E-02	6.50E-02						0.00E+00	2.60E-01					U
U-238	1.37E+00	3.30E-01												
<b>Total U Alpha</b>	<b>2.91E+00</b>	<b>4.78E-01</b>												
<b>Alpha Sum</b>	<b>6.07E+00</b>	<b>1.31E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Cs-137	9.10E-02	5.10E-02												
K-40	1.59E+01	3.00E+00												
Th-234 (Assumed from U-238)	1.37E+00	3.30E-01						1.13E+00	8.20E-01					
Pa-234m (Assumed from U-238)	1.37E+00	3.30E-01						3.20E+00	7.70E+00					U
Ac-227														
Ra-228	5.50E-01	1.80E-01												
Pa-231	-2.00E-01	1.30E+00												UJ
<b>Beta Sum</b>	<b>1.93E+01</b>	<b>3.05E+00</b>						<b>2.08E+01</b>	<b>8.31E+00</b>					
<b>Total Activity Sum</b>	<b>2.53E+01</b>	<b>3.32E+00</b>						<b>2.69E+01</b>	<b>8.41E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.10E+00	1.20E+00						<b>0.02</b>	<b>(from gamma)</b>			<b>0.5</b>		
Gross Beta	4.30E+00	1.10E+00					J	<b>4.62</b>	<b>1.97</b>			<b>127</b>		
Total Activity	1.33E+01	4.20E+00					J	<b>2.25</b>	<b>1.45</b>			<b>62.3</b>		

Tonawanda Data Summary Tables

Analyses	TMF-0284				FROM GAMMA							Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)	
Am-241								4.70E-01	4.70E-01			
Ra-226	9.90E-01	2.60E-01					J					
Np-237												
Pu-238												
Pu-239												
Th-228	9.10E-01	1.60E-01										
Th-230	7.80E-01	1.40E-01										
Th-232	8.20E-01	1.40E-01										
U-234	9.10E-01	2.40E-01	8.20E-01	2.20E-01	0.28	10.4						
U-235	4.10E-02	4.50E-02	4.00E-03	2.30E-02	0.73	164		-4.00E-02	3.10E-01			U
U-238	8.30E-01	2.20E-01	8.70E-01	2.30E-01	0.13	4.71						
<b>Total U Alpha</b>	<b>1.78E+00</b>	<b>3.29E-01</b>	<b>1.69E+00</b>	<b>3.19E-01</b>								
<b>Alpha Sum</b>	<b>4.11E+00</b>	<b>1.44E+00</b>	<b>1.69E+00</b>	<b>3.19E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.79E+01	3.60E+00										
Th-234 (Assumed from U-238)	8.30E-01	2.20E-01	8.70E-01	2.30E-01	0.13	4.71		-9.00E-01	1.10E+00			U
Pa-234m (Assumed from U-238)	8.30E-01	2.20E-01	8.70E-01	2.30E-01	0.13	4.71		-4.90E+00	9.00E+00			U
Ac-227												
Ra-228	6.60E-01	2.10E-01										
Pa-231	-1.30E+00	1.50E+00					UJ					
<b>Beta Sum</b>	<b>2.01E+01</b>	<b>3.62E+00</b>	<b>1.74E+00</b>	<b>3.25E-01</b>				<b>1.26E+01</b>	<b>9.76E+00</b>			
<b>Total Activity Sum</b>	<b>2.42E+01</b>	<b>3.90E+00</b>	<b>3.43E+00</b>	<b>4.56E-01</b>				<b>1.67E+01</b>	<b>9.86E+00</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	4.61E+00	9.00E-01						<b>0.29</b>	<b>(from gamma)</b>			<b>11.4</b>
Gross Beta	4.24E+00	7.30E-01					J	<b>4.28</b>	<b>0.85</b>			<b>130</b>
Total Activity	8.20E+00	3.80E+00					J	<b>2.93</b>	<b>0.81</b>			<b>98.7</b>



Tonawanda Data Summary Tables

0107106-14		TMF-0285				FROM GAMMA						Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.00E-02	6.60E-01					U
Ra-226	2.26E+01	2.40E+00					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.00E-01	1.60E-01												
Th-230	3.15E+01	4.40E+00												
Th-232	9.10E-01	1.60E-01												
U-234	2.90E+01	4.60E+00												
U-235	1.72E+00	4.50E-01						1.65E+00	7.20E-01					
U-238	2.79E+01	4.50E+00												
<b>Total U Alpha</b>	<b>5.86E+01</b>	<b>6.45E+00</b>												
<b>Alpha Sum</b>	<b>1.16E+02</b>	<b>8.50E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.29E+01	2.90E+00												
Th-234 (Assumed from U-238)	2.79E+01	4.50E+00						1.82E+01	3.70E+00					
Pa-234m (Assumed from U-238)	2.79E+01	4.50E+00						3.10E+01	2.00E+01					
Ac-227														
Ra-228	7.40E-01	3.20E-01												
Pa-231	1.70E+00	2.60E+00												
<b>Beta Sum</b>	<b>6.96E+01</b>	<b>7.01E+00</b>						<b>6.30E+01</b>	<b>2.05E+01</b>					
<b>Total Activity Sum</b>	<b>1.86E+02</b>	<b>1.10E+01</b>						<b>1.79E+02</b>	<b>2.22E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	1.27E+02	1.80E+01						<b>0.55</b>	<b>(from gamma)</b>			<b>9.0</b>		
Gross Beta	7.05E+01	9.80E+00						<b>0.07</b>	<b>0.33</b>			<b>1.22</b>		
Total Activity	2.37E+02	2.50E+01						<b>1.88</b>	<b>1.73</b>			<b>24.3</b>		

Tonawanda Data Summary Tables

0107106-15		TMF-0194				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								2.30E-02	9.30E-02					U
Ra-226	1.02E+00	2.60E-01	8.10E-01	2.30E-01	0.60	23								
Np-237														
Pu-238														
Pu-239														
Th-228	8.00E-01	1.60E-01												
Th-230	7.70E-01	1.50E-01												
Th-232	9.00E-01	1.70E-01												
U-234	9.70E-01	2.60E-01												
U-235	6.60E-02	6.00E-02						1.50E-01	2.40E-01					U
U-238	7.40E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.78E+00</b>	<b>3.46E-01</b>												
<b>Alpha Sum</b>	<b>5.54E+00</b>	<b>1.44E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.66E+01	3.70E+00												
Th-234 (Assumed from U-238)	7.40E-01	2.20E-01						5.20E-01	7.50E-01					U
Pa-234m (Assumed from U-238)	7.40E-01	2.20E-01						1.00E+01	1.10E+01					
Ac-227														
Ra-228	6.10E-01	2.10E-01												
Pa-231	3.00E-01	1.50E+00												
<b>Beta Sum</b>	<b>1.87E+01</b>	<b>3.72E+00</b>						<b>2.78E+01</b>	<b>1.16E+01</b>					
<b>Total Activity Sum</b>	<b>2.43E+01</b>	<b>3.99E+00</b>						<b>3.33E+01</b>	<b>1.17E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.25E+00	8.90E-01						0.76	(from gamma)			26.28		
Gross Beta	4.52E+00	8.00E-01					J	3.73	1.99			122		
Total Activity	1.14E+01	4.00E+00					J	2.28	1.77			72.1		

## **Chemical Analytical Data Verification Comments on Data for Tonawanda Landfill, SDG 0107106**

Data for three soil samples were reported in these data packages. The soil samples were analyzed by Paragon Analytics Inc. laboratory for polychlorinated biphenyls (PCBs), pesticides, volatile organics analysis (VOAs), base neutral/acid extractables (BNAs), total metals, total cyanide, and percent moisture as requested in the SAP. The analytical data were evaluated according to the guidance provided in the referenced methods from SW-846<sup>1</sup>, ASTM<sup>2</sup>, and the sampling and analysis plan (SAP)<sup>3</sup>. The groundwater samples have the following ID numbers:

<u>Client Sample ID</u>	<u>Laboratory Sample ID</u>
TMF-0282	0107106-11
TMF-0283	0107106-12
TMF-0284	0107106-13

### **Total PCBs**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total PCBs.

#### Holding Times

The holding time requirements were met. No qualification of data is necessary.

#### Calibration

The initial and continuing calibration criteria were met. No qualification of data is necessary.

#### Blanks

No blank contamination was detected. No qualification of data is necessary.

#### Surrogate Recovery

The surrogate recoveries were acceptable. No qualification of data is necessary.

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<sup>1</sup> "EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition.

<sup>2</sup> "American Society of Testing and Materials Standard Methods".

<sup>3</sup> "Statement of Work for Radiological and Chemical Analytical Laboratory Services, Town of Tonawanda Landfill, Vicinity FUSRAP Property, Tonawanda, NY," April 2001.

#### Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS recoveries for Aroclor 1016 (61%, 69%, QC limits 72-116%), and Aroclor 1260 (54%, 65%, QC limits 66-116%) were outside the QC limits. **The Aroclor 1260 results for samples TMF-0282 and TMF-0283 should be qualified as estimated (J), and the remaining Aroclor results for samples TMF-0282, TMF-0283, and TMF-0284 should be qualified as undetected at an estimated detection limit (UJ) due to low MS recoveries.**

#### Laboratory Control Sample (LCS)

The LCS recoveries were acceptable. No qualification of data is necessary.

#### GC column percent difference (%D)

The GC column %D for Aroclor 1260 for samples TMF-0282 (34.2%) and TMF-0283 (27.5%) were greater than the QC limit of 25%. **The Aroclor 1260 results for samples TMF-0282 and TMF-0283 should be qualified as estimated (J) due to high GC column %D.**

### **Total Pesticides**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total pesticides.

#### Holding Times

The holding time requirements were met. No qualification of data is necessary.

#### Calibration

The initial and continuing calibration criteria were met except for the continuing calibration percent differences (%Ds) for 4,4'-DDT (53%, 66%), methoxychlor (53%, 57%), and endrin ketone (21%, 23%) associated with samples TMF-0282, TMF-0283, and TMF-0284, which were greater than the QC limit of 15%. **The 4,4'-DDT result for sample TMF-0282 should be qualified as estimated (J), and the methoxychlor and endrin ketone results for sample TMF-0282, and the 4,4'-DDT, methoxychlor, and endrin ketone results for samples TMF-0283 and TMF-0284 should be qualified as undetected at an estimated detection limit (UJ) due to high continuing calibration %D.**

#### Blanks

No blank contamination was detected. No qualification of data is necessary.

#### Surrogate Recovery

The surrogate recoveries were acceptable. No qualification of data is necessary.

#### Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The MS/MSD recoveries and RPDs were acceptable except for the MS/MSD RPDs for aldrin (24%), dieldrin (22%), and 4,4'-DDT (25%), which were greater than the QC limit of 20%. **The aldrin result for sample TMF-0282, the aldrin and 4,4'-DDT results for sample TMF-0283, and the aldrin, dieldrin, and 4,4'-DDT results for sample TMF-0284 should be qualified as undetected at an estimated detection limit (UJ), and the dieldrin and 4,4'-DDT**

results for sample TMF-0282, and the dieldrin result for sample TMF-0283 should be qualified as estimated (J) due to high MS/MSD RPD.

#### Laboratory Control Sample (LCS)

The LCS recoveries were acceptable. No qualification of data is necessary.

#### GC column percent difference (%D)

The GC column %Ds were acceptable except for the heptachlor epoxide (25.6%), gamma-chlordane (76.5%), alpha-chlordane (27.8%), and dieldrin (105.3%) %Ds for sample TMF-0282, and the gamma-chlordane (180.0%), alpha-chlordane (64.7%), 4,4'-DDE (109.9%), 4,4'-DDD (36.6%), and endosulfan sulfate (617.9%) %Ds for sample TMF-0283, which were greater than the QC limit of 25%. **The heptachlor epoxide, gamma-chlordane, alpha-chlordane, and dieldrin results for sample TMF-0282, and the gamma-chlordane, alpha-chlordane, 4,4'-DDE, 4,4'-DDD, and endosulfan sulfate results for sample TMF-0283 should be qualified as estimated (J) due to high GC column %D.**

#### Endrin and 4,4'-DDT Breakdown

The endrin and 4,4'-DDT percent breakdown results were acceptable. No qualification of data is necessary.

### **Total VOAs**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total VOAs.

#### Holding Times

The holding time requirements were met. No qualification of data is necessary.

#### GC/MS Tune

The GC/MS tuning requirements were met. No qualification of data is necessary.

#### Calibration

The initial and continuing calibration results were acceptable except for the initial calibration relative standard deviation (RSD) for methylene chloride (40.2%) associated with samples TMF-0282, TMF-0283, and TMF-0284, which was greater than the QC limit of 30%, and the continuing calibration percent difference (%D) for methylene chloride (55.8%) associated with sample TMF-0282, which was greater than the acceptability limit for non-detected results of 40%. **The methylene chloride results for samples TMF-0283 and TMF-0284 should be qualified as estimated (J) due to initial calibration RSD greater than the QC limit, and the methylene chloride result for sample TMF-0282 should be qualified as rejected (R) due to continuing calibration %D greater than the acceptability limit for non-detected results.**

### Blanks

The method blanks were contaminated with methylene chloride, at concentrations requiring qualification of data. Based on professional judgment for VOAs analysis, if the sample to blank concentration ratio is less than 2.5 (5 for common laboratory contaminants), the sample result should be qualified as undetected at an estimated detection limit (UJ), and if the sample to blank concentration ratio is between 2.5 and 5 (between 5 and 10 for common laboratory contaminants), the sample result should be qualified as estimated (J). The compound methylene chloride is considered to be a common laboratory contaminant for VOAs analysis. **The methylene chloride results for samples TMF-0283 and TMF-0284 should be qualified as undetected at an estimated detection limit (UJ) due to blank contamination.**

### Internal Standard (IS) Area

The IS percent recoveries and retention times were acceptable. No qualification of data is necessary.

### Surrogate Recovery

The surrogate recoveries were acceptable. No qualification of data is necessary.

### Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS samples were prepared from a sample from another project. Since the LCS recoveries were acceptable, no qualification of data is recommended.

### Laboratory Control Sample (LCS)

The LCS recoveries were acceptable. No qualification of data is necessary.

## **Total BNAs**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total BNAs. Samples TMF-0282 and TMF-0283 were reanalyzed at higher detection limits due to high surrogate recovery and low internal standard recovery in the original analyses. **It is recommended that the project use the original analysis results for samples TMF-0282 and TMF-0283 since these analyses were reported at lower detection limits with no rejection of data.**

### Holding Times

The holding time requirements were met. No qualification of data is necessary.

### GC/MS Tune

The GC/MS tuning requirements were met. No qualification of data is necessary.

### Calibration

The initial and continuing calibration results were acceptable. No qualification of data is necessary.

### Blanks

Method blank contamination was not detected. No qualification of data is necessary.

### Internal Standard (IS) Areas

The IS percent recoveries and retention times were acceptable except for the IS5 (18.8%) and IS6 (12.3%) recoveries for sample TMF-282, and the IS5 (38.5%) and IS6 (24.0%) recoveries for sample TMF-283, which were outside the QC limits of 50-200%. **The benzidine, pyrene, butylbenzylphthalate, benzo(a)anthracene, 3,3'-dichlorobenzidine, chrysene, bis(2-ethylhexyl)phthalate, di-n-octyl phthalate, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene results for samples TMF-282 and TMF-283 should be qualified as undetected at an estimated detection limit (UJ) for non-detected results and as estimated (J) for detected results due to low IS recovery.**

### Surrogate Recovery

The surrogate recoveries were acceptable. No qualification of data is necessary.

### Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS samples were prepared from a sample from another project. Since the LCS recoveries were acceptable, no qualification of data is recommended.

### Laboratory Control Sample (LCS)

The LCS recoveries were acceptable. No qualification of data is necessary.

## **Total Metals**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total metals.

### Holding Times

The holding time requirements were met. No qualification of data is necessary.

### Calibration

The initial and continuing calibration criteria were met. No qualification of data is necessary.

### Blanks

No blank contamination requiring qualification of data was detected. No qualification of data is necessary.

### Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The matrix spike samples were prepared from a sample from another project. Therefore, an evaluation of the MS recoveries could not be performed. Since the LCS recoveries were acceptable, no qualification of data is recommended.

#### Laboratory Control Sample (LCS)

The LCS recoveries were acceptable. No qualification of data is necessary.

#### Laboratory Duplicate Relative Percent Difference (RPD)

The laboratory duplicate was performed on a sample from another project. Therefore, an evaluation of the laboratory duplicate RPD could not be performed. Based on professional judgment and the intended use of the data, no qualification of data is recommended.

#### Serial Dilution Percent Difference (%D)

The serial dilution was performed on a sample from another project. Therefore, an evaluation of the serial dilution %D could not be performed. Based on professional judgment and the intended use of the data, no qualification of data is recommended.

#### Interference Check Standard

The interference check standard results were acceptable. No qualification of data is necessary.

### **Wet Chemistry**

Samples TMF-0282, TMF-0283, and TMF-0284 were analyzed for total cyanide and percent moisture. The results were evaluated for holding times, calibration, blank contamination, matrix spike recovery, laboratory control sample recovery, and duplicate RPD where applicable. The matrix spike sample for total cyanide was prepared from a sample from another project and therefore the matrix spike recovery for total cyanide could not be evaluated. However, since the total cyanide LCS recovery was acceptable, no qualification of results is recommended. The other QC results were acceptable. No qualification of data is necessary.



**Radiological Analytical Data Verification**  
**Comments on Data for SDG 0107107**

This sample delivery group (SDG) contained twenty (20) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on July 14, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0169	0107107-1
TMF-0170	0107107-2
TMF-0172	0107107-3
TMF-0173	0107107-4
TMF-0210	0107107-5
TMF-0211	0107107-6
TMF-9246	0107107-7
TMF-9247	0107107-8
TMF-0212	0107107-9
TMF-0213	0107107-10
TMF-0214	0107107-11
TMF-021	0107107-12
TMF-0216	0107107-13
TMF-0217	0107107-14
TMF-0218	0107107-15
TMF-0219	0107107-16
TMF-0220	0107107-17
TMF-0221	0107107-18
TMF-0222	0107107-19
TMF-0223	0107107-20

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

S = First Sample Value (original)

D = Second Sample Value (duplicate)

$2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was reported by the laboratory in the EQ-1 and EQ-02 equipment rinsate blanks. However,  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for equipment rinsate sample EQ-1. All associated sample results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J). The  $^{137}\text{Cs}$  activity was reported for samples TMF-0218 and TMF-0223. The reported  $^{137}\text{Cs}$  results were greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification of  $^{137}\text{Cs}$  results in the sample is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium.

In addition,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples. The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near or total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . **Therefore, it is recommended that they remain in the data base for information purposes only.** Results for natural  $^{40}\text{K}$  were reported for all samples. Results for the fission product  $^{137}\text{Cs}$  activity was also reported for samples TMF-0218 and TMF-0223.

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtraction was indicated for  $^{235}\text{U}$  result for sample TMF-0211,  $^{241}\text{Am}$  result for samples TMF-0219 and  $^{231}\text{Pa}$  results for samples TMF-9246, TMF-0214, TMF-0215 and TMF-0223. **It is recommended that the  $^{235}\text{U}$  result for sample TMF-0211,  $^{241}\text{Am}$  result for TMF-0219 and  $^{231}\text{Pa}$  results for samples TMF-9246, TMF-0214, TMF-0215 and TMF-0223 be qualified as estimated (J).** No other problems were observed for the gamma spectrometry analyses.

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was an indication of blank contamination for  $^{238}\text{U}$  result in method blank. All associated samples results less than 5 times the blank value for  $^{238}\text{U}$  analyses should be qualified as estimated (J). For all samples the  $^{238}\text{U}$  results are greater than 5 times the  $^{238}\text{U}$  concentrations identified in the method blank. No qualification of  $^{238}\text{U}$  results is necessary.

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis. There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the  $^{228/230/232}\text{Th}$  results is necessary.

#### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses. No qualification is required.

#### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 47.99% for all samples for the alpha analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty. No qualification of is required.

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for the isotopic uranium and thorium.

### 3.0 <sup>226</sup>Ra ANALYSES

#### Method Blank:

There is no indication of blank contamination either in the method blank sample for the <sup>226</sup>Ra analysis.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the <sup>226</sup>Ra analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the <sup>226</sup>Ra analysis were within acceptable limits.

#### Duplicate Analysis:

The DER (1.32) as well as RPD (52.1%) are outside the acceptable limits for the duplicate <sup>226</sup>Ra analysis. **Therefore, it is recommended that the <sup>226</sup>Ra results for all samples be qualified as estimated (J).**

#### Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

#### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

### **4.0 GROSS ALPHA AND BETA ANALYSIS**

#### Method Blank:

There was no indication of blank contamination in the method blank for the gross alpha/beta analyses.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

#### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

#### Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

#### Matrix Spike Sample:

The percent recovery for the MSS for the gross alpha/beta analyses is within acceptable limits.

#### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

### **5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING**

Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis.

Duplicate Analysis:

The total activity analysis duplicate DER is within acceptable limits.

Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC.

**It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## **6.0 DATA INTERCOMPARISON**

U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties.

Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities for samples TMF-0170 (1.32) and TMF-9246 (1.64) outside acceptable limits indicating that the gross alpha analysis for these samples did not agree with the sum of alpha activities within a 99% confidence level. The RPDs (51.7% and 166% respectively) are also outside acceptable limits. The gross alpha results are greater than the sum of the alpha emitters for both samples by approximate factors of 1.7 and 10.8 respectively. This maybe an indication of other activity in the sample that was not specifically analyzed for or a positive bias on the gross alpha analysis. **It is recommended that the possible missing activity be investigated in the future and the gross alpha results for samples TMF-0170 and TMF-9246 be qualified as estimated (J).**

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.34 to 4.63) for all samples are outside the acceptable limits indicating that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (84.8% to 144%) are also outside acceptable limits. The gross beta results are smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the loss of volatile radionuclides, volatile radionuclide salts, or the sample preparation method, as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the sum of the alpha and beta emitters, the DERs for samples TMF-0169 (3.25), TMF-0170 (3.11), TMF-0173 (3.01), TMF-0210 (2.56), TMF-0211 (3.25), TMF-9246 (3.11), TMF-0212 (4.21), TMF-0213 (3.51), TMF-0214 (2.03), TMF-0215 (3.27), TMF-0216 (1.83), TMF-0217 (2.43), TMF-0218 (2.09), TMF-0219 (3.25), TMF-0220 (3.37), TMF-0221 (3.46) and TMF-0223 (1.81) indicates that the total activity analysis did not agree with the sum of the alpha and beta emitters with a 99% confidence level. The RPDs (95.6%, 112%, 113%, 102%, 99.1%, 88.1%, 143%, 121%, 91.4%, 124%, 64.6%, 77.2%, 83.1% 112%, 101.7%, 1105% and 42.6% respectively) are also outside acceptable limits. These samples have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor ranging from approximately 1.5 to 5.5. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides, radionuclide salts, or sample preparation method, as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

$^{228}\text{Ac}$  Gamma and  $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.



Tonawanda Data Summary Tables

Analyses	TMF-0169				FROM GAMMA				DER	RPD	Val Q	DER	RPD	Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate						
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)						
Am-241					3.00E-02	2.60E-01	2.00E-01	3.20E-01	0.41	148	U			
Ra-226	8.00E-01	1.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	8.30E-01	3.60E-01												
Th-230	9.90E-01	3.00E-01												
Th-232	9.40E-01	2.90E-01												
U-234	8.30E-01	2.30E-01												
U-235	8.70E-02	6.70E-02			1.20E-01	2.80E-01	-1.00E-01	3.00E-01	0.54	2200	U			
U-238	6.70E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.59E+00</b>	<b>3.12E-01</b>												
<b>Alpha Sum</b>	<b>6.32E+00</b>	<b>1.42E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.95E+01	3.60E+00	1.55E+01	3.30E+00	0.82	22.9								
Th-234 (Assumed from U-238)	6.70E-01	2.00E-01					5.00E-01	8.10E-01	6.00E-01	1.10E+00	0.07	18.2	U	
Pa-234m (Assumed from U-238)	6.70E-01	2.00E-01					-6.00E-01	7.50E+00	4.00E+00	1.10E+01	0.35	271	U	
Ac-227														
Ra-228	7.10E-01	1.90E-01	6.00E-01	2.30E-01	0.37	16.8								
Pa-231	1.30E+00	1.40E+00	-3.00E-01	1.70E+00	0.73	320								
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>3.62E+00</b>					<b>2.03E+01</b>	<b>8.36E+00</b>	<b>2.07E+01</b>	<b>1.15E+01</b>				
<b>Total Activity Sum</b>	<b>2.80E+01</b>	<b>3.89E+00</b>					<b>2.66E+01</b>	<b>8.48E+00</b>						
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>				
Gross Alpha	6.00E+00	1.10E+00					0.18	(from gamma)		5.15				
Gross Beta	5.27E+00	9.40E-01					4.39			122				
Total Activity	9.90E+00	4.00E+00					J 3.25	1.78		95.6				

Tonawanda Data Summary Tables

Analyses	TMF-0170					FROM GAMMA				Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)		Uncertainty (pCi/g)
Am-241							1.80E-01	3.00E-01			U
Ra-226	9.50E-01	2.30E-01									J
Np-237											
Pu-238											
Pu-239											
Th-228	7.90E-01	3.10E-01									
Th-230	7.60E-01	2.50E-01									
Th-232	8.00E-01	2.50E-01									
U-234	7.10E-01	1.90E-01	7.10E-01	1.90E-01	0.00	0.00					
U-235	3.80E-02	4.10E-02	1.45E-01	7.90E-02	1.20	117	7.00E-02	2.90E-01			U
U-238	5.90E-01	1.70E-01	7.30E-01	1.90E-01	0.55	21.2					
<b>Total U Alpha</b>	<b>1.34E+00</b>	<b>2.58E-01</b>	<b>1.59E+00</b>	<b>2.80E-01</b>							
<b>Alpha Sum</b>	<b>3.83E+00</b>	<b>1.64E+00</b>	<b>1.59E+00</b>	<b>2.80E-01</b>							
Total U by KPA											
Total U by KPA											
U-235 wt% (by alpha spect)											
U-233 wt%											
<b>Total U Alpha (Calc)</b>											
Total Radiological Sr											
K-40	1.80E+01	3.60E+00									
Th-234 (Assumed from U-238)	5.90E-01	1.70E-01	7.30E-01	1.90E-01	0.55	21.2	1.10E+00	1.10E+00			
Pa-234m (Assumed from U-238)	5.90E-01	1.70E-01	7.30E-01	1.90E-01	0.55	21.2	-5.00E-01	9.80E+00			U
Ac-227											
Ra-228	9.20E-01	2.60E-01									
Pa-231	-9.00E-01	1.70E+00									U
<b>Beta Sum</b>	<b>2.00E+01</b>	<b>3.62E+00</b>	<b>1.46E+00</b>	<b>2.69E-01</b>			<b>1.94E+01</b>	<b>1.05E+01</b>			
<b>Total Activity Sum</b>	<b>2.38E+01</b>	<b>3.98E+00</b>	<b>3.05E+00</b>	<b>3.88E-01</b>			<b>2.32E+01</b>	<b>1.06E+01</b>			
							<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	6.50E+00	1.20E+00					J	1.32	(from gamma)		51.7
Gross Beta	4.70E+00	9.00E-01					J	4.10	1.40		124
Total Activity	6.70E+00	3.80E+00					J	3.11	1.47		112

Tonawanda Data Summary Tables

Analyses	TMF-0172				FROM GAMMA				Val Q					
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate						
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)						
				DER	RPD			DER	RPD					
Am-241								1.00E-01	2.80E-01	4.00E-02	1.10E-01	0.20	85.7	U
Ra-226	1.10E+00	3.30E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	2.50E-01	2.30E-01	4.60E-01	2.20E-01	0.66	59.2								
Th-230	7.70E-01	2.60E-01	5.50E-01	2.30E-01	0.63	33.3								
Th-232	3.20E-01	1.70E-01	3.00E-01	1.70E-01	0.08	6.45								
U-234	6.80E-01	1.90E-01												
U-235	9.50E-02	6.40E-02						1.00E-02	3.90E-01	5.00E-02	3.80E-01	0.07	133	U
U-238	9.00E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.68E+00</b>	<b>3.05E-01</b>												
<b>Alpha Sum</b>	<b>5.11E+00</b>	<b>1.98E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	9.50E+00	2.40E+00	6.30E+00	2.70E+00	0.89	40.5								
Th-234 (Assumed from U-238)	9.00E-01	2.30E-01						1.00E+00	1.10E+00	7.80E-01	9.50E-01	0.15	24.7	
Pa-234m (Assumed from U-238)	9.00E-01	2.30E-01						-2.00E+00	1.40E+01	5.00E+00	1.40E+01	0.35	467	U
Ac-227														
Ra-228	3.70E-01	2.50E-01	3.80E-01	4.50E-01	0.02	2.7								
Pa-231	1.10E+00	2.10E+00	-1.30E+00	2.80E+00	0.69	2400	U							
<b>Beta Sum</b>	<b>1.18E+01</b>	<b>2.45E+00</b>						<b>9.00E+00</b>	<b>1.43E+01</b>	<b>1.23E+01</b>	<b>1.43E+01</b>			
<b>Total Activity Sum</b>	<b>1.69E+01</b>	<b>3.15E+00</b>						<b>1.41E+01</b>	<b>1.44E+01</b>					
Gross Alpha	4.90E+00	1.40E+00						<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Beta	2.40E+00	1.50E+00					J	0.08	(from gamma)		4.10			
Total Activity	1.14E+01	4.00E+00					J	3.27	0.46		132			
								1.08	0.18		38.9			

Tonawanda Data Summary Tables

Analyses	TMF-0173				FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD		
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)				
Am-241					7.90E-02	9.30E-02						
Ra-226	1.11E+00	2.80E-01										J
Np-237												
Pu-238												
Pu-239												
Th-228	9.50E-01	2.80E-01										
Th-230	1.17E+00	3.00E-01										
Th-232	1.00E+00	2.70E-01										
U-234	9.10E-01	2.30E-01										
U-235	2.20E-01	1.00E-01			-1.10E-01	3.20E-01						U
U-238	9.10E-01	2.30E-01										
<b>Total U Alpha</b>	<b>2.04E+00</b>	<b>3.40E-01</b>										
<b>Alpha Sum</b>	<b>5.10E+00</b>	<b>1.75E+00</b>										
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
K-40	1.59E+01	3.70E+00										
Th-234 (Assumed from U-238)	9.10E-01	2.30E-01			1.19E+00	9.10E-01						
Pa-234m (Assumed from U-238)	9.10E-01	2.30E-01			6.00E+00	1.10E+01						U
Ac-227												
Ra-228	7.00E-01	2.80E-01										
Pa-231	-1.30E+00	1.80E+00										U
<b>Beta Sum</b>	<b>1.83E+01</b>	<b>3.73E+00</b>			<b>2.36E+01</b>	<b>1.16E+01</b>						
<b>Total Activity Sum</b>	<b>2.34E+01</b>	<b>4.12E+00</b>			<b>2.87E+01</b>	<b>1.18E+01</b>						
					<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>			
Gross Alpha	3.75E+00	6.90E-01			<b>0.72</b>	<b>(from gamma)</b>			<b>30.5</b>			
Gross Beta	2.97E+00	5.60E-01			<b>4.05</b>	<b>1.77</b>	J		<b>144</b>			
Total Activity	6.50E+00	3.80E+00			<b>3.01</b>	<b>1.80</b>	J		<b>113</b>			

Tonawanda Data Summary Tables

0107107-5		TMF-0210				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.00E-02	1.20E-01					U
Ra-226	8.80E-01	2.30E-01	9.30E-01	2.20E-01	0.16	5.52	J							
Np-237														
Pu-238														
Pu-239														
Th-228	1.09E+00	3.50E-01												
Th-230	9.00E-01	2.60E-01												
Th-232	9.20E-01	2.70E-01												
U-234	7.10E-01	2.00E-01												
U-235	1.89E-01	9.50E-02						-2.60E-01	4.50E-01					U
U-238	9.60E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.86E+00</b>	<b>3.27E-01</b>												
<b>Alpha Sum</b>	<b>5.83E+00</b>	<b>2.52E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.74E+01	5.00E+00												
Th-234 (Assumed from U-238)	9.60E-01	2.40E-01						3.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	9.60E-01	2.40E-01						-5.00E+00	1.80E+01					U
Ac-227														
Ra-228	6.40E-01	4.20E-01												
Pa-231	2.00E-01	2.70E+00												U
<b>Beta Sum</b>	<b>2.00E+01</b>	<b>5.04E+00</b>						<b>1.34E+01</b>	<b>1.87E+01</b>					
<b>Total Activity Sum</b>	<b>2.58E+01</b>	<b>5.63E+00</b>						<b>1.92E+01</b>	<b>1.89E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	8.50E+00	1.50E+00	6.70E+00	1.20E+00	0.94	23.7		0.91	(from gamma)				37.3	
Gross Beta	6.60E+00	1.10E+00	5.47E+00	9.80E-01	0.77	18.7	J	2.59	0.36				101	
Total Activity	8.40E+00	3.80E+00	1.16E+01	4.00E+00	0.58	32.0	J	2.56	0.56				102	

Tonawanda Data Summary Tables

0107107-6		TMF-0211				FROM GAMMA								Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Q		
															Am-241	
Ra-226	8.10E-01	1.80E-01														J
Np-237																
Pu-238																
Pu-239																
Th-228	9.30E-01	3.00E-01														
Th-230	8.20E-01	2.40E-01														
Th-232	7.90E-01	2.40E-01														
U-234	8.60E-01	2.20E-01	7.50E-01	2.20E-01	0.35	13.7										
U-235	1.10E-01	6.80E-02	1.65E-01	9.30E-02	0.48	40.0	-6.10E-01	4.70E-01								UJ
U-238	8.70E-01	2.20E-01	8.40E-01	2.30E-01	0.09	3.51										
<b>Total U Alpha</b>	<b>1.84E+00</b>	<b>3.18E-01</b>	<b>1.76E+00</b>	<b>3.32E-01</b>												
<b>Alpha Sum</b>	<b>6.90E+00</b>	<b>2.41E+00</b>	<b>1.76E+00</b>	<b>3.32E-01</b>												
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
K-40	2.29E+01	4.70E+00														
Th-234 (Assumed from U-238)	8.70E-01	2.20E-01	8.40E-01	2.30E-01	0.09	3.51	-5.00E-01	1.00E+00								U
Pa-234m (Assumed from U-238)	8.70E-01	2.20E-01	8.40E-01	2.30E-01	0.09	3.51	-8.00E+00	1.70E+01								U
Ac-227																
Ra-228	5.50E-01	3.20E-01														
Pa-231	1.90E+00	2.60E+00														U
<b>Beta Sum</b>	<b>2.54E+01</b>	<b>4.73E+00</b>	<b>1.68E+00</b>	<b>3.25E-01</b>			<b>1.52E+01</b>	<b>1.77E+01</b>								
<b>Total Activity Sum</b>	<b>3.23E+01</b>	<b>5.31E+00</b>	<b>3.44E+00</b>	<b>4.64E-01</b>			<b>2.21E+01</b>	<b>1.78E+01</b>								
<b>DER (sums to gross)</b>																
Gross Alpha	5.20E+00	1.10E+00					<b>0.64</b>	<b>(from gamma)</b>								<b>28.1</b>
Gross Beta	4.75E+00	9.20E-01					<b>4.29</b>	<b>0.59</b>								<b>137</b>
Total Activity	1.09E+01	3.90E+00					<b>3.25</b>	<b>0.61</b>								<b>99.1</b>

Tonawanda Data Summary Tables

0107107-7		TMF-9246				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.00E-02	1.20E-01					U
Ra-226	7.40E-01	1.80E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.60E-01	2.70E-01	8.60E-01	3.00E-01	0.25	12.3								
Th-230	8.40E-01	2.60E-01	1.03E+00	2.90E-01	0.49	20.3								
Th-232	7.50E-01	2.40E-01	8.40E-01	2.60E-01	0.25	11.3								
U-234	6.20E-01	2.70E-01												
U-235	2.30E-02	5.20E-02					U	-3.00E-01	4.70E-01					U
U-238	8.90E-01	3.20E-01												
<b>Total U Alpha</b>	<b>1.53E+00</b>	<b>4.22E-01</b>												
<b>Alpha Sum</b>	<b>5.73E-01</b>	<b>3.21E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.58E+01	5.00E+00												
Th-234 (Assumed from U-238)	8.90E-01	3.20E-01						4.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	8.90E-01	3.20E-01						9.00E+00	2.30E+01					U
Ac-227														
Ra-228	1.08E+00	6.90E-01												
Pa-231	-4.50E+00	3.50E+00					UJ							
<b>Beta Sum</b>	<b>1.81E+01</b>	<b>5.09E+00</b>						<b>2.57E+01</b>	<b>2.36E+01</b>					
<b>Total Activity Sum</b>	<b>1.87E+01</b>	<b>6.02E+00</b>						<b>2.63E+01</b>	<b>2.38E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.20E+00	1.20E+00					J	1.64	(from gamma)				166	
Gross Beta	6.00E+00	1.00E+00					J	2.34	0.84				100	
Total Activity	1.00E+01	4.00E+00					J	1.20	0.68				60.6	

Tonawanda Data Summary Tables

0107107-8		TMF-9247				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.00E-02	1.50E-01					U
Ra-226	8.00E-01	2.00E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.80E-01	2.70E-01												
Th-230	7.30E-01	2.20E-01												
Th-232	1.00E+00	2.60E-01												
U-234	9.00E-01	2.30E-01												
U-235	8.30E-02	6.30E-02						-8.00E-02	2.50E-01					U
U-238	9.90E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.97E+00</b>	<b>3.38E-01</b>												
<b>Alpha Sum</b>	<b>5.33E+00</b>	<b>1.07E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.94E+01	3.50E+00												
Th-234 (Assumed from U-238)	9.90E-01	2.40E-01						2.60E-01	4.70E-01					U
Pa-234m (Assumed from U-238)	9.90E-01	2.40E-01						2.30E+00	6.90E+00					U
Ac-227														
Ra-228	5.80E-01	1.80E-01												
Pa-231	5.00E-02	1.00E+00					U							
<b>Beta Sum</b>	<b>2.20E+01</b>	<b>3.52E+00</b>						<b>2.25E+01</b>	<b>7.75E+00</b>					
<b>Total Activity Sum</b>	<b>2.73E+01</b>	<b>3.68E+00</b>						<b>2.79E+01</b>	<b>7.83E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.00E+00	1.00E+00						<b>0.22</b>	<b>(from gamma)</b>			<b>6.35</b>		
Gross Beta	5.09E+00	9.30E-01					J	<b>4.63</b>	<b>2.24</b>			<b>125</b>		
Total Activity	1.06E+01	3.90E+00					J	<b>3.11</b>	<b>1.98</b>			<b>88.1</b>		



Tonawanda Data Summary Tables

0107107-9		TMF-0212				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.00E-02	2.50E-01					U
Ra-226	1.08E+00	2.10E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.50E-01	3.10E-01												
Th-230	9.20E-01	2.60E-01												
Th-232	8.80E-01	2.50E-01												
U-234	6.90E-01	2.20E-01												
U-235	5.50E-02	5.60E-02						-1.10E-01	2.80E-01					U
U-238	7.10E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.46E+00</b>	<b>3.16E-01</b>												
<b>Alpha Sum</b>	<b>5.56E+00</b>	<b>1.40E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.88E+01	3.40E+00												
Th-234 (Assumed from U-238)	7.10E-01	2.20E-01						1.05E+00	7.40E-01					
Pa-234m (Assumed from U-238)	7.10E-01	2.20E-01						7.40E+00	7.20E+00					
Ac-227														
Ra-228	5.90E-01	1.80E-01												
Pa-231	3.00E-01	1.40E+00												U
<b>Beta Sum</b>	<b>2.08E+01</b>	<b>3.42E+00</b>						<b>2.79E+01</b>	<b>8.00E+00</b>					
<b>Total Activity Sum</b>	<b>2.64E+01</b>	<b>3.70E+00</b>						<b>3.34E+01</b>	<b>8.12E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.30E+00	1.20E+00						<b>0.40</b>	<b>(from gamma)</b>			<b>12.6</b>		
Gross Beta	5.80E+00	1.00E+00					J	<b>4.22</b>	<b>2.74</b>			<b>113</b>		
Total Activity	4.40E+00	3.70E+00					J	<b>4.21</b>	<b>3.25</b>			<b>143</b>		

Tonawanda Data Summary Tables

0107107-10		TMF-0213				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	3.00E-01	1.10E-01	2.20E-01	0.11	44.4	U
Ra-226	1.04E+00	2.80E-01	6.10E-01	1.70E-01	1.31	52.1	J							
Np-237														
Pu-238														
Pu-239														
Th-228	1.18E+00	3.60E-01												
Th-230	1.18E+00	3.10E-01												
Th-232	1.29E+00	3.30E-01												
U-234	7.50E-01	2.10E-01												
U-235	4.30E-02	4.30E-02						2.30E-01	2.90E-01	-2.80E-01	2.80E-01	1.27	2040	U
U-238	1.00E+00	2.50E-01												
<b>Total U Alpha</b>	<b>1.79E+00</b>	<b>3.29E-01</b>												
<b>Alpha Sum</b>	<b>6.03E+00</b>	<b>2.28E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.83E+01	3.70E+00	1.95E+01	3.50E+00	0.24	6.35								
Th-234 (Assumed from U-238)	1.00E+00	2.50E-01						3.00E-02	8.40E-01	5.80E-01	9.10E-01	0.44	180	U
Pa-234m (Assumed from U-238)	1.00E+00	2.50E-01						4.50E+00	9.90E+00	3.60E+00	6.60E+00	0.08	22.2	U
Ac-227														
Ra-228	6.70E-01	2.30E-01	7.50E-01	1.90E-01	0.27	11.3								
Pa-231	-5.00E-01	2.40E+00	-4.00E-01	1.80E+00	0.03	22.2	U							
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>3.74E+00</b>						<b>2.34E+01</b>	<b>1.06E+01</b>	<b>2.44E+01</b>	<b>7.53E+00</b>			
<b>Total Activity Sum</b>	<b>2.69E+01</b>	<b>4.37E+00</b>						<b>2.95E+01</b>	<b>1.09E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.00E+00	1.00E+00	4.68E+00	9.60E-01	0.23	6.61		0.42	(from gamma)		18.7			
Gross Beta	4.83E+00	9.30E-01	4.75E+00	9.00E-01	0.06	1.67	J	4.18	1.75		125			
Total Activity	6.60E+00	3.80E+00	9.40E+00	3.90E+00	0.51	35.0	J	3.51	1.99		121			

Tonawanda Data Summary Tables

0107107-11		TMF-0214				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								1.02E-01	9.30E-02					
Ra-226	9.10E-01	2.10E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.60E-01	2.80E-01												
Th-230	9.70E-01	3.00E-01												
Th-232	5.80E-01	2.20E-01												
U-234	7.40E-01	2.10E-01												
U-235	1.35E-01	8.20E-02						-1.60E-01	2.60E-01					U
U-238	7.80E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>3.15E-01</b>												
<b>Alpha Sum</b>	<b>3.34E+00</b>	<b>1.48E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.09E+01	2.80E+00												
Th-234 (Assumed from U-238)	7.80E-01	2.20E-01						9.50E-01	5.30E-01					
Pa-234m (Assumed from U-238)	7.80E-01	2.20E-01						1.00E+00	1.10E+01					U
Ac-227														
Ra-228	4.90E-01	3.30E-01												
Pa-231	-1.60E+00	1.50E+00					UJ							
<b>Beta Sum</b>	<b>1.28E+01</b>	<b>2.84E+00</b>						<b>1.31E+01</b>	<b>1.14E+01</b>					
<b>Total Activity Sum</b>	<b>1.61E+01</b>	<b>3.20E+00</b>						<b>1.65E+01</b>	<b>1.15E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	3.70E+00	9.30E-01						<b>0.21</b>	<b>(from gamma)</b>			<b>10.4</b>		
Gross Beta	3.56E+00	7.90E-01					J	<b>3.12</b>	<b>0.84</b>			<b>113</b>		
Total Activity	6.00E+00	3.80E+00					J	<b>2.03</b>	<b>0.87</b>			<b>91.4</b>		

Tonawanda Data Summary Tables

0107107-12		TMF-0215				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.00E-02	1.10E-01					U
Ra-226	9.30E-01	2.00E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.40E-01	2.90E-01												
Th-230	9.30E-01	2.40E-01												
Th-232	8.50E-01	2.30E-01												
U-234	8.80E-01	2.30E-01												
U-235	8.70E-02	6.30E-02						2.00E-01	2.40E-01					
U-238	8.90E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.86E+00</b>	<b>3.31E-01</b>												
<b>Alpha Sum</b>	<b>3.89E+00</b>	<b>1.39E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.70E+01	3.60E+00												
Th-234 (Assumed from U-238)	8.90E-01	2.30E-01						9.30E-01	8.30E-01					
Pa-234m (Assumed from U-238)	8.90E-01	2.30E-01						-2.80E+00	9.60E+00					U
Ac-227														
Ra-228	8.40E-01	2.60E-01												
Pa-231	-1.80E+00	1.40E+00												UJ
<b>Beta Sum</b>	<b>1.94E+01</b>	<b>3.63E+00</b>						<b>1.58E+01</b>	<b>1.03E+01</b>					
<b>Total Activity Sum</b>	<b>2.33E+01</b>	<b>3.89E+00</b>						<b>1.96E+01</b>	<b>1.04E+01</b>					
<b>DER (sums to gross)</b>														
Gross Alpha	5.00E+00	1.20E+00						<b>0.61</b>	<b>(from gamma)</b>				<b>25.0</b>	
Gross Beta	3.20E+00	1.10E+00					J	<b>4.27</b>	<b>1.21</b>				<b>143</b>	
Total Activity	5.50E+00	3.80E+00					J	<b>3.27</b>	<b>1.28</b>				<b>124</b>	

Tonawanda Data Summary Tables

Analyses	TMF-0216				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								-2.00E-02	2.80E-01					U
Ra-226	7.50E-01	2.00E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.90E-01	2.60E-01												
Th-230	9.20E-01	2.80E-01												
Th-232	5.80E-01	2.10E-01												
U-234	9.30E-01	2.40E-01												
U-235	1.20E-02	3.30E-02					U	2.50E-01	2.80E-01					
U-238	5.80E-01	1.80E-01												
<b>Total U Alpha</b>	<b>1.52E+00</b>	<b>3.02E-01</b>												
<b>Alpha Sum</b>	<b>3.74E+00</b>	<b>1.46E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.45E+01	2.90E+00												
Th-234 (Assumed from U-238)	5.80E-01	1.80E-01						9.10E-01	8.50E-01					
Pa-234m (Assumed from U-238)	5.80E-01	1.80E-01						-5.00E+00	8.60E+00					U
Ac-227														
Ra-228	6.30E-01	2.10E-01												
Pa-231	-8.00E-01	1.50E+00					U							
<b>Beta Sum</b>	<b>1.62E+01</b>	<b>2.92E+00</b>						<b>1.09E+01</b>	<b>9.12E+00</b>					
<b>Total Activity Sum</b>	<b>1.99E+01</b>	<b>3.27E+00</b>						<b>1.47E+01</b>	<b>9.24E+00</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.30E+00	1.10E+00						<b>0.85</b>	<b>(from gamma)</b>		<b>34.5</b>			
Gross Beta	4.53E+00	8.80E-01					J	<b>3.82</b>	<b>0.70</b>		<b>113</b>			
Total Activity	1.02E+01	4.20E+00					J	<b>1.83</b>	<b>0.44</b>		<b>64.6</b>			

Tonawanda Data Summary Tables

0107107-14		TMF-0217				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.90E-02	8.30E-02					U
Ra-226	1.04E+00	2.20E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	1.04E+00	3.30E-01												
Th-230	1.17E+00	3.10E-01												
Th-232	8.50E-01	2.60E-01												
U-234	8.10E-01	2.10E-01												
U-235	1.40E-01	7.70E-02						4.00E-02	2.80E-01					U
U-238	8.70E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.82E+00</b>	<b>3.14E-01</b>												
<b>Alpha Sum</b>	<b>5.20E+00</b>	<b>1.42E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.71E+01	3.80E+00												
Th-234 (Assumed from U-238)	8.70E-01	2.20E-01						9.70E-01	5.60E-01					
Pa-234m (Assumed from U-238)	8.70E-01	2.20E-01						-4.00E+00	1.10E+01					U
Ac-227														
Ra-228	6.60E-01	2.60E-01												
Pa-231	-8.00E-01	1.40E+00					U							
<b>Beta Sum</b>	<b>1.94E+01</b>	<b>3.83E+00</b>						<b>1.46E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.46E+01</b>	<b>4.08E+00</b>						<b>1.98E+01</b>	<b>1.17E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.40E+00	1.30E+00						<b>0.62</b>	<b>(from gamma)</b>			<b>20.7</b>		
Gross Beta	5.10E+00	1.00E+00					J	<b>3.62</b>	<b>0.81</b>			<b>117</b>		
Total Activity	1.09E+01	3.90E+00					J	<b>2.43</b>	<b>0.72</b>			<b>77.2</b>		

Tonawanda Data Summary Tables

0107107-15		TMF-0218				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								0.00E+00	1.60E-01					U
Ra-226	7.50E-01	2.00E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.60E-01	2.60E-01												
Th-230	1.24E+00	3.30E-01												
Th-232	9.40E-01	2.80E-01												
U-234	8.40E-01	2.30E-01												
U-235	1.72E-01	9.40E-02						3.00E-01	4.60E-01					U
U-238	8.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.87E+00</b>	<b>3.39E-01</b>												
<b>Alpha Sum</b>	<b>5.64E+00</b>	<b>3.13E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Cs-137	3.20E-01	1.90E-01												
K-40	1.76E+01	5.00E+00												
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01						1.30E+00	1.40E+00					
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01						-3.00E+00	2.60E+01					U
Ac-227														
Ra-228	6.20E-01	6.40E-01												
Pa-231	2.00E-01	3.40E+00												U
<b>Beta Sum</b>	<b>2.03E+01</b>	<b>5.07E+00</b>						<b>1.69E+01</b>	<b>2.65E+01</b>					
<b>Total Activity Sum</b>	<b>2.59E+01</b>	<b>5.96E+00</b>						<b>2.25E+01</b>	<b>2.67E+01</b>					
								<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	4.60E+00	1.10E+00						<b>0.31</b>	<b>(from gamma)</b>					<b>20.3</b>
Gross Beta	5.60E+00	1.10E+00					J	<b>2.83</b>	<b>0.42</b>					<b>113</b>
Total Activity	1.07E+01	4.20E+00					J	<b>2.09</b>	<b>0.44</b>					<b>83.1</b>

Tonawanda Data Summary Tables

0107107-16		TMF-0219				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.34E-01	9.90E-02					UJ
Ra-226	7.00E-01	1.70E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.50E-01	3.00E-01												
Th-230	1.06E+00	3.00E-01												
Th-232	7.20E-01	2.40E-01												
U-234	9.20E-01	2.50E-01												
U-235	1.55E-01	9.00E-02						-3.00E-02	2.60E-01					U
U-238	8.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.94E+00</b>	<b>3.51E-01</b>												
<b>Alpha Sum</b>	<b>4.37E+00</b>	<b>1.49E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.88E+01	3.80E+00												
Th-234 (Assumed from U-238)	8.60E-01	2.30E-01						1.32E+00	8.10E-01					
Pa-234m (Assumed from U-238)	8.60E-01	2.30E-01						-7.00E+00	1.10E+01					U
Ac-227														
Ra-228	6.30E-01	2.20E-01												
Pa-231	-1.00E+00	1.50E+00					U							
<b>Beta Sum</b>	<b>2.10E+01</b>	<b>3.82E+00</b>						<b>1.36E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.54E+01</b>	<b>4.10E+00</b>						<b>1.80E+01</b>	<b>1.18E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.10E+00	1.20E+00						<b>0.91</b>	<b>(from gamma)</b>			<b>33.2</b>		
Gross Beta	5.60E+00	1.00E+00					J	<b>3.90</b>	<b>0.69</b>			<b>116</b>		
Total Activity	7.20E+00	3.80E+00					J	<b>3.25</b>	<b>0.87</b>			<b>112</b>		



Tonawanda Data Summary Tables

0107107-17		TMF-0220				FROM GAMMA							Val	
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.30E-01	1.50E-01					U
Ra-226	8.60E-01	1.90E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.90E-01	2.90E-01												
Th-230	8.50E-01	2.50E-01												
Th-232	1.02E+00	2.80E-01												
U-234	9.80E-01	2.60E-01												
U-235	1.45E-01	8.90E-02						2.00E-01	2.50E-01					U
U-238	1.06E+00	2.70E-01												
<b>Total U Alpha</b>	<b>2.19E+00</b>	<b>3.85E-01</b>												
<b>Alpha Sum</b>	<b>5.10E+00</b>	<b>1.26E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.90E+01	3.40E+00												
Th-234 (Assumed from U-238)	1.06E+00	2.70E-01						7.10E-01	6.80E-01					
Pa-234m (Assumed from U-238)	1.06E+00	2.70E-01						2.80E+00	6.30E+00					U
Ac-227														
Ra-228	6.10E-01	1.70E-01												
Pa-231	-9.00E-01	1.20E+00												U
<b>Beta Sum</b>	<b>2.16E+01</b>	<b>3.43E+00</b>						<b>2.30E+01</b>	<b>7.19E+00</b>					
<b>Total Activity Sum</b>	<b>2.67E+01</b>	<b>3.65E+00</b>						<b>2.81E+01</b>	<b>7.30E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.30E+00	1.10E+00						<b>0.12</b>	<b>(from gamma)</b>			<b>3.94</b>		
Gross Beta	5.50E+00	1.00E+00					J	<b>4.51</b>	<b>2.41</b>			<b>119</b>		
Total Activity	8.70E+00	3.90E+00					J	<b>3.37</b>	<b>2.34</b>			<b>101.7</b>		

Tonawanda Data Summary Tables

0107107-18		TMF-0221				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Ra-226	7.30E-01	1.80E-01												J
Np-237														
Pu-238														
Pu-239														
Th-228	1.02E+00	3.20E-01												
Th-230	8.80E-01	2.50E-01												
Th-232	9.90E-01	2.70E-01												
U-234	6.20E-01	1.90E-01												
U-235	1.22E-01	7.80E-02						-1.80E-01	2.70E-01					U
U-238	6.50E-01	1.90E-01												
<b>Total U Alpha</b>	<b>1.39E+00</b>	<b>2.80E-01</b>												
<b>Alpha Sum</b>	<b>5.46E+00</b>	<b>1.31E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.92E+01	3.50E+00												
Th-234 (Assumed from U-238)	6.50E-01	1.90E-01						6.70E-01	6.50E-01					
Pa-234m (Assumed from U-238)	6.50E-01	1.90E-01						7.00E+00	6.40E+00					
Ac-227														
Ra-228	7.50E-01	1.90E-01												
Pa-231	5.00E-01	1.30E+00												U
<b>Beta Sum</b>	<b>2.13E+01</b>	<b>3.52E+00</b>						<b>2.77E+01</b>	<b>7.33E+00</b>					
<b>Total Activity Sum</b>	<b>2.68E+01</b>	<b>3.75E+00</b>						<b>3.31E+01</b>	<b>7.44E+00</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	6.00E+00	1.20E+00						<b>0.30</b>	<b>(from gamma)</b>					<b>9.4</b>
Gross Beta	5.60E+00	1.00E+00					J	<b>4.29</b>	<b>2.99</b>					<b>117</b>
Total Activity	8.30E+00	3.80E+00					J	<b>3.46</b>	<b>2.97</b>					<b>105</b>

Tonawanda Data Summary Tables

0107107-19		TMF-0222				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-2.00E-01	3.20E-01					U
Ra-226	1.32E+00	2.60E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	3.50E-01	2.30E-01												
Th-230	1.79E+00	4.30E-01												
Th-232	3.10E-01	1.50E-01												
U-234	2.67E+00	5.10E-01												
U-235	1.04E-01	7.60E-02						3.00E-01	4.20E-01					U
U-238	2.73E+00	5.20E-01												
<b>Total U Alpha</b>	<b>5.50E+00</b>	<b>7.32E-01</b>												
<b>Alpha Sum</b>	<b>9.81E+00</b>	<b>2.35E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	5.80E+00	1.90E+00												
Th-234 (Assumed from U-238)	2.73E+00	5.20E-01						1.00E+00	1.10E+00					
Pa-234m (Assumed from U-238)	2.73E+00	5.20E-01						5.00E+00	1.30E+01					U
Ac-227														
Ra-228	2.90E-01	3.10E-01												
Pa-231	6.00E-01	2.40E+00												U
<b>Beta Sum</b>	<b>1.16E+01</b>	<b>2.08E+00</b>						<b>1.22E+01</b>	<b>1.32E+01</b>					
<b>Total Activity Sum</b>	<b>2.14E+01</b>	<b>3.14E+00</b>						<b>2.20E+01</b>	<b>1.34E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.90E+00	1.70E+00						<b>0.66</b>	<b>(from gamma)</b>				<b>21.6</b>	
Gross Beta	4.70E+00	1.20E+00					J	<b>2.88</b>	<b>0.56</b>				<b>84.8</b>	
Total Activity	1.83E+01	4.30E+00					J	<b>0.59</b>	<b>0.26</b>				<b>15.8</b>	

Tonawanda Data Summary Tables

0107107-20		TMF-0223				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.30E-01	3.50E-01					U
Ra-226	4.20E-01	1.10E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	1.08E+00	3.00E-01												
Th-230	1.06E+00	2.70E-01												
Th-232	9.90E-01	2.60E-01												
U-234	2.92E+00	5.90E-01												
U-235	5.00E-01	1.90E-01						1.40E-01	3.10E-01					U
U-238	3.04E+00	6.10E-01												
<b>Total U Alpha</b>	<b>6.46E+00</b>	<b>8.70E-01</b>												
<b>Alpha Sum</b>	<b>8.03E+00</b>	<b>1.98E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Cs-137	2.36E-01	9.20E-02												
K-40	1.82E+01	3.80E+00												
Th-234 (Assumed from U-238)	3.04E+00	6.10E-01						2.80E+00	1.30E+00					
Pa-234m (Assumed from U-238)	3.04E+00	6.10E-01						7.70E+00	9.80E+00					U
Ac-227														
Ra-228	8.60E-01	2.70E-01												
Pa-231	-2.20E+00	1.90E+00												
<b>Beta Sum</b>	<b>2.51E+01</b>	<b>3.91E+00</b>						<b>2.95E+01</b>	<b>1.06E+01</b>					
<b>Total Activity Sum</b>	<b>3.31E+01</b>	<b>4.39E+00</b>						<b>3.76E+01</b>	<b>1.08E+01</b>					
<b>DER (sums to gross)</b>														
Gross Alpha	1.01E+01	1.60E+00						<b>0.81</b>	<b>(from gamma)</b>				<b>22.8</b>	
Gross Beta	8.50E+00	1.30E+00					J	<b>4.03</b>	<b>1.97</b>				<b>98.8</b>	
Total Activity	2.15E+01	4.70E+00					J	<b>1.81</b>	<b>1.37</b>				<b>42.6</b>	

## Radiological Analytical Data Verification Comments on Data for SDG 0107108

This sample delivery group (SDG) contained six individual soil samples from the Tonawanda Landfill FUSRAP Site for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] were  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry,  $^{228}\text{Ac}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ , and any radioisotopes detected above the decision level (DL) by gamma spectrometry;  $^{226}\text{Ra}$  by radon emanation; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation were requested for all samples. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics, Inc. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data; therefore, the gross alpha/beta analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0224	0107108-1
TMF-0225	0107108-2
TMF-0226	0107108-3
TMF-0227	0107108-4
TMF-0230	0107108-5
TMF-0231	0107108-6

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_S)^2 + (2\sigma_D)^2}}$$

Where,

- S = First Sample Value (original)
- D = Second Sample Value (duplicate)
- $2\sigma_S$  = First Sample Uncertainty
- $2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was an indication of blank contamination in one of the method blanks for  $^{235}\text{U}$ . All associated sample results less than 5 times the blank value for  $^{235}\text{U}$  analyses should be qualified as estimated (J). **Therefore, it is recommended that the  $^{235}\text{U}$  results for samples TMF-0224, TMF-0224 (laboratory duplicate), TMF-0225, TMF-0226, TMF-0227, TMF-0230, and TMF-0231 be qualified as estimated (J).**

### Equipment Rinsate Sample:

There was no indication of contamination of the equipment rinsate blank for gamma spectrometry analyses.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported for in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{137}\text{Cs}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ ,  $^{228}\text{Ra}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples.

The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. A result for fission product  $^{137}\text{Cs}$  was reported for one sample. **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is not recommended since any modeling will assume equilibrium with parents  $^{235/238}\text{U}$  or  $^{232}\text{Th}$ .**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{231}\text{Pa}$  result for samples

TMF-0230 and the  $^{241}\text{Am}$  result for sample TMF-0231. **Therefore, it is recommended that the  $^{231}\text{Pa}$  result for sample TMF-0230 and the  $^{241}\text{Am}$  result for sample TMF-0231 be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination in the  $^{234/235/238}\text{U}$  alpha spectrometry analyses. There was an indication of blank contamination in the method blank for  $^{230}\text{Th}$ . All associated sample results less than 5 times the blank value for  $^{230}\text{Th}$  analyses should be qualified as estimated (J). **Therefore, it is recommended that for the  $^{230}\text{Th}$  results for all samples be qualified as estimated (J).**

### Equipment Rinsate Sample:

There was an indication of  $^{228}\text{Th}$  and  $^{230}\text{Th}$  contamination of equipment rinsate blank contamination for alpha spectrometry analyses. All associated sample results less than 5 times the blank value for  $^{228}\text{Th}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples had  $^{228}\text{Th}$  and  $^{230}\text{Th}$  results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 58.91% for all samples for the Th and U alpha spectrometry analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty for the Th and U alpha spectrometry analyses.

### Spectral Analysis:

Spectral interferences were observed in the alpha spectra all samples for the isotopic thorium analyses. The spectral interference observed is from the tailing of a higher energy peak into a lower energy peak. In each case and in the matrix blank sample, the isotopic thorium analyses, the tracer peaks for  $^{229}\text{Th}$  tails into the  $^{230}\text{Th}$  peak region. The measured  $^{230}\text{Th}$  blank activity is below the MDC (1.0 pCi/g). Sample activities for  $^{230}\text{Th}$  ranged from 1.09 " 0.32 to 1.36 " 0.35 pCi/g. Spectral interference observed is also observed in the isotopic uranium analyses for all

samples. The  $^{234}\text{U}$  peaks tail into the  $^{235}\text{U}$  peak region. **Therefore, it is recommended that the  $^{235}\text{U}$  and  $^{230}\text{Th}$  results for all samples be qualified as estimated (J).**

Several of the isotopic thorium alpha spectra show at least five extra peaks. These peaks are in the 5.8 MeV, 6.3 MeV, 6.7 MeV, 6.9 MeV, and 7.1 MeV regions. It is assumed that the peaks can be attributed to  $^{216}\text{Po}$ ,  $^{217}\text{At}$ ,  $^{225}\text{Ac}$  and  $^{221}\text{Fr}$ , which are progeny of  $^{228}\text{Th}$  and the  $^{229}\text{Th}$  tracer. There is no indication of interference with the quantitation of the isotopic thorium results. No further qualification of the isotopic thorium results is required.

### 3.0 $^{226}\text{Ra}$ ANALYSES

#### Method Blank:

There was no indication of blank contamination in the method blank for  $^{226}\text{Ra}$  analyses.

#### Equipment Rinsate Sample:

There was no indication of  $^{226}\text{Ra}$  contamination of equipment rinsate blank contamination for the radon emanation analyses.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Duplicate Analysis:

The duplicate DERs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Chemical Recoveries:

The sample-specific chemical recovery (197.40%) for the  $^{226}\text{Ra}$  analysis of sample TMF-0225 was outside acceptable limits. The reported  $^{226}\text{Ra}$  result was calculated using 100% recovery. **Therefore, it is recommended that the  $^{226}\text{Ra}$  result for sample TMF-0225 be estimated (J).**

#### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/g for  $^{226}\text{Ra}$ .



#### 4.0 GROSS ALPHA AND BETA ANALYSIS

##### Method Blank:

There was no indication of blank contamination in the gross alpha/beta analyses.

##### Equipment Rinsate Sample:

There was no indication of gross alpha or gross beta contamination of equipment rinsate blank.

##### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

##### Duplicate Analysis:

The duplicate DERs for the gross alpha/beta analyses are within acceptable limits.

##### Matrix Spike Sample Analysis:

There was no MSS analysis for the gross alpha and gross beta analyses as specified by the SOW.

##### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting, which is not quantitative and does not include volatile radionuclides (e.g.,  $^3\text{H}$  and  $^{99}\text{Tc}$ ).**

##### Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. All gross alpha and beta analysis MDLs were below the required MDL.

#### 5.0 TOTAL ACTIVITY

##### Method Blank:

There was no indication of blank contamination for the total activity analyses.

##### Equipment Rinsate Sample:

There was no indication of total activity contamination of equipment rinsate blank.

Laboratory Control Sample:

The percent recoveries for the reported LCSs are within acceptable limits for the total activity analysis.

Duplicate Analysis:

The total activity laboratory duplicate DER is within acceptable limits.

Matrix Spike Sample:

The MSS recovery was within acceptable limits for the total activity analysis.

Spectral Analysis:

Spectral plots of the total activity analyses were not included in the laboratory data package.

Method Detection Limit:

The required method detection limit (MDL) for the total activity analysis is 10 pCi/g. All samples met the required MDLs.

## **6.0 DATA INTERCOMPARISON**

U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gamma agree within the uncertainties. No further qualification of the gamma spectrometry results is required.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DER for all samples indicates that the gross alpha analyses agree with the sum of the alpha emitters within a 99% confidence level.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (ranging from 3.57 to 4.36) for all samples are greater than or equal to 1.29 indicating that the gross beta analyses are in agreement with the sum of the beta emitters within a 99% confidence level. The corresponding RPDs (ranging from 104% to 116%) are also outside acceptable limits. The gross beta activity for all samples was smaller than the beta sum values by approximately a factor of 3. This difference may be indicative of a negative bias in the gross beta sample results. **Therefore, it is recommended that the gross beta results from all samples be qualified as estimated (J).**

### Total Activity to Sum of Alpha and Beta Emitters:

The DERs (ranging from 1.90 to 3.10) for all samples indicate that the total activity analysis agrees with the sum of the alpha and beta emitters within a 99% confidence level. In addition, the corresponding RPDs (ranging from 58.3% to 91.7%) are also outside acceptable limits. The total activity results ranged from approximately a factor of 2 to 5 lower than the beta sums. Again, this may be indicative of a negative bias in the total activity. **Therefore, it is recommended that the total activity results from all samples be qualified as estimated (J).**

### $^{228}\text{Ra}$ Gamma to $^{232}\text{Th}$ Alpha:

When comparing the  $^{228}\text{Ra}$  ( $^{228}\text{Ac}$ ) gamma activity to  $^{232}\text{Th}$  alpha activity, it was assumed that the radium and thorium were in equilibrium. The activities are all within the uncertainties of the measurements for all samples.

### $^{231}\text{Pa}$ Gamma to $^{235}\text{U}$ Alpha:

When comparing the  $^{231}\text{Pa}$  gamma activity and  $^{235}\text{U}$  alpha activity, it was assumed that the protactinium was in equilibrium. The  $^{231}\text{Pa}$  and  $^{235}\text{U}$  activities are within the measurement uncertainties for all samples except TMF-0230. Since the  $^{231}\text{Pa}$  gamma activity result for samples TMF-0230 was previously qualified for improper background subtraction, no further qualification is necessary.

Summary:

For all samples, there was agreement within the measurement uncertainties between the total activity results and the sum of the gross alpha and gross beta results. However, there appears to be a negative bias on the gross alpha/beta and total activity results. **Therefore it is recommended that individual analysis results be used.**

**Tonwanda Data Summary Tables**

Analyses	TMF-0224				FROM GAMMA							Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								2.80E-01	2.60E-01	1.00E-01	5.20E-01	0.31	94.7		
Ra-226	1.37E+00	2.60E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.03E+00	3.40E-01	1.02E+00	3.30E-01	0.02	0.98									
Th-230	1.28E+00	3.40E-01	1.36E+00	3.50E-01	0.16	6.06	J								
Th-232	9.20E-01	2.70E-01	9.10E-01	2.70E-01	0.03	1.09									
U-234	1.96E+00	4.20E-01													
U-235	4.80E-01	1.70E-01					J	2.50E-01	2.80E-01	6.00E-02	3.20E-01	0.45	123	J	
U-238	1.30E+00	3.10E-01													
<b>Total U Alpha</b>	<b>3.74E+00</b>	<b>5.49E-01</b>													
<b>Alpha Sum</b>	<b>9.24E+00</b>	<b>1.50E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
Tc-99															
Th-234 (Assumed from U-238)	1.30E+00	3.10E-01						1.48E+00	8.00E-01	2.10E+00	1.20E+00	0.43	34.6		
Pa-234m (Assumed from U-238)	1.30E+00	3.10E-01						2.70E+00	7.00E+00	-8.00E-01	9.10E+00	0.30	368	U	
K-40	1.89E+01	3.40E+00	1.78E+01	3.60E+00	0.22	5.99									
Ra-228	8.20E-01	2.00E-01	9.10E-01	2.70E-01	0.27	10.4									
Pa-231	1.00E+00	1.40E+00	-1.10E+00	1.90E+00	0.89	4200	U								
<b>Beta Sum</b>	<b>2.24E+01</b>	<b>3.44E+00</b>						<b>2.40E+01</b>	<b>7.83E+00</b>	<b>1.99E+01</b>	<b>9.87E+00</b>				
<b>Total Activity Sum</b>	<b>3.17E+01</b>	<b>3.75E+00</b>						<b>3.33E+01</b>	<b>7.97E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	8.20E+00	1.40E+00	8.00E+00	1.40E+00	0.10	2.47		0.51	(from gamma)			11.9			
Gross Beta	6.70E+00	1.10E+00	7.20E+00	1.20E+00	0.31	7.19	J	4.36	2.19			108			
Total Activity	1.50E+01	4.20E+00	1.49E+01	4.20E+00	0.02	0.67	J	2.96	2.03			71.5			

Tonwanda Data Summary Tables

Analyses	TMF-0225					FROM GAMMA					Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)
Am-241								4.00E-02	5.20E-01			U
Ra-226	1.34E+00	2.40E-01					J					
Np-237												
Pu-238												
Pu-239												
Th-228	1.07E+00	3.50E-01										
Th-230	1.29E+00	3.40E-01					J					
Th-232	1.24E+00	3.40E-01										
U-234	1.28E+00	3.00E-01	1.02E+00	2.60E-01	0.65	22.6						
U-235	2.70E-01	1.20E-01	4.10E-01	1.50E-01	0.73	41.2	J	3.70E-01	3.40E-01			J
U-238	9.50E-01	2.50E-01	9.30E-01	2.40E-01	0.06	2.13						
<b>Total U Alpha</b>	<b>2.50E+00</b>	<b>4.09E-01</b>	<b>2.36E+00</b>	<b>3.84E-01</b>								
<b>Alpha Sum</b>	<b>6.99E+00</b>	<b>1.79E+00</b>	<b>2.36E+00</b>	<b>3.84E-01</b>								
Total U by KPA												
Total U by KPA												
U-235 wt% (by alpha spect)												
U-233 wt%												
<b>Total U Alpha (Calc)</b>												
Total Radiological Sr												
Tc-99												
Th-234 (Assumed from U-238)	9.50E-01	2.50E-01	9.30E-01	2.40E-01	0.06	2.13		1.10E+00	1.10E+00			
Pa-234m (Assumed from U-238)	9.50E-01	2.50E-01	9.30E-01	2.40E-01	0.06	2.13		0.00E+00	9.30E+00			U
K-40	1.60E+01	3.40E+00										
Ra-228	8.30E-01	2.40E-01										
Pa-231	-5.00E-01	1.80E+00					U					
<b>Beta Sum</b>	<b>1.87E+01</b>	<b>3.43E+00</b>	<b>1.86E+00</b>	<b>3.39E-01</b>				<b>1.79E+01</b>	<b>9.97E+00</b>			
<b>Total Activity Sum</b>	<b>2.57E+01</b>	<b>3.87E+00</b>	<b>4.22E+00</b>	<b>5.13E-01</b>				<b>2.49E+01</b>	<b>1.01E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>		
Gross Alpha	8.10E+00	1.40E+00						0.49	(from gamma)			14.7
Gross Beta	5.90E+00	1.00E+00					J	3.57				104
Total Activity	1.06E+01	4.00E+00					J	2.71				83.1

Tonwanda Data Summary Tables

Analyses	TMF-0226		FROM GAMMA				Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)		
			Result (pCi/g)	Uncertainty (pCi/g)				DER
Am-241					1.00E-02	3.00E-01		U
Ra-226	1.07E+00	2.20E-01						
Np-237								
Pu-238								
Pu-239								
Th-228	1.05E+00	3.40E-01						
Th-230	1.36E+00	3.50E-01					J	
Th-232	1.22E+00	3.30E-01						
U-234	1.11E+00	2.60E-01						
U-235	1.73E-01	8.90E-02					J	
U-238	1.08E+00	2.60E-01			-4.00E-02	3.20E-01		UJ
<b>Total U Alpha</b>	<b>2.36E+00</b>	<b>3.78E-01</b>						
<b>Alpha Sum</b>	<b>6.52E+00</b>	<b>1.70E+00</b>						
Total U by KPA								
Total U by KPA								
U-235 wt% (by alpha spect)								
U-233 wt%								
<b>Total U Alpha (Calc)</b>								
Total Radiological Sr								
Cs-137	1.21E-01	7.10E-02						
Th-234 (Assumed from U-238)	1.08E+00	2.60E-01			-1.00E-02	8.40E-01		U
Pa-234m (Assumed from U-238)	1.08E+00	2.60E-01			7.90E+00	9.60E+00		U
K-40	1.44E+01	3.10E+00						
Ra-228	7.60E-01	2.50E-01						
Pa-231	-6.00E-01	1.70E+00					U	
<b>Beta Sum</b>	<b>1.74E+01</b>	<b>3.14E+00</b>			<b>2.31E+01</b>	<b>1.01E+01</b>		
<b>Total Activity Sum</b>	<b>2.39E+01</b>	<b>3.57E+00</b>			<b>2.96E+01</b>	<b>1.03E+01</b>		
					<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>	
Gross Alpha	6.20E+00	1.10E+00			<b>0.16</b>	<b>(from gamma)</b>		<b>5.08</b>
Gross Beta	5.60E+00	1.00E+00			<b>3.57</b>	<b>1.72</b>	J	<b>102</b>
Total Activity	1.31E+01	4.40E+00			<b>1.90</b>	<b>1.48</b>	J	<b>58.3</b>

Tonwanda Data Summary Tables

Analyses	TMF-0227		FROM GAMMA				Val Q
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	Result (pCi/g)	Uncertainty (pCi/g)	
			Result (pCi/g)	Uncertainty (pCi/g)			
DER	RPD	DER	RPD	DER	RPD	Q	
Am-241					-5.00E-03	9.50E-02	U
Ra-226	9.40E-01	2.10E-01					
Np-237							
Pu-238							
Pu-239							
Th-228	1.42E+00	3.90E-01					
Th-230	1.16E+00	3.10E-01					J
Th-232	1.05E+00	2.90E-01					
U-234	1.22E+00	2.90E-01					
U-235	3.70E-01	1.40E-01			3.00E-02	3.00E-01	UJ
U-238	1.06E+00	2.70E-01					
<b>Total U Alpha</b>	<b>2.65E+00</b>	<b>4.20E-01</b>					
<b>Alpha Sum</b>	<b>8.75E+00</b>	<b>2.28E+00</b>					
Total U by KPA							
Total U by KPA							
U-235 wt% (by alpha spect)							
U-233 wt%							
<b>Total U Alpha (Calc)</b>							
Total Radiological Sr							
Tc-99							
Th-234 (Assumed from U-238)	1.06E+00	2.70E-01			1.20E+00	8.50E-01	
Pa-234m (Assumed from U-238)	1.06E+00	2.70E-01			-1.00E+00	1.00E+01	U
K-40	1.68E+01	3.70E+00					
Ra-228	8.60E-01	2.70E-01					
Pa-231	1.70E+00	2.40E+00					U
<b>Beta Sum</b>	<b>2.00E+01</b>	<b>3.74E+00</b>			<b>1.81E+01</b>	<b>1.07E+01</b>	
<b>Total Activity Sum</b>	<b>2.87E+01</b>	<b>4.38E+00</b>			<b>2.68E+01</b>	<b>1.09E+01</b>	
					<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>
Gross Alpha	6.50E+00	1.10E+00			<b>0.89</b>	<b>(from gamma)</b>	<b>29.5</b>
Gross Beta	5.70E+00	1.00E+00			<b>3.69</b>	<b>1.15</b>	<b>111</b>
Total Activity	1.53E+01	4.50E+00			<b>2.14</b>	<b>0.97</b>	<b>61.0</b>



**Tonwanda Data Summary Tables**

<b>0107108-5</b>		<b>TMF-0230</b>				<b>FROM GAMMA</b>								
<b>Analyses</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Duplicate</b>	<b>Duplicate</b>	<b>DER</b>	<b>RPD</b>	<b>Val Q</b>	<b>Result</b>	<b>Uncertainty</b>	<b>Duplicate</b>	<b>Duplicate</b>	<b>DER</b>	<b>RPD</b>	<b>Val Q</b>
			<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>				<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>	<b>Result (pCi/g)</b>	<b>Uncertainty (pCi/g)</b>			
Am-241								6.00E-03	9.90E-02					U
Ra-226	8.80E-01	2.20E-01	8.30E-01	1.90E-01	0.17	5.85								
Np-237														
Pu-238														
Pu-239														
Th-228	1.11E+00	3.90E-01												
Th-230	1.16E+00	3.30E-01					J							
Th-232	9.10E-01	2.90E-01												
U-234	7.60E-01	2.10E-01												
U-235	1.66E-01	8.90E-02					J	-7.00E-02	2.40E-01					UJ
U-238	9.90E-01	2.50E-01												
<b>Total U Alpha</b>	<b>1.92E+00</b>	<b>3.38E-01</b>												
<b>Alpha Sum</b>	<b>3.55E+00</b>	<b>1.53E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	9.90E-01	2.50E-01						3.30E-01	6.80E-01					U
Pa-234m (Assumed from U-238)	9.90E-01	2.50E-01						2.00E+00	1.10E+01					U
K-40	1.60E+01	3.40E+00												
Ra-228	7.10E-01	2.50E-01												
Pa-231	-2.70E+00	1.50E+00					UJ							
<b>Beta Sum</b>	<b>1.84E+01</b>	<b>3.43E+00</b>						<b>1.87E+01</b>	<b>1.15E+01</b>					
<b>Total Activity Sum</b>	<b>2.19E+01</b>	<b>3.76E+00</b>						<b>2.23E+01</b>	<b>1.16E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.70E+00	1.10E+00						1.14	(from gamma)			46.6		
Gross Beta	4.91E+00	9.20E-01					J	3.79				116		
Total Activity	9.40E+00	3.90E+00					J	2.31				79.9		

Tonwanda Data Summary Tables

0107108-6		TMF-0231				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-2.10E-01	1.50E-01					UJ
Ra-226	3.30E-01	1.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	5.70E-01	2.90E-01												
Th-230	1.09E+00	3.20E-01					J							
Th-232	8.50E-01	2.80E-01												
U-234	1.15E+00	2.70E-01												
U-235	2.70E-01	1.10E-01					J	-1.00E-01	2.50E-01					UJ
U-238	8.00E-01	2.10E-01												
<b>Total U Alpha</b>	<b>2.22E+00</b>	<b>3.59E-01</b>												
<b>Alpha Sum</b>	<b>5.27E+00</b>	<b>1.09E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
Tc-99														
Th-234 (Assumed from U-238)	8.00E-01	2.10E-01						1.80E-01	6.30E-01					U
Pa-234m (Assumed from U-238)	8.00E-01	2.10E-01						3.60E+00	6.20E+00					U
K-40	1.86E+01	3.40E+00												
Ra-228	6.40E-01	1.80E-01												
Pa-231	2.30E-01	9.70E-01					U							
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>3.42E+00</b>						<b>2.30E+01</b>	<b>7.10E+00</b>					
<b>Total Activity Sum</b>	<b>2.61E+01</b>	<b>3.59E+00</b>						<b>2.83E+01</b>	<b>7.18E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.80E+00	1.10E+00						<b>0.34</b>	<b>(from gamma)</b>				<b>9.6</b>	
Gross Beta	6.40E+00	1.10E+00				J		<b>4.03</b>	<b>2.32</b>				<b>106</b>	
Total Activity	9.70E+00	3.90E+00				J		<b>3.10</b>	<b>2.28</b>				<b>91.7</b>	

## Radiological Analytical Data Verification Comments on Data for SDG 0107115

This sample delivery group (SDG) contained twelve individual soil samples from the Tonawanda Landfill FUSRAP Site for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] were  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry,  $^{228}\text{Ac}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ , and any radioisotopes detected above the decision level (DL) by gamma spectrometry;  $^{226}\text{Ra}$  by radon emanation; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation were requested for all samples. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics, Inc. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data; therefore, the gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0232	0107115-1
TMF-0233	0107115-2
TMF-0234	0107115-3
TMF-0235	0107115-4
TMF-9248	0107115-5
TMF-9249	0107115-6
TMF-0236	0107115-7
TMF-0237	0107115-8
TMF-0238	0107115-9
TMF-0239	0107115-10
TMF-0240	0107115-11
TMF-0241	0107115-12

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_s)^2 + (2\sigma_D)^2}}$$

Where,

- S = First Sample Value (original)
- D = Second Sample Value (duplicate)
- $2\sigma_s$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was an indication of blank contamination in one of the method blanks for  $^{231}\text{Pa}$ . All associated sample results less than 5 times the blank value for  $^{235}\text{U}$  analyses should be qualified as estimated (J). **Therefore, it is recommended that the  $^{231}\text{Pa}$  results for all samples be qualified as estimated (J).**

### Equipment Rinsate Sample:

There was no indication of contamination of the equipment rinsate blank for gamma spectrometry analyses.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported for in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{137}\text{Cs}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ ,  $^{228}\text{Ra}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples.

The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. A result for fission product  $^{137}\text{Cs}$  was reported for one sample. **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is not recommended since any modeling will assume equilibrium with parents  $^{235/238}\text{U}$  or  $^{232}\text{Th}$ .**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{241}\text{Am}$  result for sample TMF-0236. **Therefore, it is recommended that the  $^{241}\text{Am}$  result for sample TMF-0236 be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination in the  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  alpha spectrometry analyses.

### Equipment Rinsate Sample:

There was an indication of  $^{228}\text{Th}$  and  $^{230}\text{Th}$  contamination of equipment rinsate blank contamination for alpha spectrometry analyses. All associated sample results less than 5 times the blank value for  $^{228}\text{Th}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples had  $^{228}\text{Th}$  and  $^{230}\text{Th}$  results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 41.01% for all samples for the Th and U alpha spectrometry analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty for the Th and U alpha spectrometry analyses.

### Spectral Analysis:

Spectral interferences were observed in the alpha spectra for samples TMF-232, TMF-9248, TMF-0237, TMF-0239, and TMF-0241 for the isotopic thorium analyses. The spectral interference observed is from the tailing of a higher energy peak into a lower energy peak. In each case and in the matrix blank sample, the isotopic thorium analyses, the tracer peaks for  $^{229}\text{Th}$  tails into the  $^{230}\text{Th}$  peak region. The measured  $^{230}\text{Th}$  blank activity is below the MDC (1.0 pCi/g). Sample activities for  $^{230}\text{Th}$  ranged from 0.69 " 0.23 to 1.05 " 0.42 pCi/g. Spectral interference observed is also observed in the isotopic uranium analyses for samples TMF-0239 and TMF-0240. The  $^{234}\text{U}$  peaks tail into the  $^{235}\text{U}$  peak region. **Therefore, it is recommended that the  $^{235}\text{U}$  results for samples TMF-0239 and TMF-0240 and  $^{230}\text{Th}$  results for samples TMF-232, TMF-9248, TMF-0237, TMF-0239, and TMF-0241 be qualified as estimated (J).**

Several of the isotopic thorium alpha spectra show at least five extra peaks. These peaks are in the 5.8 MeV, 6.3 MeV, 6.7 MeV, 6.9 MeV, and 7.1 MeV regions. It is assumed that the peaks can be attributed to  $^{216}\text{Po}$ ,  $^{217}\text{At}$ ,  $^{225}\text{Ac}$  and  $^{221}\text{Fr}$ , which are progeny of  $^{228}\text{Th}$  and the  $^{229}\text{Th}$  tracer. There is no indication of interference with the quantitation of the isotopic thorium results. No further qualification of the isotopic thorium results is required.

### **3.0 $^{226}\text{Ra}$ ANALYSES**

#### Method Blank:

There was no indication of blank contamination in the method blank for  $^{226}\text{Ra}$  analyses.

#### Equipment Rinse Sample:

There was no indication of  $^{226}\text{Ra}$  contamination of equipment rinse blank contamination for the radon emanation analyses.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Duplicate Analysis:

The duplicate DERs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Chemical Recoveries:

The sample-specific chemical recovery was within acceptable limits for the  $^{226}\text{Ra}$  analyses.

#### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/g for  $^{226}\text{Ra}$ .

#### 4.0 GROSS ALPHA AND BETA ANALYSIS

##### Method Blank:

There was no indication of blank contamination in the gross alpha/beta analyses.

##### Equipment Rinsate Sample:

There was no indication of gross alpha or gross beta contamination of equipment rinsate blank.

##### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

##### Duplicate Analysis:

The duplicate DERs for the gross alpha/beta analyses are within acceptable limits.

##### Matrix Spike Sample Analysis:

There was no MSS analysis for the gross alpha and gross beta analyses as specified by the SOW.

##### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{KCl}$ , and  $^{40}\text{KF}$ ). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

##### Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. Samples TMF-0237, TMF-0238, TMF-0239, and TMF-0240 gross alpha analyses exceeded the required MDL. Samples TMF-9249, TMF-0236, TMF-0237, TMF-0238, TMF-0239, and TMF-0240 gross beta analyses exceeded the required MDL. The gross alpha and gross beta results for these samples may not have met the project data quality objectives (DQOs). Since the gross alpha/beta analyses are just estimates, no qualification is recommended.

## 5.0 TOTAL ACTIVITY

### Method Blank:

There was no indication of blank contamination for the total activity analyses.

### Equipment Rinsate Sample:

There was no indication of total activity contamination of equipment rinsate blank.

### Laboratory Control Sample:

The percent recoveries for the reported LCSs are within acceptable limits for the total activity analysis.

### Duplicate Analysis:

The total activity laboratory duplicate DER is within acceptable limits.

### Matrix Spike Sample:

The MSS analysis result was within acceptable limits for the total activity analysis.

### Spectral Analysis:

Spectral plots of the total activity analyses were not included in the laboratory data package.

### Method Detection Limit:

The required method detection limit (MDL) for the total activity analysis is 10 pCi/g. All samples met the required MDLs.

### Quantification:

**It is recommended that the total activity analysis results for samples TMF-0232, TMF-0233, TMF-0235, TMF-9248, TMF-9249, TMF-0236, TMF-0237, TMF-0238, TMF-0239, TMF-0240, and TMF-0241 be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{KCl}$ , and  $^{40}\text{KF}$ ). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**



## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gamma agree within the uncertainties. No further qualification of the gamma spectrometry results is required.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DER for all samples indicates that the gross alpha analyses agree with the sum of the alpha emitters within a 99% confidence level.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (ranging from 1.89 to 4.94) for all samples are greater than 1.29 indicating that the gross beta analyses are not in agreement with the sum of the beta emitters within a 99% confidence level. The corresponding RPDs (ranging from 92% to 146%) are also outside acceptable limits. The gross beta activity for all samples was smaller than the beta sum values by approximately a factor ranging from 3 to 5. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

### Total Activity to Sum of Alpha and Beta Emitters:

The DERs (ranging from 1.46 to 3.10) for all samples, except TMF-0234, indicate that the total activity analyses are not in agreement with the sum of the alpha and beta emitters within a 99% confidence level. In addition, the corresponding RPDs (ranging from 46.1% to 94.6%) are also outside acceptable limits. Samples TMF-0232, TMF-0233, TMF-0235, TMF-9248, TMF-9249, TMF-0236, TMF-0237, TMF-0238, TMF-0239, TMF-0240, and TMF-0241 have total activity results that is less than the sum of the alpha and beta emitters by an approximate factor of approximately 2. This is most likely due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

### $^{228}\text{Ra}$ Gamma to $^{232}\text{Th}$ Alpha:

When comparing the  $^{228}\text{Ra}$  ( $^{228}\text{Ac}$ ) gamma activity to  $^{232}\text{Th}$  alpha activity, it was assumed that the radium and thorium were in equilibrium. The activities are all within the uncertainties of the measurements for all samples.

$^{231}\text{Pa}$  Gamma to  $^{235}\text{U}$  Alpha:

When comparing the  $^{231}\text{Pa}$  gamma activity and  $^{235}\text{U}$  alpha activity, it was assumed that the protactinium was in equilibrium. The  $^{231}\text{Pa}$  and  $^{235}\text{U}$  activities are within the measurement uncertainties for all samples.

Summary:

For all samples, there was agreement within the measurement uncertainties between the total activity results and the sum of the gross alpha and gross beta results. However, there appears to be a negative bias on the gross beta and total activity results. (According to laboratory procedure, the gross alpha/beta and total activity samples are heated to dryness prior to counting. The loss of volatile radionuclides is likely. **Therefore it is recommended that individual analysis results be used.**)

**Tonwanda Data Summary Tables**

0107115-1		TMF-0232				FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									1.00E-01	2.40E-01	2.00E-02	4.70E-01	0.15	133	U
Ra-226	9.50E-01	2.00E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.06E+00	3.80E-01	1.15E+00	3.80E-01	0.17	8.14									
Th-230	1.03E+00	3.20E-01	1.05E+00	3.10E-01	0.04	1.92	J								
Th-232	1.00E+00	3.10E-01	1.02E+00	3.00E-01	0.05	1.98									
U-234	9.70E-01	2.50E-01													
U-235	6.40E-02	5.90E-02							6.00E-02	2.70E-01	2.40E-01	2.50E-01	0.49	120	U
U-238	7.40E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.77E+00</b>	<b>3.32E-01</b>													
<b>Alpha Sum</b>	<b>4.82E+00</b>	<b>1.44E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Cs-137			8.50E-02	5.80E-02											
K-40	1.76E+01	3.20E+00	1.83E+01	3.70E+00	0.14	3.90									
Th-234 (Assumed from U-238)	7.40E-01	2.10E-01							4.50E-01	8.40E-01	1.10E+00	1.20E+00	0.44	83.9	U
Pa-234m (Assumed from U-238)	7.40E-01	2.10E-01							6.20E+00	6.50E+00	1.60E+00	7.70E+00	0.46	118	
Ac-227															
Ra-228	6.40E-01	1.70E-01	6.40E-01	2.10E-01	0.00	0.00	J								
Pa-231	-1.10E+00	1.40E+00	-4.00E-01	1.60E+00	0.33	93.3	UJ								
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>3.22E+00</b>							<b>2.48E+01</b>	<b>7.30E+00</b>	<b>2.17E+01</b>	<b>8.63E+00</b>			
<b>Total Activity Sum</b>	<b>2.44E+01</b>	<b>3.53E+00</b>							<b>2.96E+01</b>	<b>7.44E+00</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	7.30E+00	1.30E+00	7.20E+00	1.20E+00	0.06	1.38			1.28	(from gamma)			40.8		
Gross Beta	6.10E+00	1.10E+00	5.80E+00	1.00E+00	0.20	5.04	J		3.96	2.53			105		
Total Activity	1.07E+01	4.10E+00	1.04E+01	4.00E+00	0.05	2.84	J		2.53	2.22			78.1		

Tonwanda Data Summary Tables

0107115-2		TMF-0233					FROM GAMMA						
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-2.70E-01	4.60E-01			U	
Ra-226	7.00E-02	1.20E-01					U						
Np-237													
Pu-238													
Pu-239													
Th-228	9.80E-01	3.80E-01											
Th-230	1.02E+00	3.30E-01											
Th-232	9.40E-01	3.10E-01											
U-234	7.60E-01	2.20E-01	8.80E-01	2.40E-01	0.37	14.6							
U-235	7.40E-02	6.10E-02	1.12E-01	7.60E-02	0.39	40.9		1.00E-01	2.80E-01			U	
U-238	7.50E-01	2.20E-01	9.10E-01	2.40E-01	0.49	19.3							
<b>Total U Alpha</b>	<b>1.58E+00</b>	<b>3.17E-01</b>	<b>1.90E+00</b>	<b>3.48E-01</b>									
<b>Alpha Sum</b>	<b>3.60E+00</b>	<b>1.67E+00</b>	<b>1.90E+00</b>	<b>3.48E-01</b>									
Total U by KPA													
Total U by KPA													
U-235 wt% (by alpha spect)													
U-233 wt%													
<b>Total U Alpha (Calc)</b>													
Total Radiological Sr													
K-40	1.72E+01	3.50E+00											
Th-234 (Assumed from U-238)	7.50E-01	2.20E-01	9.10E-01	2.40E-01	0.49	19.3		6.00E-01	1.10E+00			U	
Pa-234m (Assumed from U-238)	7.50E-01	2.20E-01	9.10E-01	2.40E-01	0.49	19.3		-2.30E+00	8.70E+00			U	
Ac-227													
Ra-228	6.20E-01	2.10E-01											
Pa-231	-1.10E+00	1.70E+00					UJ						
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>3.53E+00</b>	<b>1.82E+00</b>	<b>3.39E-01</b>				<b>1.60E+01</b>	<b>9.45E+00</b>				
<b>Total Activity Sum</b>	<b>2.28E+01</b>	<b>3.90E+00</b>	<b>3.72E+00</b>	<b>4.86E-01</b>				<b>1.96E+01</b>	<b>9.59E+00</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>			
Gross Alpha	5.30E+00	1.00E+00						0.87	(from gamma)			38.1	
Gross Beta	5.36E+00	9.70E-01					J	3.78	1.12			113	
Total Activity	1.24E+01	4.10E+00						1.84	0.69			59.1	

Tonwanda Data Summary Tables

0107115-3			TMF-0234		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-9.00E-02	3.30E-01					U	
Ra-226	4.70E-01	1.40E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	4.20E-01	3.10E-01													
Th-230	6.90E-01	2.70E-01													
Th-232	4.20E-01	2.00E-01													
U-234	5.10E-01	1.60E-01													
U-235	7.20E-02	5.70E-02						-1.30E-01	2.80E-01					U	
U-238	4.80E-01	1.60E-01													
<b>Total U Alpha</b>	<b>1.06E+00</b>	<b>2.33E-01</b>													
<b>Alpha Sum</b>	<b>2.07E+00</b>	<b>1.45E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	6.10E+00	1.90E+00													
Th-234 (Assumed from U-238)	4.80E-01	1.60E-01						1.02E+00	8.30E-01						
Pa-234m (Assumed from U-238)	4.80E-01	1.60E-01						7.30E+00	8.90E+00					U	
Ac-227															
Ra-228	4.00E-01	1.90E-01													
Pa-231	-1.10E+00	1.50E+00													
<b>Beta Sum</b>	<b>7.33E+00</b>	<b>1.93E+00</b>						<b>1.47E+01</b>	<b>9.14E+00</b>						
<b>Total Activity Sum</b>	<b>9.40E+00</b>	<b>2.42E+00</b>						<b>1.68E+01</b>	<b>9.26E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	3.20E+00	1.50E+00						<b>0.54</b>	<b>(from gamma)</b>			<b>42.8</b>			
Gross Beta	1.50E+00	1.60E+00						<b>2.32</b>	<b>1.42</b>			<b>132</b>			
Total Activity	8.50E+00	4.30E+00						<b>0.18</b>	<b>0.81</b>			<b>10.1</b>			

Tonwanda Data Summary Tables

0107115-4			TMF-0235		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q			Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								3.40E-02	8.80E-02					U	
Ra-226	1.05E+00	3.00E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	1.10E+00	4.00E-01													
Th-230	6.90E-01	2.70E-01													
Th-232	8.90E-01	3.00E-01													
U-234	7.90E-01	2.10E-01													
U-235	8.30E-02	6.30E-02						1.60E-01	2.40E-01					U	
U-238	7.80E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.65E+00</b>	<b>3.04E-01</b>													
<b>Alpha Sum</b>	<b>4.03E+00</b>	<b>1.53E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.48E+01	3.30E+00													
Th-234 (Assumed from U-238)	7.80E-01	2.10E-01						1.43E+00	9.20E-01						
Pa-234m (Assumed from U-238)	7.80E-01	2.10E-01						2.00E+00	1.10E+01					U	
Ac-227															
Ra-228	5.50E-01	2.00E-01													
Pa-231	-1.50E+00	1.50E+00													
<b>Beta Sum</b>	<b>1.67E+01</b>	<b>3.32E+00</b>						<b>1.86E+01</b>	<b>1.15E+01</b>						
<b>Total Activity Sum</b>	<b>2.08E+01</b>	<b>3.66E+00</b>						<b>2.26E+01</b>	<b>1.16E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.40E+00	1.00E+00						0.75	(from gamma)				29.0		
Gross Beta	5.24E+00	9.60E-01					J	3.32	1.16				105		
Total Activity	8.20E+00	3.90E+00					J	2.35	1.18				86.8		

Tonwanda Data Summary Tables

0107115-5		TMF-9248				FROM GAMMA						Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								4.50E-02	9.80E-02					U
Ra-226	9.80E-01	2.10E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.05E+00	4.20E-01	8.40E-01	3.30E-01	0.39	22.2								
Th-230	8.10E-01	3.00E-01	1.08E+00	3.20E-01	0.62	28.6	J							
Th-232	7.40E-01	2.80E-01	9.70E-01	3.00E-01	0.56	26.9								
U-234	8.70E-01	2.30E-01												
U-235	9.10E-02	6.50E-02						-3.00E-02	2.60E-01					U
U-238	7.80E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.74E+00</b>	<b>3.25E-01</b>												
<b>Alpha Sum</b>	<b>5.77E+00</b>	<b>2.10E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.68E+01	3.50E+00												
Th-234 (Assumed from U-238)	7.80E-01	2.20E-01						1.09E+00	8.90E-01					
Pa-234m (Assumed from U-238)	7.80E-01	2.20E-01						1.80E+00	9.50E+00					U
Ac-227														
Ra-228	6.80E-01	2.30E-01												
Pa-231	5.00E-01	2.20E+00												
<b>Beta Sum</b>	<b>1.91E+01</b>	<b>3.53E+00</b>						<b>2.04E+01</b>	<b>1.02E+01</b>					
<b>Total Activity Sum</b>	<b>2.49E+01</b>	<b>4.11E+00</b>						<b>2.62E+01</b>	<b>1.04E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.83E+00	9.80E-01						0.41	(from gamma)			17.8		
Gross Beta	5.48E+00	9.90E-01					J	3.71	1.46			111		
Total Activity	1.04E+01	4.00E+00					J	2.52	1.42			82.1		

Tonwanda Data Summary Tables

0107115-6		TMF-9249				FROM GAMMA						Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								6.00E-02	1.40E-01					U
Ra-226	1.05E+00	2.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	6.30E-01	3.00E-01												
Th-230	8.60E-01	2.70E-01												
Th-232	8.90E-01	2.80E-01												
U-234	9.60E-01	2.40E-01	7.70E-01	2.10E-01	0.60	22.0								
U-235	1.52E-01	8.20E-02	4.60E-02	5.00E-02	1.10	107		6.00E-02	2.40E-01					U
U-238	8.70E-01	2.20E-01	8.40E-01	2.20E-01	0.10	3.51								
<b>Total U Alpha</b>	<b>1.98E+00</b>	<b>3.36E-01</b>	<b>1.66E+00</b>	<b>3.08E-01</b>										
<b>Alpha Sum</b>	<b>5.23E+00</b>	<b>1.18E+00</b>	<b>1.66E+00</b>	<b>3.08E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.77E+01	3.20E+00												
Th-234 (Assumed from U-238)	8.70E-01	2.20E-01	8.40E-01	2.20E-01	0.10	3.51		2.00E-01	5.70E-01					U
Pa-234m (Assumed from U-238)	8.70E-01	2.20E-01	8.40E-01	2.20E-01	0.10	3.51		3.70E+00	6.30E+00					U
Ac-227														
Ra-228	7.80E-01	1.90E-01												
Pa-231	-2.00E-01	1.10E+00												
<b>Beta Sum</b>	<b>2.02E+01</b>	<b>3.22E+00</b>	<b>1.68E+00</b>	<b>3.11E-01</b>				<b>2.24E+01</b>	<b>7.09E+00</b>					
<b>Total Activity Sum</b>	<b>2.54E+01</b>	<b>3.43E+00</b>	<b>3.34E+00</b>	<b>4.38E-01</b>				<b>2.76E+01</b>	<b>7.19E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.00E+00	1.20E+00						0.46	(from gamma)			13.7		
Gross Beta	5.10E+00	1.00E+00						4.47	2.41			119		
Total Activity	9.10E+00	4.00E+00						3.10	2.25			94.6		



Tonwanda Data Summary Tables

0107115-7			TMF-0236		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-1.90E-01	1.50E-01					UJ	
Ra-226	9.60E-01	2.10E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	5.70E-01	2.70E-01													
Th-230	9.90E-01	3.10E-01					J								
Th-232	7.00E-01	2.60E-01													
U-234	1.05E+00	2.50E-01													
U-235	1.67E-01	8.60E-02						-1.00E-01	2.50E-01					U	
U-238	1.03E+00	2.50E-01													
<b>Total U Alpha</b>	<b>2.25E+00</b>	<b>3.64E-01</b>													
<b>Alpha Sum</b>	<b>5.02E+00</b>	<b>1.26E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Cs-137	1.08E-01	5.30E-02													
K-40	1.24E+01	2.40E+00													
Th-234 (Assumed from U-238)	1.03E+00	2.50E-01						1.20E+00	1.00E+00						
Pa-234m (Assumed from U-238)	1.03E+00	2.50E-01						-1.70E+00	7.20E+00					U	
Ac-227															
Ra-228	6.20E-01	2.00E-01													
Pa-231	-5.00E-01	1.20E+00					UJ								
<b>Beta Sum</b>	<b>1.51E+01</b>	<b>2.44E+00</b>						<b>1.26E+01</b>	<b>7.66E+00</b>						
<b>Total Activity Sum</b>	<b>2.01E+01</b>	<b>2.74E+00</b>						<b>1.76E+01</b>	<b>7.76E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	3.46E+00	8.80E-01						<b>1.01</b>	<b>(from gamma)</b>			<b>36.7</b>			
Gross Beta	2.36E+00	8.60E-01					J	<b>4.94</b>	<b>1.32</b>			<b>146</b>			
Total Activity	1.26E+01	4.40E+00					J	<b>1.46</b>	<b>0.56</b>			<b>46.1</b>			

Tonwanda Data Summary Tables

0107115-8			TMF-0237		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									1.00E-02	2.40E-01					U
Ra-226	1.02E+00	2.30E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	7.00E-01	3.10E-01													
Th-230	1.04E+00	3.20E-01					J								
Th-232	7.90E-01	2.70E-01													
U-234	8.30E-01	2.40E-01													
U-235	5.60E-02	5.60E-02							-4.00E-02	2.60E-01					U
U-238	6.90E-01	2.20E-01													
<b>Total U Alpha</b>	<b>1.58E+00</b>	<b>3.30E-01</b>													
<b>Alpha Sum</b>	<b>5.22E+00</b>	<b>1.26E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.76E+01	3.20E+00													
Th-234 (Assumed from U-238)	6.90E-01	2.20E-01							4.30E-01	6.20E-01					U
Pa-234m (Assumed from U-238)	6.90E-01	2.20E-01							3.60E+00	6.80E+00					U
Ac-227															
Ra-228	7.60E-01	1.90E-01													
Pa-231	1.00E-01	1.20E+00													
<b>Beta Sum</b>	<b>1.98E+01</b>	<b>3.22E+00</b>							<b>2.24E+01</b>	<b>7.54E+00</b>					
<b>Total Activity Sum</b>	<b>2.50E+01</b>	<b>3.46E+00</b>							<b>2.76E+01</b>	<b>7.65E+00</b>					
									<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>			
Gross Alpha	5.20E+00	1.10E+00							<b>0.01</b>	<b>(from gamma)</b>					<b>0.31</b>
Gross Beta	4.90E+00	1.00E+00					J		<b>4.40</b>	<b>2.30</b>					<b>120</b>
Total Activity	9.50E+00	4.00E+00					J		<b>2.92</b>	<b>2.10</b>					<b>89.8</b>

Tonwanda Data Summary Tables

0107115-9			TMF-0238				FROM GAMMA								
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result	Uncertainty	Duplicate	Duplicate	DER	RPD	Val
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									1.20E-01	3.70E-01	-3.00E-02	1.20E-01	0.39	333	U
Ra-226	9.90E-01	2.20E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	6.30E-01	2.80E-01													
Th-230	1.08E+00	3.20E-01													
Th-232	8.80E-01	2.80E-01													
U-234	1.29E+00	3.20E-01													
U-235	2.10E-01	1.10E-01							-1.00E-01	4.70E-01	1.00E-02	4.40E-01	0.17	244	U
U-238	1.10E+00	2.90E-01													
<b>Total U Alpha</b>	<b>2.60E+00</b>	<b>4.46E-01</b>													
<b>Alpha Sum</b>	<b>4.92E+00</b>	<b>2.36E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.79E+01	3.90E+00	1.72E+01	5.00E+00	0.11	3.99									
Th-234 (Assumed from U-238)	1.10E+00	2.90E-01							1.10E+00	1.20E+00	1.30E+00	1.00E+00	0.13	16.7	
Pa-234m (Assumed from U-238)	1.10E+00	2.90E-01							7.00E+00	1.60E+01	8.00E+00	2.30E+01	0.04	13.3	U
Ac-227															
Ra-228	7.30E-01	3.10E-01	1.15E+00	6.30E-01	0.60	44.7									
Pa-231	-1.40E+00	2.50E+00	-2.80E+00	2.70E+00	0.38	66.7	UJ								
<b>Beta Sum</b>	<b>2.07E+01</b>	<b>3.95E+00</b>							<b>2.66E+01</b>	<b>1.65E+01</b>	<b>2.73E+01</b>	<b>2.36E+01</b>			
<b>Total Activity Sum</b>	<b>2.56E+01</b>	<b>4.60E+00</b>							<b>3.15E+01</b>	<b>1.67E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.30E+00	1.40E+00							0.50	(from gamma)		24.6			
Gross Beta	7.40E+00	1.30E+00					J		3.19	1.16		94.5			
Total Activity	1.40E+01	4.20E+00					J		1.86	1.02		58.5			

Tonwanda Data Summary Tables

0107115-10			TMF-0239				FROM GAMMA							
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.00E-02	3.20E-01					U
Ra-226	8.50E-01	2.20E-01	8.60E-01	2.00E-01	0.03	1.17								
Np-237														
Pu-238														
Pu-239														
Th-228	7.30E-01	3.60E-01												
Th-230	1.04E+00	3.30E-01					J							
Th-232	1.05E+00	3.30E-01												
U-234	7.80E-01	2.00E-01												
U-235	8.30E-02	5.90E-02					J	-1.70E-01	2.70E-01					U
U-238	6.50E-01	1.80E-01												
<b>Total U Alpha</b>	<b>1.51E+00</b>	<b>2.75E-01</b>												
<b>Alpha Sum</b>	<b>4.37E+00</b>	<b>1.60E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.75E+01	3.60E+00												
Th-234 (Assumed from U-238)	6.50E-01	1.80E-01						1.13E+00	8.30E-01					
Pa-234m (Assumed from U-238)	6.50E-01	1.80E-01						-5.30E+00	9.40E+00					U
Ac-227														
Ra-228	8.80E-01	2.40E-01												
Pa-231	-9.00E-01	1.60E+00					UJ							
<b>Beta Sum</b>	<b>1.96E+01</b>	<b>3.62E+00</b>						<b>1.41E+01</b>	<b>1.01E+01</b>					
<b>Total Activity Sum</b>	<b>2.39E+01</b>	<b>3.96E+00</b>						<b>1.85E+01</b>	<b>1.02E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.40E+00	1.20E+00						<b>0.51</b>	<b>(from gamma)</b>			<b>21.0</b>		
Gross Beta	5.90E+00	1.10E+00					J	<b>3.61</b>	<b>0.81</b>			<b>107</b>		
Total Activity	9.50E+00	3.90E+00					J	<b>2.60</b>	<b>0.82</b>			<b>86.4</b>		

Tonwanda Data Summary Tables

0107115-11			TMF-0240		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)							Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									0.00E+00	1.20E-01					U
Ra-226	6.50E-01	1.90E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	8.70E-01	3.70E-01													
Th-230	6.60E-01	2.60E-01													
Th-232	6.80E-01	2.50E-01													
U-234	8.90E-01	2.40E-01													
U-235	5.90E-02	5.40E-02					J		1.20E-01	4.30E-01					U
U-238	9.20E-01	2.40E-01													
<b>Total U Alpha</b>	<b>1.87E+00</b>	<b>3.44E-01</b>													
<b>Alpha Sum</b>	<b>4.91E+00</b>	<b>2.52E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	9.40E+00	3.40E+00													
Th-234 (Assumed from U-238)	9.20E-01	2.40E-01							8.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	9.20E-01	2.40E-01							-7.00E+00	2.00E+01					U
Ac-227															
Ra-228	4.20E-01	4.90E-01													
Pa-231	2.00E-01	2.70E+00													
<b>Beta Sum</b>	<b>1.17E+01</b>	<b>3.47E+00</b>							<b>3.64E+00</b>	<b>2.03E+01</b>					
<b>Total Activity Sum</b>	<b>1.66E+01</b>	<b>4.28E+00</b>							<b>8.55E+00</b>	<b>2.05E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	6.40E+00	1.90E+00							0.47	(from gamma)					26.4
Gross Beta	4.30E+00	1.80E+00					J		1.89	0.03					92.4
Total Activity	4.80E+00	3.80E+00					J		2.06	0.18					110.3

Tonwanda Data Summary Tables

0107115-12			TMF-0241		FROM GAMMA										
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)				
Am-241								-3.80E-02	8.60E-02					U	
Ra-226	9.40E-01	2.10E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	7.20E-01	2.90E-01													
Th-230	6.90E-01	2.30E-01					J								
Th-232	9.70E-01	2.80E-01													
U-234	8.10E-01	2.10E-01													
U-235	1.08E-01	6.60E-02						-1.00E-01	2.70E-01					U	
U-238	8.30E-01	2.10E-01													
<b>Total U Alpha</b>	<b>1.75E+00</b>	<b>3.04E-01</b>													
<b>Alpha Sum</b>	<b>4.62E+00</b>	<b>1.56E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.81E+01	3.90E+00													
Th-234 (Assumed from U-238)	8.30E-01	2.10E-01						5.60E-01	6.10E-01						
Pa-234m (Assumed from U-238)	8.30E-01	2.10E-01						7.30E+00	9.10E+00					U	
Ac-227															
Ra-228	8.50E-01	2.90E-01													
Pa-231	-5.00E-01	1.60E+00													
<b>Beta Sum</b>	<b>2.06E+01</b>	<b>3.93E+00</b>						<b>2.68E+01</b>	<b>9.93E+00</b>						
<b>Total Activity Sum</b>	<b>2.52E+01</b>	<b>4.22E+00</b>						<b>3.14E+01</b>	<b>1.00E+01</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.30E+00	1.10E+00						<b>0.36</b>	<b>(from gamma)</b>				<b>13.8</b>		
Gross Beta	5.90E+00	1.10E+00					J	<b>3.59</b>	<b>2.09</b>				<b>111</b>		
Total Activity	1.02E+01	4.00E+00					J	<b>2.57</b>	<b>1.96</b>				<b>84.6</b>		

## Radiological Analytical Data Verification Comments on Data for SDG 0107116

This sample delivery group (SDG) contained thirteen individual soil samples from the Tonawanda Landfill FUSRAP Site for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] were  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry,  $^{228}\text{Ac}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$ , and any radioisotopes detected above the decision level (DL) by gamma spectrometry;  $^{226}\text{Ra}$  by radon emanation; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation were requested for all samples. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics, Inc. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data; therefore, the gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0294	0107116-1
TMF-0295	0107116-2
TMF-0296	0107116-3
TMF-9342	0107116-4
TMF-9343	0107116-5
TMF-9344	0107116-6
TMF-0306	0107116-7
TMF-0307	0107116-8
TMF-0308	0107116-9
TMF-0243	0107116-10
TMF-0242	0107116-11
TMF-0244	0107116-12
TMF-0245	0107116-13

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_S)^2 + (2\sigma_D)^2}}$$

Where,

- S = First Sample Value (original)
- D = Second Sample Value (duplicate)
- $2\sigma_S$  = First Sample Uncertainty

$2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the method blanks for gamma spectrometry.

### Equipment Rinsate Sample:

There was no indication of contamination of the equipment rinsate blank for gamma spectrometry analyses.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses.

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. In addition,  $^{40}\text{K}$ ,  $^{137}\text{Cs}$ ,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples.

The  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . Results for natural  $^{40}\text{K}$  were reported for all samples. A result for fission product  $^{137}\text{Cs}$  was reported for one sample. However, a  $^{137}\text{Cs}$  peak was identified in gamma spectrometry report for TMF-0294 but not reported by the laboratory. The  $^{137}\text{Cs}$  activity in this sample was higher than the required DL ( $1.65 * \text{TPU}$ ). **Inclusion of  $^{212}\text{Pb}$ ,  $^{214}\text{Pb}$ ,  $^{212}\text{Bi}$ ,  $^{214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the database is not recommended since any modeling will assume equilibrium with parent  $^{235/238}\text{U}$  or  $^{232}\text{Th}$ .**



Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{231}\text{Pa}$  results for samples TMF-0295 (laboratory duplicate), TMF-0307 (laboratory duplicate), and TMF-0242 (laboratory duplicate). **Therefore, it is recommended that the  $^{231}\text{Pa}$  results for samples TMF-0295, (laboratory duplicate), TMF-0307 (laboratory duplicate), and TMF-0242 be qualified as estimated (J).**

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was no indication of blank contamination in the  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  alpha spectrometry analyses.

### Equipment Rinsate Sample:

There was an indication of  $^{228}\text{Th}$  and  $^{230}\text{Th}$  contamination of equipment rinsate blank contamination for alpha spectrometry analyses. All associated sample results less than 5 times the blank value for  $^{228}\text{Th}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). All samples had  $^{228}\text{Th}$  and  $^{230}\text{Th}$  results greater than 5 times the blank. No qualification is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

### Sample-Specific Chemical Recovery:

The tracer recoveries were greater than 46.32% for all samples for the Th and U alpha spectrometry analyses. The sample-specific percent recovery results for all samples have less than 10% uncertainty for the Th and U alpha spectrometry analyses.

### Spectral Analysis:

Spectral interferences were observed in the alpha spectra for samples TMF-9342, TMF-9343, TMF-9343 (laboratory duplicate), TMF-9344, TMF-0307, TMF-0308, and TMF-0242 for the isotopic thorium analyses. The spectral interference observed is from the tailing of a higher energy peak into a lower energy peak. In each case and in the matrix blank sample, the isotopic thorium analyses, the tracer peaks for  $^{229}\text{Th}$  tails into the  $^{230}\text{Th}$  peak region. The measured  $^{230}\text{Th}$

blank activity is below the MDC (1.0 pCi/g). Sample activities for  $^{230}\text{Th}$  ranged from 0.84 " 0.27 to 1.32 " 0.36 pCi/g. Spectral interference observed is also observed in the isotopic uranium analyses for sample TMF-0307. The  $^{234}\text{U}$  peak tails into the  $^{235}\text{U}$  peak region. **Therefore, it is recommended that the  $^{235}\text{U}$  result for samples TMF-0307 and  $^{230}\text{Th}$  results for samples TMF-9342, TMF-9343, TMF-9343 (laboratory duplicate), TMF-9344, TMF-0307, TMF-0308, and TMF-0242 be qualified as estimated (J).**

Several of the isotopic thorium alpha spectra show at least five extra peaks. These peaks are in the 5.8 MeV, 6.3 MeV, 6.7 MeV, 6.9 MeV, and 7.1 MeV regions. It is assumed that the peaks can be attributed to  $^{216}\text{Po}$ ,  $^{217}\text{At}$ ,  $^{225}\text{Ac}$  and  $^{221}\text{Fr}$ , which are progeny of  $^{228}\text{Th}$  and the  $^{229}\text{Th}$  tracer. There is no indication of interference with the quantitation of the isotopic thorium results. No further qualification of the isotopic thorium results is required.

### 3.0 $^{226}\text{Ra}$ ANALYSES

#### Method Blank:

There was no indication of blank contamination in the method blank for  $^{226}\text{Ra}$  analyses.

#### Equipment Rinse Sample:

There was no indication of  $^{226}\text{Ra}$  contamination of equipment rinse blank contamination for the radon emanation analyses.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Duplicate Analysis:

The duplicate DERs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Chemical Recoveries:

The sample-specific chemical recovery was within acceptable limits for the  $^{226}\text{Ra}$  analyses.

#### Method Detection Limit:

All samples met the required method detection limit (MDL) of 0.5 pCi/g for  $^{226}\text{Ra}$ .

#### 4.0 GROSS ALPHA AND BETA ANALYSIS

##### Method Blank:

There was no indication of blank contamination in the gross alpha/beta analyses.

##### Equipment Rinsate Sample:

There was no indication of gross alpha or gross beta contamination of equipment rinsate blank.

##### Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

##### Duplicate Analysis:

The duplicate DERs for the gross alpha/beta analyses are within acceptable limits.

##### Matrix Spike Sample Analysis:

The MSS results for the gross alpha/beta analyses were within acceptable limits.

##### Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ , and  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

##### Method Detection Limit:

The required method detection limit (MDL) for the gross alpha/beta analysis is 1 pCi/g. Sample TMF-0244 gross alpha analyses exceeded the required MDL. Samples TMF-9344, TMF-0308, TMF-0242, and TMF-0244 gross beta analyses exceeded the required MDL. The gross alpha and gross beta results for these samples may not have met the project data quality objectives (DQOs). Since the gross alpha/beta analyses are just estimates, no qualification is recommended.

## 5.0 TOTAL ACTIVITY

### Method Blank:

There was no indication of blank contamination for the total activity analyses.

### Equipment Rinsate Sample:

There was no indication of total activity contamination of equipment rinsate blank.

### Laboratory Control Sample:

The percent recoveries for the reported LCSs are within acceptable limits for the total activity analysis.

### Duplicate Analysis:

The total activity laboratory duplicate DER is within acceptable limits.

### Matrix Spike Sample:

The MSS analysis result was within acceptable limits for the total activity analysis.

### Spectral Analysis:

Spectral plots of the total activity analyses were not included in the laboratory data package.

### Method Detection Limit:

The required method detection limit (MDL) for the total activity analysis is 10 pCi/g. All samples met the required MDLs.

### Quantification:

**It is recommended that the total activity analysis results for samples TMF-0294, TMF-0295, TMF-0296, TMF-9342, TMF-9343, TMF-9344, TMF-0306, TMF-0307, TMF-0308, TMF-0243, TMF-0242, and TMF-0245 be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ , and  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gamma agree within the uncertainties except for sample TMF-0307. The  $^{234}\text{Th}$  gamma spectrometry result for this sample is smaller than the  $^{238}\text{U}$  alpha spectrometry result. However, the  $^{234}\text{Th}$  result for TMF-0307 (laboratory duplicate) is in agreement with the uranium alpha result. No further qualification of the gamma spectrometry results is required.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs (1.33 and 1.67) for samples TMF-0296 and TMF-0243 indicate that the gross alpha analyses did not agree with the sum of the alpha emitters within a 99% confidence level. In addition, the RPDs (42.2% and 50.6%) were also outside acceptable limits. The gross alpha activity was smaller than the alpha sum value. The gross alpha analysis was performed by gas proportional counting, which has uncertainties in corrections for geometry and self-absorption of the alpha particles, which may cause the negative bias observed in the gross alpha analysis. **Therefore, it is recommended that the gross alpha results for samples TMF-0296 and TMF-0243 be qualified as estimated (J).**

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (ranging from 2.53 to 4.70) for all samples are greater than 1.29 indicating that the gross beta analyses are not in agreement with the sum of the beta emitters within a 99% confidence level. The corresponding RPDs (ranging from 93.5% to 130%) are also outside acceptable limits. The gross beta activity for all samples was smaller than the beta sum values by approximately a factor ranging from 3 to 5. This negative bias is most likely due to the loss of volatile radionuclides and volatile radionuclide salts as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

### Total Activity to Sum of Alpha and Beta Emitters:

The DERs (ranging from 2.28 to 3.76) for all samples, except TMF-0244, indicate that the total activity analyses are not in agreement with the sum of the alpha and beta emitters within a 99% confidence level. In addition, the corresponding RPDs (ranging from 95.9% to 128%) are also outside acceptable limits. These samples have total activity results that are less than the sum of the alpha and beta emitters by an approximate factor of ranging from 2 to 4. This is most likely

due to a negative bias in the total activity results due to the loss of volatile radionuclides and/or radionuclide salts as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

$^{228}\text{Ra}$  Gamma to  $^{232}\text{Th}$  Alpha:

When comparing the  $^{228}\text{Ra}$  ( $^{228}\text{Ac}$ ) gamma activity to  $^{232}\text{Th}$  alpha activity, it was assumed that the radium and thorium were in equilibrium. The activities are all within the uncertainties of the measurements for all samples except TMF-0306. The  $^{228}\text{Ra}$  result in sample TMF-0306 is smaller than the  $^{232}\text{Th}$  result by a factor of 1.24 and is indicative of either a non-equilibrium condition or sample heterogeneity. No qualification of the  $^{228}\text{Ra}$  or  $^{232}\text{Th}$  results is necessary.

$^{231}\text{Pa}$  Gamma to  $^{235}\text{U}$  Alpha:

When comparing the  $^{231}\text{Pa}$  gamma activity and  $^{235}\text{U}$  alpha activity, it was assumed that the protactinium was in equilibrium with uranium. The  $^{231}\text{Pa}$  and  $^{235}\text{U}$  activities are outside the measurement uncertainties for samples TMF-0295 (laboratory duplicate), TMF-0307 (laboratory duplicate), TMF-0243 and TMF-0242. For sample TMF-0243, the  $^{231}\text{Pa}$  activity is greater than the  $^{235}\text{U}$  alpha result by a factor of about 1.5 and is indicative of either a non-equilibrium condition or sample heterogeneity. Samples TMF-0295 (laboratory duplicate), TMF-0307 (laboratory duplicate), and TMF-0242 were previously qualified due to improper background subtraction. No qualification of the  $^{231}\text{Pa}$  or  $^{235}\text{U}$  results is necessary.

Summary:

For all samples, there was agreement within the measurement uncertainties between the total activity results and the sum of the gross alpha and gross beta results. However, there appears to be a negative bias on the gross beta and total activity results. (According to laboratory procedure, the gross alpha/beta and total activity samples are heated to dryness prior to counting. The loss of volatile radionuclides is likely. **Therefore it is recommended that individual analysis results be used.**)

**Tonawanda Data Summary Tables**

Analyses	TMF-0294				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								2.10E-01	4.70E-01					U
Ra-226	8.00E-01	2.00E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.50E-01	3.20E-01	9.80E-01	3.70E-01	0.47	26.6								
Th-230	9.40E-01	2.90E-01	9.10E-01	2.90E-01	0.07	3.24								
Th-232	6.60E-01	2.30E-01	8.90E-01	2.90E-01	0.62	29.7								
U-234	8.20E-01	2.20E-01												
U-235	7.00E-02	5.80E-02						2.10E-01	3.30E-01					U
U-238	7.10E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.60E+00</b>	<b>3.03E-01</b>												
<b>Alpha Sum</b>	<b>4.30E+00</b>	<b>1.73E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.48E+01	3.10E+00												
Th-234 (Assumed from U-238)	7.10E-01	2.00E-01						8.00E-01	1.10E+00					U
Pa-234m (Assumed from U-238)	7.10E-01	2.00E-01						9.00E-01	9.20E+00					U
Ac-227														
Ra-228	6.10E-01	2.20E-01												
Pa-231	-5.00E-01	1.80E+00												U
<b>Beta Sum</b>	<b>1.68E+01</b>	<b>3.13E+00</b>						<b>1.71E+01</b>	<b>9.78E+00</b>					
<b>Total Activity Sum</b>	<b>2.11E+01</b>	<b>3.57E+00</b>						<b>2.14E+01</b>	<b>9.93E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.90E+00	1.10E+00	4.56E+00	9.80E-01	0.91	25.6		0.78	(from gamma)			31.4		
Gross Beta	4.07E+00	8.10E-01	3.50E+00	7.60E-01	0.51	15.1	J	3.93	1.32			122		
Total Activity	6.80E+00	3.90E+00	5.80E+00	4.00E+00	0.18	15.9	J	2.70	1.36			102		

Tonawanda Data Summary Tables

Analyses	TMF-0295				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)					
Am-241								-2.00E-01	3.10E-01	-6.00E-02	4.00E-01	0.28	108	U
Ra-226	4.90E-01	1.50E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.70E-01	3.70E-01												
Th-230	9.30E-01	3.20E-01												
Th-232	7.60E-01	2.90E-01												
U-234	1.10E+00	2.80E-01	1.18E+00	2.70E-01	0.21	7.02								
U-235	1.07E-01	7.50E-02	1.63E-01	8.60E-02	0.49	41.5		1.90E-01	3.30E-01	2.90E-01	2.50E-01	0.24	41.7	U
U-238	1.09E+00	2.70E-01	1.05E+01	2.50E-01	25.6	162								
<b>Total U Alpha</b>	<b>2.30E+00</b>	<b>3.96E-01</b>	<b>1.18E+01</b>	<b>3.78E-01</b>										
<b>Alpha Sum</b>	<b>4.62E+00</b>	<b>1.69E+00</b>	<b>8.33E+00</b>	<b>2.02E+00</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.83E+01	3.50E+00	1.47E+01	3.40E+00	0.74	21.8								
Th-234 (Assumed from U-238)	1.09E+00	2.70E-01	1.05E+01	2.50E-01	25.6	162		1.00E+00	9.60E-01	1.80E+00	1.40E+00	0.47	57.1	
Pa-234m (Assumed from U-238)	1.09E+00	2.70E-01	1.05E+01	2.50E-01	25.6	162		5.40E+00	8.80E+00	8.00E+00	1.20E+01	0.17	38.8	U
Ac-227														
Ra-228	7.30E-01	2.30E-01	6.70E-01	2.70E-01	0.17	8.57								
Pa-231	-7.00E-01	1.70E+00	-3.90E+00	2.20E+00	1.15	139	U							
<b>Beta Sum</b>	<b>2.11E+01</b>	<b>3.53E+00</b>	<b>3.59E+01</b>	<b>3.44E+00</b>				<b>2.53E+01</b>	<b>9.52E+00</b>	<b>2.47E+01</b>	<b>1.26E+01</b>			
<b>Total Activity Sum</b>	<b>2.57E+01</b>	<b>3.92E+00</b>	<b>4.42E+01</b>	<b>3.99E+00</b>				<b>3.00E+01</b>	<b>9.67E+00</b>	<b>3.30E+01</b>	<b>1.27E+01</b>			
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.80E+00	1.00E+00						0.09	(from gamma)		3.89			
Gross Beta	5.51E+00	9.70E-01					J	4.26	2.07		117			
Total Activity	1.12E+01	4.30E+00					J	2.50	1.77		78.7			



Tonawanda Data Summary Tables

Analyses	TMF-0296				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								-1.40E-01	2.90E-01					U
Ra-226	1.04E+00	2.40E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.09E+00	3.30E-01												
Th-230	7.80E-01	2.50E-01												
Th-232	9.70E-01	2.80E-01												
U-234	7.50E-01	2.00E-01												
U-235	7.70E-02	5.60E-02						6.00E-02	2.80E-01					U
U-238	9.90E-01	2.40E-01												
<b>Total U Alpha</b>	<b>1.82E+00</b>	<b>3.17E-01</b>												
<b>Alpha Sum</b>	<b>5.88E+00</b>	<b>1.25E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.56E+01	3.20E+00												
Th-234 (Assumed from U-238)	9.90E-01	2.40E-01						3.40E-01	6.60E-01					U
Pa-234m (Assumed from U-238)	9.90E-01	2.40E-01						5.30E+00	8.30E+00					U
Ac-227														
Ra-228	7.30E-01	2.40E-01												
Pa-231	2.00E-01	1.20E+00												U
<b>Beta Sum</b>	<b>1.83E+01</b>	<b>3.23E+00</b>						<b>2.20E+01</b>	<b>8.92E+00</b>					
<b>Total Activity Sum</b>	<b>2.42E+01</b>	<b>3.47E+00</b>						<b>2.79E+01</b>	<b>9.01E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	3.83E+00	9.00E-01					J	<b>1.33</b>	<b>(from gamma)</b>				<b>42.2</b>	
Gross Beta	3.50E+00	7.50E-01					J	<b>4.47</b>	<b>2.07</b>				<b>136</b>	
Total Activity	8.20E+00	3.90E+00					J	<b>3.07</b>	<b>2.00</b>				<b>98.8</b>	

Tonawanda Data Summary Tables

Analyses	TMF-9342				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241								-5.50E-02	8.30E-02					U
Ra-226	3.90E-01	1.60E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.90E-01	3.20E-01												
Th-230	1.32E+00	3.60E-01					J							
Th-232	9.30E-01	2.90E-01												
U-234	6.70E-01	1.80E-01												
U-235	1.20E-01	6.80E-02						0.00E+00	2.50E-01					U
U-238	8.40E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.63E+00</b>	<b>2.85E-01</b>												
<b>Alpha Sum</b>	<b>3.71E+00</b>	<b>1.58E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.26E+01	3.00E+00												
Th-234 (Assumed from U-238)	8.40E-01	2.10E-01						2.20E-01	6.90E-01					U
Pa-234m (Assumed from U-238)	8.40E-01	2.10E-01						1.10E+00	8.30E+00					U
Ac-227														
Ra-228	6.70E-01	2.50E-01												
Pa-231	-1.50E+00	1.60E+00					U							
<b>Beta Sum</b>	<b>1.48E+01</b>	<b>3.03E+00</b>						<b>1.44E+01</b>	<b>8.86E+00</b>					
<b>Total Activity Sum</b>	<b>1.85E+01</b>	<b>3.42E+00</b>						<b>1.81E+01</b>	<b>9.00E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.10E+00	1.00E+00						<b>0.74</b>	<b>(from gamma)</b>			<b>31.6</b>		
Gross Beta	4.37E+00	8.50E-01					J	<b>3.30</b>	<b>1.13</b>			<b>109</b>		
Total Activity	6.50E+00	4.00E+00					J	<b>2.28</b>	<b>1.18</b>			<b>95.9</b>		

**Tonawanda Data Summary Tables**

Analyses	TMF-9343				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								7.00E-02	1.10E-01					U
Ra-226	9.20E-01	2.10E-01	9.90E-01	2.10E-01	<b>0.24</b>	<b>7.33</b>								
Np-237														
Pu-238														
Pu-239														
Th-228	9.70E-01	3.60E-01	1.01E+00	3.40E-01	<b>0.08</b>	<b>4.04</b>								
Th-230	1.03E+00	3.30E-01	8.40E-01	2.70E-01	<b>0.45</b>	<b>20.3</b>	J							
Th-232	8.40E-01	2.90E-01	6.90E-01	2.50E-01	<b>0.39</b>	<b>19.6</b>								
U-234	8.20E-01	2.20E-01												
U-235	5.80E-02	5.20E-02						-1.90E-01	2.70E-01					U
U-238	7.40E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.62E+00</b>	<b>3.09E-01</b>												
<b>Alpha Sum</b>	<b>5.65E+00</b>	<b>1.76E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Cs-137	1.40E-01	8.60E-02												
K-40	1.43E+01	3.40E+00												
Th-234 (Assumed from U-238)	7.40E-01	2.10E-01						5.10E-01	8.70E-01					U
Pa-234m (Assumed from U-238)	7.40E-01	2.10E-01						1.10E+01	1.20E+01					
Ac-227														
Ra-228	7.90E-01	2.60E-01												
Pa-231	3.00E-01	1.80E+00												U
<b>Beta Sum</b>	<b>1.67E+01</b>	<b>3.43E+00</b>						<b>2.68E+01</b>	<b>1.25E+01</b>					
<b>Total Activity Sum</b>	<b>2.24E+01</b>	<b>3.85E+00</b>						<b>3.24E+01</b>	<b>1.26E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.20E+00	1.00E+00	4.80E+00	1.00E+00	<b>0.28</b>	<b>8.00</b>		<b>0.22</b>	<b>(from gamma)</b>			<b>8.26</b>		
Gross Beta	4.36E+00	8.40E-01	4.08E+00	8.30E-01	<b>0.24</b>	<b>6.64</b>	J	<b>3.51</b>	<b>1.79</b>			<b>117</b>		
Total Activity	7.00E+00	3.90E+00	5.50E+00	3.80E+00	<b>0.28</b>	<b>24.0</b>	J	<b>2.81</b>	<b>1.92</b>			<b>105</b>		

Tonawanda Data Summary Tables

Analyses	TMF-9344				FROM GAMMA							Val Q		
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate		DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.90E-01	5.40E-01					U
Ra-226	6.80E-01	1.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.12E+00	3.90E-01												
Th-230	9.80E-01	3.20E-01					J							
Th-232	1.02E+00	3.20E-01												
U-234	7.70E-01	2.30E-01	9.70E-01	2.40E-01	0.60	23.0								
U-235	9.20E-02	7.00E-02	1.19E-01	7.10E-02	0.27	25.6		1.40E-01	3.30E-01					U
U-238	8.00E-01	2.30E-01	1.01E+00	2.40E-01	0.63	23.2								
<b>Total U Alpha</b>	<b>1.66E+00</b>	<b>3.33E-01</b>	<b>2.10E+00</b>	<b>3.47E-01</b>										
<b>Alpha Sum</b>	<b>5.55E+00</b>	<b>1.77E+00</b>	<b>2.10E+00</b>	<b>3.47E-01</b>										
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.73E+01	3.80E+00												
Th-234 (Assumed from U-238)	8.00E-01	2.30E-01	1.01E+00	2.40E-01	0.63	23.2		5.00E-01	1.30E+00					U
Pa-234m (Assumed from U-238)	8.00E-01	2.30E-01	1.01E+00	2.40E-01	0.63	23.2		-1.20E+01	1.30E+01					U
Ac-227														
Ra-228	7.60E-01	2.90E-01												
Pa-231	1.00E-01	1.80E+00					U							
<b>Beta Sum</b>	<b>1.97E+01</b>	<b>3.83E+00</b>	<b>2.02E+00</b>	<b>3.39E-01</b>				<b>6.57E+00</b>	<b>1.36E+01</b>					
<b>Total Activity Sum</b>	<b>2.52E+01</b>	<b>4.22E+00</b>	<b>4.12E+00</b>	<b>4.85E-01</b>				<b>1.21E+01</b>	<b>1.37E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.26E+00	1.00E+00						<b>0.64</b>	<b>(from gamma)</b>			<b>26.3</b>		
Gross Beta	4.80E+00	1.10E+00					J	<b>3.73</b>	<b>0.13</b>			<b>122</b>		
Total Activity	6.90E+00	3.90E+00	5.80E+00	4.00E+00	0.20	17.3	J	<b>3.19</b>	<b>0.37</b>			<b>114</b>		

Tonawanda Data Summary Tables

Analyses	TMF-0306				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		Duplicate	DER	RPD
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)		Uncertainty (pCi/g)		
Am-241							1.10E-01	1.50E-01						U
Ra-226	6.70E-01	1.70E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	7.40E-01	3.20E-01												
Th-230	1.16E+00	3.50E-01												
Th-232	1.11E+00	3.40E-01												
U-234	6.80E-01	2.00E-01												
U-235	3.70E-02	4.20E-02					9.00E-02	2.50E-01						U
U-238	7.00E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.42E+00</b>	<b>2.93E-01</b>												
<b>Alpha Sum</b>	<b>5.46E+00</b>	<b>1.27E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.83E+01	3.30E+00												
Th-234 (Assumed from U-238)	7.00E-01	2.10E-01					4.90E-01	7.00E-01						U
Pa-234m (Assumed from U-238)	7.00E-01	2.10E-01					-9.00E-01	6.20E+00						U
Ac-227														
Ra-228	4.70E-01	1.50E-01												
Pa-231	4.00E-01	1.20E+00												U
<b>Beta Sum</b>	<b>2.02E+01</b>	<b>3.32E+00</b>					<b>1.84E+01</b>	<b>7.06E+00</b>						
<b>Total Activity Sum</b>	<b>2.57E+01</b>	<b>3.56E+00</b>					<b>2.39E+01</b>	<b>7.18E+00</b>						
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>				
Gross Alpha	5.90E+00	1.00E+00					<b>0.27</b>	<b>(from gamma)</b>			<b>7.80</b>			
Gross Beta	4.55E+00	8.60E-01				J	<b>4.57</b>	<b>1.95</b>			<b>127</b>			
Total Activity	8.30E+00	4.00E+00				J	<b>3.25</b>	<b>1.89</b>			<b>102</b>			

Tonawanda Data Summary Tables

Analyses	TMF-0307				FROM GAMMA							Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate			DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)						
Am-241								-1.20E-01	2.30E-01	-1.70E-01	3.10E-01	0.13	34.5	U	
Ra-226	8.30E-01	1.90E-01													
Np-237															
Pu-238															
Pu-239															
Th-228	9.40E-01	3.70E-01													
Th-230	9.70E-01	3.10E-01					J								
Th-232	7.90E-01	2.80E-01													
U-234	9.20E-01	2.50E-01													
U-235	1.04E-01	7.50E-02					J	2.00E-02	2.70E-01	1.50E-01	3.00E-01	0.32	153	U	
U-238	8.80E-01	2.40E-01													
<b>Total U Alpha</b>	<b>1.90E+00</b>	<b>3.55E-01</b>													
<b>Alpha Sum</b>	<b>4.98E+00</b>	<b>1.93E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.93E+01	3.50E+00	1.75E+01	3.60E+00	0.36	9.78									
Th-234 (Assumed from U-238)	8.80E-01	2.40E-01						-2.00E-02	6.30E-01	4.80E-01	8.00E-01	0.49	217	U	
Pa-234m (Assumed from U-238)	8.80E-01	2.40E-01						1.70E+00	7.10E+00	2.30E+00	9.10E+00	0.05	30.0	U	
Ac-227															
Ra-228	7.10E-01	1.80E-01	8.00E-01	2.50E-01	0.29	11.9									
Pa-231	-5.00E-01	2.00E+00	-2.00E+00	1.80E+00	0.56	120	U								
<b>Beta Sum</b>	<b>2.17E+01</b>	<b>3.53E+00</b>						<b>2.16E+01</b>	<b>7.95E+00</b>	<b>2.08E+01</b>	<b>9.82E+00</b>				
<b>Total Activity Sum</b>	<b>2.67E+01</b>	<b>4.02E+00</b>						<b>2.66E+01</b>	<b>8.18E+00</b>						
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	6.20E+00	1.20E+00						0.54	(from gamma)			21.7			
Gross Beta	4.60E+00	8.90E-01					J	4.70	2.13			130			
Total Activity	5.90E+00	3.80E+00					J	3.76	2.30			128			

Tonawanda Data Summary Tables

0107116-9			TMF-0308		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.20E-01	4.90E-01					U
Ra-226	9.30E-01	1.90E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.23E+00	3.80E-01												
Th-230	1.04E+00	3.00E-01					J							
Th-232	9.90E-01	2.90E-01												
U-234	7.60E-01	2.10E-01												
U-235	4.10E-02	4.60E-02						-1.00E-02	3.00E-01					U
U-238	8.40E-01	2.30E-01												
<b>Total U Alpha</b>	<b>1.64E+00</b>	<b>3.15E-01</b>												
<b>Alpha Sum</b>	<b>5.47E+00</b>	<b>1.75E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.61E+01	3.30E+00												
Th-234 (Assumed from U-238)	8.40E-01	2.30E-01						1.40E+00	1.00E+00					
Pa-234m (Assumed from U-238)	8.40E-01	2.30E-01						6.50E+00	9.00E+00					U
Ac-227														
Ra-228	7.20E-01	2.30E-01												
Pa-231	-4.00E-01	1.80E+00					U							
<b>Beta Sum</b>	<b>1.85E+01</b>	<b>3.33E+00</b>						<b>2.47E+01</b>	<b>9.64E+00</b>					
<b>Total Activity Sum</b>	<b>2.39E+01</b>	<b>3.76E+00</b>						<b>3.01E+01</b>	<b>9.80E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.20E+00	1.00E+00						<b>0.63</b>	<b>(from gamma)</b>			<b>26.3</b>		
Gross Beta	4.40E+00	1.10E+00					J	<b>4.01</b>	<b>2.09</b>			<b>123</b>		
Total Activity	7.60E+00	3.90E+00					J	<b>3.01</b>	<b>2.14</b>			<b>104</b>		

Tonawanda Data Summary Tables

0107116-10		TMF-0243				FROM GAMMA						Val		
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								5.20E-02	8.60E-02					U
Ra-226	9.00E-01	2.60E-01	6.40E-01	1.70E-01	0.84	33.8								
Np-237														
Pu-238														
Pu-239														
Th-228	9.90E-01	3.70E-01												
Th-230	1.23E+00	3.60E-01												
Th-232	7.70E-01	2.70E-01												
U-234	7.50E-01	1.90E-01												
U-235	8.10E-02	5.40E-02						0.00E+00	2.80E-01					U
U-238	6.40E-01	1.70E-01												
<b>Total U Alpha</b>	<b>1.47E+00</b>	<b>2.61E-01</b>												
<b>Alpha Sum</b>	<b>6.71E+00</b>	<b>1.36E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.45E+01	3.30E+00												
Th-234 (Assumed from U-238)	6.40E-01	1.70E-01						6.70E-01	5.60E-01					
Pa-234m (Assumed from U-238)	6.40E-01	1.70E-01						-1.00E+00	1.10E+01					U
Ac-227														
Ra-228	8.80E-01	2.70E-01												
Pa-231	1.50E+00	1.30E+00												
<b>Beta Sum</b>	<b>1.68E+01</b>	<b>3.32E+00</b>						<b>1.52E+01</b>	<b>1.15E+01</b>					
<b>Total Activity Sum</b>	<b>2.36E+01</b>	<b>3.59E+00</b>						<b>2.19E+01</b>	<b>1.16E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.00E+00	8.90E-01				J		<b>1.67</b>	<b>(from gamma)</b>			<b>50.6</b>		
Gross Beta	4.60E+00	8.70E-01				J		<b>3.56</b>	<b>0.92</b>			<b>114</b>		
Total Activity	9.10E+00	3.90E+00				J		<b>2.73</b>	<b>1.05</b>			<b>88.5</b>		



Tonawanda Data Summary Tables

Analyses	TMF0242				FROM GAMMA						Val Q			
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate		DER	RPD	
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)				Uncertainty (pCi/g)
Am-241							2.50E-02	9.50E-02						U
Ra-226	1.03E+00	2.20E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	1.17E+00	3.90E-01												
Th-230	8.80E-01	2.80E-01				J								
Th-232	8.50E-01	2.80E-01												
U-234	1.10E+00	2.60E-01												
U-235	6.00E-02	5.10E-02					0.00E+00	2.50E-01						U
U-238	9.60E-01	2.30E-01												
<b>Total U Alpha</b>	<b>2.12E+00</b>	<b>3.51E-01</b>												
<b>Alpha Sum</b>	<b>3.98E+00</b>	<b>1.52E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.87E+01	3.80E+00												
Th-234 (Assumed from U-238)	9.60E-01	2.30E-01					1.38E+00	8.80E-01						
Pa-234m (Assumed from U-238)	9.60E-01	2.30E-01					4.40E+00	9.20E+00						U
Ac-227														
Ra-228	7.50E-01	2.40E-01												
Pa-231	-2.30E+00	1.50E+00				UJ								
<b>Beta Sum</b>	<b>2.11E+01</b>	<b>3.83E+00</b>					<b>2.50E+01</b>	<b>1.00E+01</b>						
<b>Total Activity Sum</b>	<b>2.51E+01</b>	<b>4.12E+00</b>					<b>2.89E+01</b>	<b>1.01E+01</b>						
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>				
Gross Alpha	5.30E+00	1.10E+00					<b>0.70</b>	<b>(from gamma)</b>			<b>28.4</b>			
Gross Beta	4.72E+00	9.60E-01				J	<b>4.15</b>	<b>2.01</b>			<b>127</b>			
Total Activity	8.60E+00	3.90E+00				J	<b>2.91</b>	<b>1.88</b>			<b>97.8</b>			

Tonawanda Data Summary Tables

0107116-12			TMF-0244		FROM GAMMA											
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val	Q	Duplicate		Duplicate		DER	RPD	Val	Q
			Result (pCi/g)	Uncertainty (pCi/g)					Result (pCi/g)	Uncertainty (pCi/g)	Result (pCi/g)	Uncertainty (pCi/g)				
Am-241									-1.30E-01	1.50E-01						U
Ra-226	5.60E-01	1.60E-01														
Np-237																
Pu-238																
Pu-239																
Th-228	1.50E-01	3.10E-01						U								
Th-230	5.00E-01	2.30E-01														
Th-232	5.00E-01	2.30E-01														
U-234	6.50E-01	1.80E-01														
U-235	2.00E-02	2.90E-02						U	-1.40E-01	2.50E-01						U
U-238	5.20E-01	1.60E-01														
<b>Total U Alpha</b>	<b>1.19E+00</b>	<b>2.43E-01</b>														
<b>Alpha Sum</b>	<b>2.90E+00</b>	<b>1.21E+00</b>														
Total U by KPA																
Total U by KPA																
U-235 wt% (by alpha spect)																
U-233 wt%																
<b>Total U Alpha (Calc)</b>																
Total Radiological Sr																
K-40	8.20E+00	1.80E+00														
Th-234 (Assumed from U-238)	5.20E-01	1.60E-01							7.80E-01	7.10E-01						
Pa-234m (Assumed from U-238)	5.20E-01	1.60E-01							8.10E+00	6.80E+00						
Ac-227																
Ra-228	4.00E-01	1.50E-01														
Pa-231	0.00E+00	1.20E+00						U								
<b>Beta Sum</b>	<b>9.64E+00</b>	<b>1.83E+00</b>							<b>1.75E+01</b>	<b>7.07E+00</b>						
<b>Total Activity Sum</b>	<b>1.25E+01</b>	<b>2.19E+00</b>							<b>2.04E+01</b>	<b>7.17E+00</b>						
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	3.70E+00	1.20E+00							<b>0.47</b>	<b>(from gamma)</b>					<b>24.2</b>	
Gross Beta	3.50E+00	1.60E+00						J	<b>2.53</b>	<b>1.93</b>				<b>93.5</b>		
Total Activity	8.50E+00	4.50E+00							<b>0.81</b>	<b>1.40</b>				<b>38.4</b>		

Tonawanda Data Summary Tables

0107116-13			TMF-0245		FROM GAMMA									
Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								1.80E-01	5.00E-01					U
Ra-226	9.40E-01	2.10E-01												
Np-237														
Pu-238														
Pu-239														
Th-228	6.90E-01	3.40E-01												
Th-230	9.60E-01	3.10E-01												
Th-232	8.60E-01	2.90E-01												
U-234	7.00E-01	2.10E-01												
U-235	8.70E-02	6.70E-02						4.00E-02	3.30E-01					U
U-238	6.90E-01	2.10E-01												
<b>Total U Alpha</b>	<b>1.48E+00</b>	<b>3.04E-01</b>												
<b>Alpha Sum</b>	<b>5.56E+00</b>	<b>1.83E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.82E+01	3.90E+00												
Th-234 (Assumed from U-238)	6.90E-01	2.10E-01						7.00E-01	1.20E+00					U
Pa-234m (Assumed from U-238)	6.90E-01	2.10E-01						-4.00E+00	1.10E+01					U
Ac-227														
Ra-228	5.60E-01	2.50E-01												
Pa-231	7.00E-01	1.90E+00												U
<b>Beta Sum</b>	<b>2.02E+01</b>	<b>3.93E+00</b>						<b>1.55E+01</b>	<b>1.17E+01</b>					
<b>Total Activity Sum</b>	<b>2.58E+01</b>	<b>4.33E+00</b>						<b>2.11E+01</b>	<b>1.19E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.70E+00	1.00E+00						<b>0.41</b>	<b>(from gamma)</b>				<b>16.7</b>	
Gross Beta	4.70E+00	9.10E-01					J	<b>3.85</b>	<b>0.92</b>				<b>125</b>	
Total Activity	9.10E+00	3.90E+00					J	<b>2.86</b>	<b>0.96</b>				<b>95.6</b>	

## Radiological Analytical Data Verification Comments on Data for SDG 0108014

This sample delivery group (SDG) contained ten (10) individual soil samples from the town of Tonawanda Landfill vicinity FUSRAP property Tonawanda, NY for radiological analysis. The requested analyses from [Statement of Work for Radiological and Chemical Analytical Laboratory Services Town of Tonawanda Landfill Vicinity FUSRAP Property Tonawanda, NY, April 2001] for all samples included  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  by alpha spectrometry;  $^{226}\text{Ra}$  by radon emanation;  $^{228}\text{Ra}$ ,  $^{234}\text{Th}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{235}\text{U}$ ,  $^{241}\text{Am}$  and radioisotopes detected above the decision level (DL) by gamma spectrometry; gross alpha/beta by gas proportional counting; and total activity by liquid scintillation counting. All of the analyses requested by the statement of work (SOW) were performed and reported by Paragon Analytics. The samples were received by Paragon Analytics, Inc. on August 2, 2001. The uncertainties and results were provided in the Sample Result Summary, Certificate of Analysis, or in the raw data. The gross alpha/beta and total activity analyses can be compared to the sum of the individual results using the propagated uncertainties to determine if the differences are statistically significant.

Client Identification	Laboratory Identification
TMF-0312	0108014-1
TMF-0313	0108014-2
TMF-0314	0108014-3
TMF-0315	0108014-4
TMF-0316	0108014-5
TMF-0317	0108014-6
TMF-0309	0108014-7
TMF-0310	0108014-8
TMF-0311	0108014-9
TMF-9250	0108014-10

The duplicate results were evaluated by calculation of the duplicate error ratio (DER). The DER is defined in the following equation:

$$\text{DER} = \frac{|S - D|}{\sqrt{(2\sigma_S)^2 + (2\sigma_D)^2}}$$

Where,

- S = First Sample Value (original)
- D = Second Sample Value (duplicate)
- $2\sigma_S$  = First Sample Uncertainty
- $2\sigma_D$  = Second Sample Uncertainty.

A DER of less than 1.29 indicates that the duplicate analyses agree at the 99% confidence level. The uncertainties reported were assumed to be 2 sigma. The attached sheets show the DER results with the results for each sample.

## 1.0 GAMMA SPECTROMETRY ANALYSIS

### Method Blank

There was no indication of blank contamination in the gamma spectrometry method blank for the samples.

### Equipment Rinsate Sample:

No target radionuclide equipment rinsate blank contamination was observed in the EQ-1 and EQ-2 equipment rinsate blanks.  $^{137}\text{Cs}$  activity was observed in the equipment rinsate blank EQ-1, but it was not observed in all samples. However,  $^{137}\text{Cs}$  activity was reported by the laboratory in sample TMF-0315 as the  $^{137}\text{Cs}$  activity in the sample was higher than the required DL (1.65\*TPU). All associated samples results less than 5 times the blank value for  $^{137}\text{Cs}$  analyses should be qualified as estimated (J).  $^{137}\text{Cs}$  activity value observed in the sample TMF-0315 was greater than 5 times the  $^{137}\text{Cs}$  concentration identified in the rinsate blank. No qualification on Cs-137 results in the sample is necessary.

### Laboratory Control Sample:

The percent recoveries for the laboratory control sample (LCS) are within acceptable limits for the gamma spectrometry analysis.

### Duplicate Analysis:

The DERs are within acceptable limits for the duplicate analysis for all gamma spectrometry analyses except  $^{235}\text{U}$ . The DER (1.47) was outside the acceptable limits for  $^{235}\text{U}$  as well as the RPD (404%). **Therefore it is recommended that  $^{235}\text{U}$  gamma spectrometry results for all samples be qualified as estimated (J).**

### Identification and Quantification:

As the following tables show, all target radionuclides ( $^{241}\text{Am}$ ,  $^{228}\text{Ra}$ ,  $^{231/234\text{m}}\text{Pa}$ ,  $^{234}\text{Th}$  and  $^{235}\text{U}$ ) were reported in all samples. Since  $^{228}\text{Ra}$  decay emits no discernible gamma photons, this activity is calculated from the gamma energies of its immediate daughter  $^{228}\text{Ac}$ , assuming secular equilibrium. Results for natural  $^{40}\text{K}$  were also reported for all samples. The result for fission product  $^{137}\text{Cs}$  activity was reported by the laboratory for sample TMF-0315 as the  $^{137}\text{Cs}$  activity in the sample was higher than the required DL (1.65\*TPU). There were no incidents of identified radionuclides being excluded from the laboratory reports.

In addition,  $^{212/214}\text{Bi}$ ,  $^{212/214}\text{Pb}$ , and  $^{208}\text{Tl}$  gamma emitting radionuclides were reported for most samples. The  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  reported results are progeny from the  $^{238}\text{U}$  and  $^{232}\text{Th}$  series. These reported radionuclides may be due to near or total equilibrium with  $^{238}\text{U}$  and  $^{232}\text{Th}$ . The presence of  $^{212/214}\text{Pb}$ ,  $^{212/214}\text{Bi}$ , and  $^{208}\text{Tl}$  in the stated concentration is not out of the question for these samples considering the amount of  $^{228/232}\text{Th}$  and  $^{234/238}\text{U}$  present. **Therefore, it is recommended that they remain in the data base for information purposes only.**

Improper background subtraction is indicated when a negative result is reported with a smaller  $2\sigma$  uncertainty. This would indicate a negative bias on the analysis data for a particular radionuclide. Improper background subtractions were indicated for the  $^{241}\text{Am}$  ( $-5.30\text{E-}01\pm 3.80\text{E-}01$ ) and  $^{235}\text{U}$  ( $-7.10\text{E-}01\pm 5.00\text{E-}01$ ) results for sample TMF-0312 and  $^{231}\text{Pa}$  result ( $-2.30\pm 1.70$ ) for sample TMF-0313 (laboratory duplicate). **It is recommended that the gamma spectrometry  $^{241}\text{Am}$  and  $^{235}\text{U}$  results for sample TMF-0312 and  $^{231}\text{Pa}$  result for the laboratory duplicate sample TMF-0313 be qualified as estimated (J).** No other problems were observed for the gamma spectrometry analyses.

## 2.0 ALPHA SPECTROMETRY

### Method Blank:

There was an indication of blank contamination for  $^{234/235}\text{U}$  and  $^{230}\text{Th}$  analyses in the method blank. All associated sample results less than 5 times the blank value for  $^{234/235}\text{U}$  and  $^{230}\text{Th}$  analyses should be qualified as estimated (J). The  $^{234}\text{U}$  and  $^{230}\text{Th}$  analyses results for all samples were greater than 5 times the blank. However,  $^{235}\text{U}$  results for all samples were less than 5 times the method blank result. **Therefore, it is recommended that the  $^{235}\text{U}$  results for all samples be qualified as estimated (J).**

### Equipment Rinsate Blank:

There was no indication of equipment rinsate blank contamination for the isotopic uranium analysis.

There were indications of equipment rinsate blank contamination for  $^{228/230/232}\text{Th}$ . All associated samples result less than 5 times the blank value for  $^{228/230/232}\text{Th}$  analyses should be qualified as estimated (J). However,  $^{228/230/232}\text{Th}$  activity values for all samples are greater than 5 times the  $^{228/230/232}\text{Th}$  concentration identified in the rinsate blank. No qualification of the isotopic thorium results is necessary.

### Laboratory Control Sample:

The percent recoveries for the LCSs are within acceptable limits for all the alpha spectrometry analyses.

#### Duplicate Analysis:

The DERs and RPDs are within acceptable limits for the duplicate analysis for all alpha spectrometry analyses.

#### Sample-Specific Chemical Recovery:

The tracer recoveries are within acceptable limit. The tracer recoveries were greater than 11.71% for all samples for the alpha spectrometry analyses. The sample-specific percent recovery results of  $^{234/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  for all samples have less than 10% uncertainty, except for  $^{228/230/232}\text{Th}$  result for sample TMF-0309 (10.23%). **Therefore, it is recommended that the  $^{228/230/232}\text{Th}$  results for sample TMF-0309 be qualified as estimated (J).**

#### Spectral Analysis:

No Spectral interferences were observed in the samples' alpha spectra for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$  analysis.

#### Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 1.0 pCi/g for  $^{224/235/238}\text{U}$  and  $^{228/230/232}\text{Th}$ .

### 3.0 $^{226}\text{Ra}$ ANALYSES

#### Method Blank:

There is no indication of blank contamination in the method blank sample for the  $^{226}\text{Ra}$  analysis.

#### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the  $^{226}\text{Ra}$  analysis.

#### Laboratory Control Sample:

The percent recoveries for the LCSs for the  $^{226}\text{Ra}$  analyses were within acceptable limits.

#### Duplicate Analysis:

The DER (1.34) and RPD (40%) are outside the acceptable limits for the duplicate analysis for all  $^{226}\text{Ra}$  analyses. **Therefore, it is recommended that the  $^{226}\text{Ra}$  results for all samples be qualified as estimated (J).**

Chemical Recoveries:

The sample-specific chemical recoveries for the  $^{226}\text{Ra}$  analysis were within acceptable limits.

Method Detection Limit and Quantitation:

All samples met the required method detection limit (MDL) of 0.5 pCi/L for  $^{226}\text{Ra}$ .

#### **4.0 GROSS ALPHA AND BETA ANALYSIS**

Method Blank:

There was no indication of blank contamination in method blank for the gross alpha/beta analyses.

Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the gross alpha/beta analyses.

Laboratory Control Sample:

The percent recovery for the LCS is within acceptable limits for the gross alpha/beta analyses.

Duplicate Analysis:

The duplicate DERs and RPDs for the gross alpha/beta analyses are within acceptable limits.

Quantification:

**It is recommended that the gross beta analysis results for all samples be qualified as estimated (J) because the gross beta analysis was performed using gas proportional counting and requires the digestate to be taken to dryness, which is not quantitative and does not include volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**



## 5.0 TOTAL ACTIVITY BY LIQUID SCINTILLATION COUNTING

### Method Blank:

There was no indication of blank contamination in method blank samples for the total activity analyses.

### Equipment Rinsate Blank:

There was no indication of contamination in the equipment rinsate blank for the total activity analyses.

### Laboratory Control Sample:

The percent recovery for the reported LCS is within acceptable limits for the total activity analysis.

### Duplicate Analysis:

The total activity analysis duplicate DER is within acceptable limits.

### Matrix Spike Sample:

The percent recovery for the MSS for the total activity analysis is within acceptable limits.

### Quantitation and Method Detection Limit:

The required MDC for the Total Activity analysis is 10 pCi/g. All sample results met the required MDC. **It is recommended that the total activity analysis results for all samples be qualified as estimated (J), since the total activity analysis appears to have a negative bias. This negative bias may be due to the digestate being taken to dryness, which allowed the loss of volatile radionuclides or volatile radionuclide salts (e.g.,  $^3\text{H}$ ,  $^{99}\text{Tc}$ ,  $^{40}\text{K}$  salts). Also, the laboratory used an 8M  $\text{HNO}_3$  leach instead of total sample dissolution that was requested in the SOW. This also may cause a negative bias since not all of the radionuclides of interest may have been removed from the sample especially any indigenous radionuclides such as radium, thorium, uranium, and their daughters.**

## 6.0 DATA INTERCOMPARISON

### U Alpha to U Gamma:

For all samples, the uranium alpha and uranium gammas agree within the uncertainties. No further qualification of the gamma spectrometry results is necessary.

### Alpha/Beta Sums to Gross Alpha/Beta Analysis:

The comparison of alpha and beta emitter sums to the gross alpha and beta analyses was performed in the same way that the duplicates were evaluated. The DER equation was used to determine if the alpha and beta sums were statistically different from the gross alpha and beta analysis results at the 99% confidence level. If the DER was greater than 1.29, the sums and the gross analyses were assumed not to be in agreement. The results are shown on the attached sheets.

The DERs for gross alpha to sum of alpha activities are within acceptable limits for all samples indicating that the gross alpha analyses for all samples agree with the sum of the alpha emitters within a 99% confidence level. No qualification of the gross alpha result is necessary.

When comparing the sums of the beta emitters to the gross beta analyses, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (1.41 – 4.52) for all samples, the sums of the beta emitters activity and gross beta activity are outside the acceptable limits as well as the RPD values (70.3% - 125%). The gross beta results are 3-5 times smaller than the sum of the beta emitters for all samples. This negative bias is most likely due to the sample preparation as discussed above. Since all of the gross beta results have been qualified for this reason, no further qualification of the gross beta results is necessary.

#### Total Activity to Sums of Alpha and Beta Emitters:

When comparing the total activity to the total activity sum i.e., the sums of the beta emitters and the sum of alpha, it was assumed that the  $^{234}\text{Th}$  and  $^{234\text{m}}\text{Pa}$  are in equilibrium with  $^{238}\text{U}$ , thus having the same activity as the  $^{238}\text{U}$ . The DERs (2.61 – 3.81) for all samples are out side the acceptable limits as well as the RPD values (138%-149%). The total activity results are 2-3 times smaller than the sum of the alpha and beta emitters for all samples. This negative bias is most likely due to the sample preparation as discussed above. No further qualification of the total activity results is recommended since the total activity results for the listed samples were previously qualified for this reason.

#### $^{228}\text{Ac}$ Gamma and $^{232}\text{Th}$ :

When comparing the  $^{228}\text{Ac}$  activity to  $^{228}\text{Ra}$  activity, it was assumed that the actinium and radium are in equilibrium with  $^{232}\text{Th}$ . The activities are all within the uncertainties of the measurements for all three radionuclides.

#### Summary:

Based on the agreements between the gross alpha analyses and the sums of the individual alpha activities, all activity except gross beta activity is accounted for in all samples. Due to exclusion of volatile beta and daughter beta emitting radionuclides from the natural chain in the gross beta measurements the sums of beta activities in the sample was greater than the gross beta activity in all samples. Similarly, for the same reason the total activity for all samples was greater than the sum of the gross activities.

Tonawanda Data Summary Tables

0108014-1	TMF-0312						FROM GAMMA								
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Duplicate		Duplicate		DER	RPD	Val Q
				Result (pCi/g)	Uncertainty (pCi/g)				Result (pCi/g)	Uncertainty (pCi/g)					
Am-241									-5.30E-01	3.80E-01	-2.00E-02	1.10E-01	1.29	185	UJ
Ra-226	8.10E-01	1.90E-01						J							
Np-237															
Pu-238															
Pu-239															
Th-228	8.70E-01	4.10E-01	1.11E+00	3.60E-01	0.44	24.2									
Th-230	9.00E-01	2.90E-01	8.80E-01	2.50E-01	0.05	2.25									
Th-232	9.20E-01	2.90E-01	9.20E-01	2.60E-01	0.00	0.00									
U-234	7.60E-01	2.20E-01													
U-235	1.31E-01	8.20E-02						J	-7.10E-01	5.00E-01	2.40E-01	4.10E-01	1.47	404	UJ
U-238	7.80E-01	2.20E-01													
<b>Total U Alpha</b>	<b>1.67E+00</b>	<b>3.22E-01</b>													
<b>Alpha Sum</b>	<b>4.09E+00</b>	<b>2.44E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.72E+01	3.90E+00	1.31E+01	4.70E+00	0.67	27.1									
Th-234 (Assumed from U-238)	7.80E-01	2.20E-01							1.40E+00	1.50E+00	6.00E-01	1.10E+00	0.43	80.0	
Pa-234m (Assumed from U-238)	7.80E-01	2.20E-01							8.00E+00	1.60E+01	-3.00E+00	1.90E+01	0.44	440	U
Ac-227															
Ra-228	5.50E-01	3.20E-01	6.90E-01	6.00E-01	0.21	22.6									
Pa-231	-1.20E+00	2.60E+00	1.30E+00	3.20E+00	0.61	5000		U							
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>3.94E+00</b>							<b>2.70E+01</b>	<b>1.65E+01</b>	<b>1.15E+01</b>	<b>1.96E+01</b>			
<b>Total Activity Sum</b>	<b>2.33E+01</b>	<b>4.63E+00</b>							<b>3.11E+01</b>	<b>1.67E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.20E+00	1.10E+00							<b>0.04</b>	<b>(from gamma)</b>		<b>2.6</b>			
Gross Beta	4.04E+00	9.30E-01						J	<b>3.74</b>	<b>1.39</b>		<b>130</b>			
Total Activity	7.00E+00	4.00E+00						J	<b>2.66</b>	<b>1.40</b>		<b>107</b>			

Tonawanda Data Summary Tables

0108014-2	TMF-0313							FROM GAMMA							
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
				Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241									-7.00E-02	2.30E-01	1.40E-01	3.10E-01	0.54	600	U
Ra-226	8.60E-01	1.80E-01						J							
Np-237															
Pu-238															
Pu-239															
Th-228	1.25E+00	4.50E-01													
Th-230	1.03E+00	3.20E-01													
Th-232	1.05E+00	3.20E-01													
U-234	7.50E-01	2.00E-01	5.20E-01	1.60E-01	0.90	36.2									
U-235	9.40E-02	6.30E-02	2.80E-02	3.50E-02	0.92	108	J	2.60E-01	2.60E-01	1.00E-01	3.10E-01	0.40	88.9	J	
U-238	6.50E-01	1.80E-01	5.40E-01	1.60E-01	0.46	18.5									
<b>Total U Alpha</b>	<b>1.49E+00</b>	<b>2.76E-01</b>	<b>1.09E+00</b>	<b>2.29E-01</b>											
<b>Alpha Sum</b>	<b>4.69E+00</b>	<b>1.94E+00</b>	<b>-9.82E-01</b>	<b>1.55E+00</b>											
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.90E+01	3.40E+00	1.77E+01	3.60E+00	0.26	7.08									
Th-234 (Assumed from U-238)	6.50E-01	1.80E-01	5.40E-01	1.60E-01	0.46	18.5		3.20E-01	6.70E-01	4.80E-01	8.60E-01	0.15	40.0	U	
Pa-234m (Assumed from U-238)	6.50E-01	1.80E-01	5.40E-01	1.60E-01	0.46	18.5		2.00E+00	6.40E+00	2.00E-01	9.90E+00	0.15	164	U	
Ac-227															
Ra-228	7.40E-01	1.90E-01	5.60E-01	1.90E-01	0.67	27.7									
Pa-231	-1.10E+00	2.00E+00	-2.30E+00	1.70E+00	0.46	70.6	UJ								
<b>Beta Sum</b>	<b>2.09E+01</b>	<b>3.42E+00</b>	<b>1.91E+01</b>	<b>3.62E+00</b>				<b>2.19E+01</b>	<b>7.28E+00</b>	<b>1.87E+01</b>	<b>1.06E+01</b>				
<b>Total Activity Sum</b>	<b>2.56E+01</b>	<b>3.93E+00</b>	<b>1.81E+01</b>	<b>3.93E+00</b>				<b>2.66E+01</b>	<b>7.54E+00</b>	<b>1.77E+01</b>	<b>1.07E+01</b>				
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>					
Gross Alpha	5.20E+00	1.20E+00						0.22	(from gamma)		10.2				
Gross Beta	4.82E+00	9.80E-01					J	4.52	2.33		125				
Total Activity	6.20E+00	3.70E+00					J	3.59	2.43		122				

Tonawanda Data Summary Tables

0108014-3	TMF-0314							FROM GAMMA							
	Analyses	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								-2.30E-01	3.20E-01						U
Ra-226	8.30E-01	1.60E-01													J
Np-237															
Pu-238															
Pu-239															
Th-228	1.12E+00	4.00E-01													
Th-230	9.20E-01	2.90E-01													
Th-232	7.60E-01	2.40E-01													
U-234	1.12E+00	2.70E-01													
U-235	9.00E-03	2.20E-02						UJ	-1.70E-01	2.90E-01					UJ
U-238	8.80E-01	2.30E-01													
<b>Total U Alpha</b>	<b>2.01E+00</b>	<b>3.55E-01</b>													
<b>Alpha Sum</b>	<b>4.47E+00</b>	<b>1.75E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Total Radiological Sr															
K-40	1.71E+01	3.50E+00													
Th-234 (Assumed from U-238)	8.80E-01	2.30E-01							9.80E-01	9.70E-01					
Pa-234m (Assumed from U-238)	8.80E-01	2.30E-01							-3.00E+00	1.00E+01					U
Ac-227															
Ra-228	6.80E-01	2.20E-01													
Pa-231	-1.30E+00	1.80E+00													U
<b>Beta Sum</b>	<b>1.94E+01</b>	<b>3.53E+00</b>							<b>1.56E+01</b>	<b>1.06E+01</b>					
<b>Total Activity Sum</b>	<b>2.39E+01</b>	<b>3.94E+00</b>							<b>2.01E+01</b>	<b>1.08E+01</b>					
									<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.50E+00	1.00E+00	4.41E+00	9.80E-01	<b>0.06</b>	<b>2.02</b>			<b>0.02</b>	(from gamma)			<b>0.7</b>		
Gross Beta	4.07E+00	9.10E-01	5.11E+00	9.70E-01	<b>0.78</b>	<b>22.7</b>	J	<b>4.20</b>	<b>1.08</b>				<b>131</b>		
Total Activity	3.50E+00	3.60E+00	5.00E+00	3.70E+00	<b>0.29</b>	<b>35.3</b>	J	<b>3.81</b>	<b>1.46</b>				<b>149</b>		

Tonawanda Data Summary Tables

Analyses	0108014-4		TMF-0315				FROM GAMMA								
	Result	Uncertainty	Duplicate Result	Duplicate Uncertainty	DER	RPD	Val	Result	Uncertainty	Duplicate Result	Duplicate Uncertainty	DER	RPD	Val	
	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)			Q	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)			Q	
Am-241								-2.80E-01	4.20E-01					U	
Ra-226	9.10E-01	2.30E-01					J								
Np-237															
Pu-238															
Pu-239															
Th-228	3.90E-01	4.30E-01													
Th-230	1.14E+00	3.60E-01													
Th-232	6.30E-01	2.60E-01													
U-234	1.21E+00	2.80E-01													
U-235	1.23E-01	7.60E-02					J	5.00E-02	5.30E-01					UJ	
U-238	9.80E-01	2.50E-01													
<b>Total U Alpha</b>	<b>2.31E+00</b>	<b>3.83E-01</b>													
<b>Alpha Sum</b>	<b>6.01E+00</b>	<b>2.46E+00</b>													
Total U by KPA															
Total U by KPA															
U-235 wt% (by alpha spect)															
U-233 wt%															
<b>Total U Alpha (Calc)</b>															
Cs-137	2.10E-01	1.10E-01													
K-40	1.11E+01	3.00E+00													
Th-234 (Assumed from U-238)	9.80E-01	2.50E-01						1.00E+00	1.40E+00					U	
Pa-234m (Assumed from U-238)	9.80E-01	2.50E-01						1.20E+01	1.80E+01					U	
Ac-227															
Ra-228	6.00E-01	3.50E-01													
Pa-231	7.00E-01	2.60E+00					U								
<b>Beta Sum</b>	<b>1.40E+01</b>	<b>3.06E+00</b>						<b>2.50E+01</b>	<b>1.83E+01</b>						
<b>Total Activity Sum</b>	<b>2.00E+01</b>	<b>3.93E+00</b>						<b>3.10E+01</b>	<b>1.85E+01</b>						
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>			
Gross Alpha	4.40E+00	1.20E+00						<b>0.59</b>	<b>(from gamma)</b>			<b>31.0</b>			
Gross Beta	4.77E+00	9.60E-01					J	<b>2.86</b>	<b>1.10</b>			<b>98.1</b>			
Total Activity	4.60E+00	3.90E+00					J	<b>2.78</b>	<b>1.40</b>			<b>125</b>			

Tonawanda Data Summary Tables

0108014-5	TMF-0316				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								2.00E-02	1.30E-01					U
Ra-226	7.20E-01	1.50E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.50E-01	4.30E-01												
Th-230	7.70E-01	2.80E-01												
Th-232	4.10E-01	2.10E-01												
U-234	1.13E+00	2.60E-01												
U-235	1.09E-01	6.90E-02					J	-3.20E-01	4.20E-01					UJ
U-238	9.50E-01	2.30E-01												
<b>Total U Alpha</b>	<b>2.19E+00</b>	<b>3.54E-01</b>												
<b>Alpha Sum</b>	<b>5.11E+00</b>	<b>2.61E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	6.80E+00	3.20E+00												
Th-234 (Assumed from U-238)	9.50E-01	2.30E-01						-2.00E-01	1.00E+00					U
Pa-234m (Assumed from U-238)	9.50E-01	2.30E-01						-1.60E+01	2.00E+01					U
Ac-227														
Ra-228	5.40E-01	6.20E-01												
Pa-231	3.00E-01	2.80E+00					U							
<b>Beta Sum</b>	<b>9.28E+00</b>	<b>3.29E+00</b>						<b>-8.82E+00</b>	<b>2.03E+01</b>					
<b>Total Activity Sum</b>	<b>1.44E+01</b>	<b>4.20E+00</b>						<b>-3.72E+00</b>	<b>2.05E+01</b>					
								<b>DER (sums to gross)</b>				<b>RPD (sums to gross)</b>		
Gross Alpha	3.50E+00	1.00E+00						<b>0.58</b>	<b>(from gamma)</b>			<b>37.4</b>		
Gross Beta	4.45E+00	9.30E-01					J	<b>1.41</b>	<b>0.65</b>			<b>70.3</b>		
Total Activity	8.00E+00	3.90E+00					J	<b>1.11</b>	<b>0.56</b>			<b>57.0</b>		

Tonawanda Data Summary Tables

0108014-6	TMF-0317				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								-1.50E-02	8.80E-02					U
Ra-226	1.05E+00	2.40E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	9.00E-01	4.00E-01												
Th-230	1.08E+00	3.10E-01												
Th-232	9.90E-01	3.00E-01												
U-234	8.80E-01	2.40E-01												
U-235	7.80E-02	6.30E-02					J	7.00E-02	2.70E-01					UJ
U-238	7.30E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.69E+00</b>	<b>3.32E-01</b>												
<b>Alpha Sum</b>	<b>5.62E+00</b>	<b>1.53E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.73E+01	3.80E+00												
Th-234 (Assumed from U-238)	7.30E-01	2.20E-01						1.33E+00	7.00E-01					
Pa-234m (Assumed from U-238)	7.30E-01	2.20E-01						-2.00E+00	1.20E+01					U
Ac-227														
Ra-228	7.20E-01	2.80E-01												
Pa-231	-1.00E-01	1.50E+00					U							
<b>Beta Sum</b>	<b>1.95E+01</b>	<b>3.83E+00</b>						<b>1.73E+01</b>	<b>1.26E+01</b>					
<b>Total Activity Sum</b>	<b>2.51E+01</b>	<b>4.12E+00</b>						<b>2.30E+01</b>	<b>1.27E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	3.94E+00	9.00E-01						<b>0.95</b>	<b>(from gamma)</b>	<b>35.1</b>				
Gross Beta	4.34E+00	8.90E-01					J	<b>3.85</b>	<b>1.03</b>	<b>127</b>				
Total Activity	4.70E+00	3.60E+00					J	<b>3.73</b>	<b>1.38</b>	<b>137</b>				



Tonawanda Data Summary Tables

Analyses	TMF-0309		FROM GAMMA						Val Q	
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Duplicate			Val
			Result (pCi/g)	Uncertainty (pCi/g)			Result (pCi/g)	Uncertainty (pCi/g)		
Am-241							-1.80E-01	3.40E-01		U
Ra-226	1.03E+00	2.20E-01							J	
Np-237										
Pu-238										
Pu-239										
Th-228	6.30E-01	4.40E-01							J	
Th-230	1.35E+00	4.10E-01							J	
Th-232	1.14E+00	3.90E-01							J	
U-234	9.60E-01	2.40E-01								
U-235	7.50E-02	5.90E-02					1.00E-02	4.50E-01	J	UJ
U-238	1.24E+00	2.90E-01								
<b>Total U Alpha</b>	<b>2.28E+00</b>	<b>3.81E-01</b>								
<b>Alpha Sum</b>	<b>7.78E+00</b>	<b>2.57E+00</b>								
Total U by KPA										
Total U by KPA										
U-235 wt% (by alpha spect)										
U-233 wt%										
<b>Total U Alpha (Calc)</b>										
Total Radiological Sr										
K-40	1.57E+01	3.50E+00								
Th-234 (Assumed from U-238)	1.24E+00	2.90E-01					1.00E+00	1.30E+00		U
Pa-234m (Assumed from U-238)	1.24E+00	2.90E-01					3.00E+00	1.50E+01		U
Ac-227										
Ra-228	6.70E-01	3.30E-01								
Pa-231	1.50E+00	2.70E+00							U	
<b>Beta Sum</b>	<b>1.90E+01</b>	<b>3.55E+00</b>					<b>2.06E+01</b>	<b>1.55E+01</b>		
<b>Total Activity Sum</b>	<b>2.68E+01</b>	<b>4.39E+00</b>					<b>2.83E+01</b>	<b>1.57E+01</b>		
							<b>DER (sums to gross)</b>			<b>RPD (sums to gross)</b>
Gross Alpha	8.00E+00	1.70E+00					<b>0.07</b>	<b>(from gamma)</b>		<b>2.9</b>
Gross Beta	5.40E+00	1.10E+00				J	<b>3.66</b>	<b>0.98</b>		<b>112</b>
Total Activity	5.60E+00	3.80E+00				J	<b>3.65</b>	<b>1.41</b>		<b>131</b>

Tonawanda Data Summary Tables

0108014-8	TMF-0310				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								-3.00E-02	1.10E-01					U
Ra-226	6.60E-01	1.90E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	7.10E-01	2.00E-01												
Th-230	8.60E-01	1.90E-01												
Th-232	8.30E-01	1.90E-01												
U-234	7.50E-01	2.10E-01												
U-235	5.40E-02	4.90E-02					J	0.00E+00	3.40E-01					UJ
U-238	7.30E-01	2.00E-01												
<b>Total U Alpha</b>	<b>1.53E+00</b>	<b>2.94E-01</b>												
<b>Alpha Sum</b>	<b>5.40E+00</b>	<b>2.65E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.15E+01	3.80E+00												
Th-234 (Assumed from U-238)	7.30E-01	2.00E-01						6.20E-01	7.00E-01					
Pa-234m (Assumed from U-238)	7.30E-01	2.00E-01						1.30E+01	2.10E+01					U
Ac-227														
Ra-228	7.70E-01	4.20E-01												
Pa-231	9.00E-01	2.90E+00					U							
<b>Beta Sum</b>	<b>1.38E+01</b>	<b>3.85E+00</b>						<b>2.60E+01</b>	<b>2.14E+01</b>					
<b>Total Activity Sum</b>	<b>1.92E+01</b>	<b>4.68E+00</b>						<b>3.14E+01</b>	<b>2.15E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.20E+00	1.00E+00						<b>0.42</b>	<b>(from gamma)</b>			<b>25.1</b>		
Gross Beta	4.47E+00	9.50E-01					J	<b>2.36</b>	<b>1.01</b>			<b>102</b>		
Total Activity	3.50E+00	3.80E+00					J	<b>2.61</b>	<b>1.28</b>			<b>138</b>		

Tonawanda Data Summary Tables

0108014-9	TMF-0311				FROM GAMMA									
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate Result (pCi/g)	Duplicate Uncertainty (pCi/g)	DER	RPD	Val Q
Am-241								-2.00E-02	4.80E-01					U
Ra-226	8.20E-01	1.60E-01					J							
Np-237														
Pu-238														
Pu-239														
Th-228	8.10E-01	4.80E-01												
Th-230	9.10E-01	3.40E-01												
Th-232	1.09E+00	3.50E-01												
U-234	6.10E-01	1.80E-01												
U-235	6.30E-02	5.60E-02					J	4.00E-02	3.20E-01					UJ
U-238	8.30E-01	2.20E-01												
<b>Total U Alpha</b>	<b>1.50E+00</b>	<b>2.90E-01</b>												
<b>Alpha Sum</b>	<b>4.41E+00</b>	<b>1.71E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.70E+01	3.80E+00												
Th-234 (Assumed from U-238)	8.30E-01	2.20E-01						1.50E+00	1.40E+00					
Pa-234m (Assumed from U-238)	8.30E-01	2.20E-01						1.50E+01	1.30E+01					
Ac-227														
Ra-228	6.60E-01	2.70E-01												
Pa-231	-8.00E-01	1.70E+00					U							
<b>Beta Sum</b>	<b>1.92E+01</b>	<b>3.83E+00</b>						<b>3.41E+01</b>	<b>1.36E+01</b>					
<b>Total Activity Sum</b>	<b>2.36E+01</b>	<b>4.19E+00</b>						<b>3.85E+01</b>	<b>1.37E+01</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	5.00E+00	1.00E+00						<b>0.30</b>	<b>(from gamma)</b>			<b>12.5</b>		
Gross Beta	4.58E+00	9.10E-01					J	<b>3.72</b>	<b>2.16</b>			<b>123</b>		
Total Activity	7.00E+00	3.70E+00					J	<b>2.98</b>	<b>2.21</b>			<b>109</b>		

Tonawanda Data Summary Tables

Analyses	TMF-9250							FROM GAMMA						
	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q	Result (pCi/g)	Uncertainty (pCi/g)	Duplicate	Duplicate	DER	RPD	Val Q
			Result (pCi/g)	Uncertainty (pCi/g)						Result (pCi/g)	Uncertainty (pCi/g)			
Am-241								-1.00E-02	1.40E-01					U
Ra-226	9.60E-01	1.90E-01	6.40E-01	1.50E-01	1.32	40	J							
Np-237														
Pu-238														
Pu-239														
Th-228	6.50E-01	4.60E-01												
Th-230	7.90E-01	2.80E-01												
Th-232	5.60E-01	2.30E-01												
U-234	6.10E-01	1.80E-01												
U-235	3.90E-02	4.50E-02					J	2.00E-02	2.40E-01					UJ
U-238	6.60E-01	1.90E-01												
<b>Total U Alpha</b>	<b>1.31E+00</b>	<b>2.66E-01</b>												
<b>Alpha Sum</b>	<b>5.44E+00</b>	<b>1.27E+00</b>												
Total U by KPA														
Total U by KPA														
U-235 wt% (by alpha spect)														
U-233 wt%														
<b>Total U Alpha (Calc)</b>														
Total Radiological Sr														
K-40	1.11E+01	2.20E+00												
Th-234 (Assumed from U-238)	6.60E-01	1.90E-01						2.40E-01	4.80E-01					U
Pa-234m (Assumed from U-238)	6.60E-01	1.90E-01						5.70E+00	7.00E+00					U
Ac-227														
Ra-228	5.40E-01	1.80E-01												
Pa-231	1.30E+00	1.20E+00												
<b>Beta Sum</b>	<b>1.31E+01</b>	<b>2.23E+00</b>						<b>1.77E+01</b>	<b>7.36E+00</b>					
<b>Total Activity Sum</b>	<b>1.86E+01</b>	<b>2.57E+00</b>						<b>2.32E+01</b>	<b>7.47E+00</b>					
								<b>DER (sums to gross)</b>		<b>RPD (sums to gross)</b>				
Gross Alpha	4.10E+00	1.10E+00						<b>0.80</b>	<b>(from gamma)</b>			<b>28.07</b>		
Gross Beta	2.94E+00	7.90E-01					J	<b>4.30</b>	<b>2.00</b>			<b>127</b>		
Total Activity	5.20E+00	4.00E+00					J	<b>2.81</b>	<b>2.12</b>			<b>112</b>		