

**University of Missouri-Columbia  
Sinclair Farm Phase 4  
Final Status Report  
Revision: 0**

**Work Performed Under:  
University of Missouri – Columbia's  
NRC Broad Scope Type A  
Radioactive Materials  
License No. 24-00513-32**

**May 23, 2014**

**Prepared by:**



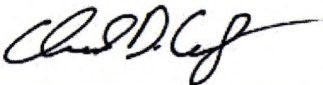
**Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830  
865-481-8801**

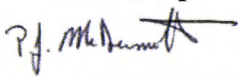



**University of Missouri - Columbia**  
**Sinclair Farm Phase 4**  
**Final Status Report**  
**Revision: 0**  
**Sinclair Farm**  
**South Sinclair Rd.**  
**Columbia, MO 65201**

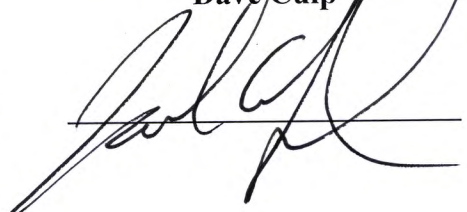
**Work Performed Under:**  
**University of Missouri - Columbia's**  
**NRC Broad Scope Type A**  
**Radioactive Materials**  
**License No. 24-00513-32**

**May 23, 2014**

**Written:**  Project Manager **Date:** 5/23/14  
**Dave Culp**

**Reviewed:**  Certified Health Physicist **Date:** 6/26/14  
**Patrick McDermott**

**Approved:**  Field Services Manager **Date:** 6/26/14  
**Dave Culp**

**Approved:**  University of Missouri -  
Columbia Representative **Date:** 3/27/15



**Prepared by:**  
**Chase Environmental Group, Inc.**  
**109 Flint Road**  
**Oak Ridge, TN 37830**  
**865-481-8801**



## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
<b>2</b>	<b>SITE DESCRIPTION AND HISTORY .....</b>	<b>2</b>
2.1	Historical Site Assessments .....	2
2.2	Site Description .....	2
2.3	Ownership .....	2
2.4	Facility Descriptions .....	2
2.5	Nuclides of Concern.....	3
2.6	Previous Decommissioning.....	3
<b>3</b>	<b>RELEASE CRITERIA.....</b>	<b>3</b>
<b>4</b>	<b>DERIVED CONCENTRATION GUIDELINE LEVELS (DCGLs).....</b>	<b>4</b>
<b>5</b>	<b>INVESTIGATION LEVELS .....</b>	<b>5</b>
<b>6</b>	<b>PROJECT MANAGEMENT AND ORGANIZATION.....</b>	<b>5</b>
<b>7</b>	<b>PROJECT TRAINING .....</b>	<b>5</b>
<b>8</b>	<b>RADIATION PROTECTION .....</b>	<b>5</b>
<b>9</b>	<b>ENVIRONMENTAL MONITORING PROGRAM .....</b>	<b>5</b>
<b>10</b>	<b>RADIOACTIVE WASTE MANAGEMENT .....</b>	<b>5</b>
<b>11</b>	<b>QUALITY ASSURANCE PROGRAM .....</b>	<b>6</b>
<b>12</b>	<b>INSTRUMENTATION .....</b>	<b>6</b>
12.1	Instrument Calibration.....	6
12.2	Datalogging .....	6
12.3	Functional Checks .....	7
12.4	Counting Times and Minimum Detectable Concentrations (MDCs).....	7
12.4.1	Beta Static Counting MDC .....	7
12.4.2	Beta Ratemeter Scanning MDC.....	8
12.4.3	Gamma Ratemeter Scanning MDC .....	9
12.4.4	Smear Counting MDC .....	9
12.4.5	Uncertainty.....	10
12.5	Instrumentation Specifications .....	10
12.6	Efficiency Determination .....	11
<b>13</b>	<b>SURVEY DESIGN.....</b>	<b>11</b>
13.1	Background Determination.....	12
13.2	Data Quality Objectives (DQO) .....	13
13.3	Area Classifications.....	13
13.3.1	Non-Impacted Areas .....	13
13.3.2	Impacted Areas .....	13
13.4	Survey Units .....	14
13.5	Surface Scans.....	15



13.6	Total Surface Activity Measurements .....	16
13.7	Soil Samples .....	16
13.8	Determination of the Number of Samples Required for the Sign Test .....	17
13.8.1	Determination of the Relative Shift .....	17
13.8.2	Determination of Acceptable Decision Errors .....	18
13.8.3	Determination of Number of Samples .....	18
13.9	Determination of Sample Locations .....	19
13.10	Removable Contamination Measurements .....	19
13.11	Surveys of Building Mechanical System Internals .....	20
<b>14</b>	<b>SURVEY DOCUMENTATION AND DATA MANAGEMENT .....</b>	<b>20</b>
14.1	Survey Packages .....	20
14.2	Location Codes .....	20
<b>15</b>	<b>DATA QUALITY ASSESSMENT (DQA) .....</b>	<b>22</b>
15.1	Data Validation .....	22
15.2	Preliminary Data Review .....	22
15.3	Review of Graphical Data .....	22
15.4	Structural Surface Data Summary .....	24
15.5	Surface Soil Sample Data Summary .....	25
15.6	Lagoon Sample Data Summary .....	25
15.6.1	ETL Lagoon (L001) .....	26
15.6.2	Cattle Lagoon (L002) .....	27
15.6.3	Swine Lagoon (L003) .....	28
15.7	Determining Compliance for Building Structural Surfaces .....	29
15.8	Mechanical System Survey Data Analysis .....	29
15.9	Determining Compliance for Lagoon Soils and Sludges .....	29
<b>16</b>	<b>CONCLUSION .....</b>	<b>31</b>
<b>17</b>	<b>REFERENCES .....</b>	<b>32</b>



## TABLES

Table 4-1: NRC Default Screening Values.....	4
Table 5-1: Survey Investigation Levels .....	5
Table 12-1: Instrumentation Specifications.....	10
Table 12-2: Typical Instrument Operating Parameters and Sensitivities .....	11
Table 13-1: Building Structural Survey Units .....	14
Table 13-2: Building Systems Survey Units.....	14
Table 13-3: Outside Grounds Survey Units.....	15
Table 13-4: Lagoon Survey Units.....	15
Table 13-5: Scan Survey Area Coverage.....	15
Table 14-1: Building Structure Location Code Description .....	21
Table 15-1: Structural Surfaces Total Beta Surface Activity (Static Measurements) .....	24
Table 15-2: Building Structural Surfaces Removable <sup>3</sup> H Summary .....	24
Table 15-3: Building Structural Surfaces Removable <sup>14</sup> C Summary .....	24
Table 15-4: Building Structural Surfaces Removable Channel 3 Summary .....	24
Table 15-5: Building Drains Removable <sup>3</sup> H Summary .....	25
Table 15-6: Building Drains Removable <sup>14</sup> C Summary .....	25
Table 15-7: Building Drains Removable Channel 3 Summary .....	25
Table 15-8: ETL Lagoon H-3 Sample Results >MDC .....	26
Table 15-9: ETL Lagoon Sample Results Summary .....	27
Table 15-10: Cattle Lagoon C-14 Sample Results >MDC .....	27
Table 15-11: Cattle Lagoon Sample Results Summary .....	28
Table 15-12: Structural Surfaces Total Beta Surface Activity Dose Calculations .....	29
Table 15-13: Cattle Lagoon Dose Modeling Inputs and Results.....	30
Table 15-14: ETL Lagoon Dose Modeling Inputs and Results .....	31

## APPENDICES

Appendix A – Site Map
Appendix B – Instrument Calibration Records
Appendix C – Structural Surface Location Maps
Appendix D – Soil Sample Location Maps
Appendix E – Soil Sample GPS Coordinates (dated 5-23-14)
Appendix F – Structural Surface Scan 4-Plot Graphs (dated 1-17-14)
Appendix G – Surface Soils Gamma Scan 4-Plot Graphs (dated 1-17-14)
Appendix H – GPS Gamma Scan Overlay Maps
Appendix I – GPS Gamma Scan Overlay Maps with K-40 Results
Appendix J – Structural Surfaces Survey Results (dated 1-17-14)
Appendix K – Drain Survey Results (dated 1-17-14)
Appendix L – Soil Sample Analytical Reports
Appendix M – Lagoon Sample Analytical Reports
Appendix N – RESRAD Reports



### ACRONYMS

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
COC	Chain of Custody
DCGL	Derived Concentration Guideline Level
DCGL <sub>w</sub>	Derived Concentration Guideline Level – Wilcoxon Rank Sum
DQA	Data Quality Assessment
DQO	Data Quality Objective
DSV	Default Screening Value
ETL	Environmental Trace Laboratory
FSS	Final Status Survey
GPS	Global Positioning System
HSA	Historical Site Assessment
LBGR	Lower Bound of the Gray Region
LSC	Liquid Scintillation Counter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MU	University of Missouri-Columbia
NRC	U.S. Nuclear Regulatory Commission
NIST	National Institute of Standards and Technology
QA	Quality Assurance
RPP	Radiation Protection Program
RSC	Radiation Safety Officer
RSO	Radiation Safety Committee
TBE	Teledyne Brown Engineering
TEDE	Total Effective Dose Equivalent



## 1 INTRODUCTION

The University of Missouri - Columbia (MU) is releasing a portion of their property located at the Sinclair Farm Site in Columbia, Missouri. Portions of the farm were historically used for activities involving radioactive materials under the MU US Nuclear Regulatory Commission (NRC) Broad Scope Type A radioactive materials license No. 24-00513-32. Over the past few years, Chase Environmental Group, Inc. (Chase) has performed confirmatory surveys of all impacted buildings except the remaining concrete pads associated with an old incinerator facility and waste storage building that are included in this report. MU subsequently demolished the buildings. The goals of Phase 4 are to verify non-impacted status of outdoor areas with no history of radioactive materials usage, and to collect data to verify that areas with a history of radioactive materials usage meet the radiological criteria for unrestricted use. Specific areas included in Phase 4 are:

- Concrete slab foundations of the demolished incinerator and waste storage buildings
- Sludge and soils of three lagoons
- Surface soils surrounding specific concrete slab foundations, down gradient from an impacted lagoon, and along the travel path from a former clinic to an animal burial site

A map of the site identifying these areas is provided in Appendix A.

The nuclides of concern for demolished building foundations and surrounding soils are C-14, H-3, and mixed fission and activation products. The nuclides of concern for other areas are C-14 and H-3.

On-site activities were conducted under the University of Missouri - Columbia's NRC Broad Scope Type A License No. 24-00513-32 and in accordance with the "*University of Missouri - Columbia Sinclair Farm Phase 4 Radiological Survey Plan*," (Plan) dated October 22, 2013. Initial onsite activities were performed from November 1 to November 4, 2013. Additional sampling of lagoons was performed from March 13 to 14, 2014.

The Plan was developed using the guidance provided in NUREG 1757, "*Consolidated NMSS Decommissioning Guidance*" and NUREG 1575, "*Multi-Agency Radiation Survey and Site Investigation Manual*" (MARSSIM). The plan provided the approach, methods, and techniques for radiological surveys of impacted areas of the facility. Final status surveys were designed to implement the protocols and guidance provided in MARSSIM to ensure that technically defensible data was generated to demonstrate that impacted areas met the release criteria for unrestricted use specified in 10CFR20.1402: "*Radiological criteria for unrestricted use*". The criteria are that residual radioactivity that is distinguishable from background radiation does not result in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group in excess of 25 mrem per year and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

Facility radiological surveys did not identify residual radioactivity above a small fraction of the default screening values (DSV). Therefore, no remediation was necessary and no radioactive waste was generated. This report presents data to support the conclusion that the



facilities surveyed meet the NRC's release criteria. Final status surveys demonstrate that building structural surfaces and outside grounds included in the scope of this report are below release criteria and are suitable for unrestricted release.

## **2 SITE DESCRIPTION AND HISTORY**

### **2.1 Historical Site Assessments**

The MU Environmental Health and Safety Department performed a Historical Site Assessment (HSA) and provided historical information to Chase.

### **2.2 Site Description**

The MU Sinclair Research Farm, located on 543 acres at South Sinclair Road in Columbia, Missouri was historically used for radioactive materials research, incineration, land disposal, and radioactive materials storage.

### **2.3 Ownership**

The site is owned by MU.

### **2.4 Facility Descriptions**

#### Buildings

The Missouri University Research Reactor (MURR) barn was historically used to store items from the reactor facility. A small area of contaminated concrete floor was previously remediated. The MURR Barn concrete pad was included with Phase 1 work; only the surrounding surface soils are included with in this report. The incineration building and adjacent storage building were also used for storing and processing items from MURR. The buildings were previously surveyed by MU and demolished with only their concrete pad foundations remaining.

#### Burial Sites

There are two waste burial areas at Sinclair Farm. The first burial area is a chemical and radiological waste burial site located near the former incineration facility. This area was released by the NRC, but is still controlled by MU due to chemical contaminants. The second burial area is north of the first burial site and was used for burying animals that were used for radioactive research involving C-14.

#### Grounds and Lagoons

Cows were used for research using C-14 in barns and in the clinic located on the west side of Sinclair Road. After research was completed, animals were transported from the clinic necropsy area to the animal burial site west of the clinic. Animals were moved out the west door of the clinic and transported by backhoe to the burial site using the existing unpaved road. Drains from the barns and clinic were directed to the Cattle Lagoon west of the buildings (survey unit L002). South of the cattle area, several buildings were used



to conduct research with swine. There is no history of radioactive materials usage associated with swine research. Drains from the swine research areas were directed to the Swine Lagoon located south of the cattle lagoon (survey unit L003). The lagoons are not connected.

Two areas on the east side of Sinclair Road are included in this report – the Environmental Trace Laboratory (ETL) Lagoon (survey unit L001) and the surface soils surrounding the MURR barn. The ETL was used to conduct research using small quantities of C-14, H-3, and short-lived radionuclides. Drains from the lab buildings were directed to the ETL Lagoon located north of the lab building. Drain disposal of radioactive material was prohibited.

## 2.5 Nuclides of Concern

Based on information provided by MU, the nuclides of concern are H-3, C-14 in all areas, and additionally mixed fission and activation products at the MURR barn and incineration areas.

## 2.6 Previous Decommissioning

MU personnel surveyed all Sinclair Farm buildings according to closeout procedures. During Phase 1, 2, and 3 confirmatory surveys completed by Chase in 2011 and 2012, five barns (buildings 13641, 13646, 13648, 13650, and 13667), a small clinic (building 13661), three laboratory buildings (13617, 13618, and 13663), two vivarium buildings (1320, 1330), and two concrete floor slabs associated with burned buildings 13669 and 13671 were surveyed and released. All buildings have subsequently been demolished. Confirmatory surveys are summarized in “*University of Missouri – Columbia, Sinclair Farm Phase 1 Final Status Report*,” dated June 2011, “*University of Missouri – Columbia, Sinclair Farm Phase 2 Final Status Report*,” dated January 2012, and “*University of Missouri – Columbia, Sinclair Farm Phase 3 Final Status Report*,” dated June 2012.

The waste burial site located near the incinerator facility was released by MU with concurrence of NRC Region III in a letter to Susan Langhorst dated August 7, 1997.

# 3 RELEASE CRITERIA

The radiological release criteria of NRC 10 CFR 20 Subpart E for unrestricted use were used. Specifically, the criteria of 10 CFR 20.1402: “*Radiological criteria for unrestricted use: A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.*”



#### 4 DERIVED CONCENTRATION GUIDELINE LEVELS (DCGLs)

Survey data were compared to the NRC DSVs in NUREG 1757, Volume 1, Appendix B that equate to 25 mrem/yr. Screening values for the nuclides of concern under default conditions (generic screening levels) are presented in the table below.

**Table 4-1: NRC Default Screening Values**

Isotope	Radiation Type	Structural Surface Default Screening Value (dpm/100cm <sup>2</sup> )	Surface Soils Default Screening Value (pCi/g)
C-14	Weak Beta	3.7E+06	12
H-3	Weak Beta	1.2E+08	110
Fission and Activation Products <sup>1</sup>	Beta-Gamma	7.1E+03 (Co-60)	11 (Cs-137)

The DCGL is the radionuclide-specific surface area concentration that could result in a dose equal to the release criterion. DCGL<sub>W</sub> is the concentration limit if the residual activity is essentially evenly distributed over a large area. For this project, DCGL<sub>W</sub> is equal to the DSV. An important assumption of the dose model for building structural surfaces is that removable contamination is <10% of total contamination. Smear surveys were taken to verify this assumption and compared to a removable DCGL equal to 10% of the total DCGL.

Based on history, usage, etc., C-14 and H-3 were the nuclides of concern for all areas, and additionally, mixed fission and activation products for the MURR Barn and Incineration areas due to their usage by the MURR reactor facility. All fission products are beta-gamma emitters due to a high neutron/proton ratio. Many are gases and/or have short half-lives, such that a majority of the dose from fission products several months to decades after production is due to Cs-137 and Sr-90. The dose from activated corrosion products (primarily isotopes of Co, Mn, Fe, and Ni) is dominated by Co-60. The actual distribution of the fission product and corrosion product activity that may be present is unknown. However, Co-60 has the lowest DSV of any beta-gamma emitter (except for beta emitters that have alpha-emitting progeny such as Pb-210, Ra-228 and Pu-241). Therefore, the Co-60 DSV of 7,100 dpm/100cm<sup>2</sup> is conservatively used as a gross beta DSV for the incinerator and waste storage building concrete pads. This method also ensures hard-to-detect nuclides, such as Fe-55 and Ni-63, that are typically a small fraction of the nuclide distribution are maintained below their screening values.

Because H-3 and other hard-to-detect nuclides cannot be efficiently detected by direct methods, they were evaluated by removable contamination measurements only. Considering the extremely conservative ALARA goals, the dose conversion factors and the

<sup>1</sup> For the remaining building structures, gross beta measurements were performed using the Co-60 DCGL as the limiting DSV for mixed fission and corrosion products. Surface soils are classified as non-impacted based on history. The only nuclide identified by soil samples was Cs-137 in concentrations consistent with background; therefore the Cs-137 DSV is presented for comparison to show that concentrations are a very small fraction of the DSV.



ratio of hard-to-detect nuclides compared to detectable nuclides, this method ensures the dose contribution from hard-to-detect nuclides is an insignificant component of the total dose.

## 5 INVESTIGATION LEVELS

Investigation levels were used to flag locations that required special attention to ensure areas were properly classified and adequate surveys were performed. Investigation levels are presented in the table below.

**Table 5-1: Survey Investigation Levels**

<b>Survey Unit Classification</b>	<b>Flag Static Measurement Result When: (dpm/100cm<sup>2</sup>)</b>	<b>Flag Scanning Measurement Result When:</b>	<b>Flag Removable Measurement Result When: (dpm/100cm<sup>2</sup> in any channel)</b>	<b>Flag Soil Measurement Result When:</b>
All	> 5,000	> MDC	> 200	> MDC

## 6 PROJECT MANAGEMENT AND ORGANIZATION

Work was performed under the MU NRC Broad Scope Type A License No. 24-00513-32, under the supervision of the MU Radiation Safety Officer (RSO) and Radiation Safety Committee (RSC). Chase designated a Project Manager to interface and inform MU personnel of all project operations.

## 7 PROJECT TRAINING

MU provided Chase personnel with site-specific Contractor Site Orientation Training. Chase provided training for project-specific programs, plans, and procedures.

## 8 RADIATION PROTECTION

Radiological work was performed according to the Plan and in accordance with the MU radioactive materials license Radiation Protection Program (RPP).

## 9 ENVIRONMENTAL MONITORING PROGRAM

Due to the small quantities of materials present at the facility, an environmental monitoring program was not required.

## 10 RADIOACTIVE WASTE MANAGEMENT

There was no radioactive waste generated from project activities.



## 11 QUALITY ASSURANCE PROGRAM

Due to the limited scope of the planned activities, project-specific quality requirements were included in the Plan, and were supported by the Chase corporate Quality Assurance (QA) program to meet the guidelines of MARSSIM Section 9.

## 12 INSTRUMENTATION

### 12.1 Instrument Calibration

Radiation detection instruments were calibrated at least annually with National Institute of Standards and Technology (NIST) traceable sources and to radiation emission types and energies that provided detection capabilities similar to the isotopes of concern. Field instruments had an efficiency determined by a licensed calibration facility using NIST traceable sources. Calibration records for field instruments are provided in Appendix B. Calibration records for the liquid scintillation counter are maintained by MU.

### 12.2 Datalogging

Beta-gamma structural surface scans were performed using datalogging instrumentation. While scanning, in addition to the surveyor listening to the audible output, integrated counts were recorded.

For surface soils scans, surface gamma exposure rates and their associated spatial coordinates were recorded once every second by the global positioning system (GPS) to produce an electronic record of the gamma surface radiation levels and their locations. Soil scan survey results were color-coded and superimposed on an aerial photo of the property to provide a visual representation of the gamma exposure rates.

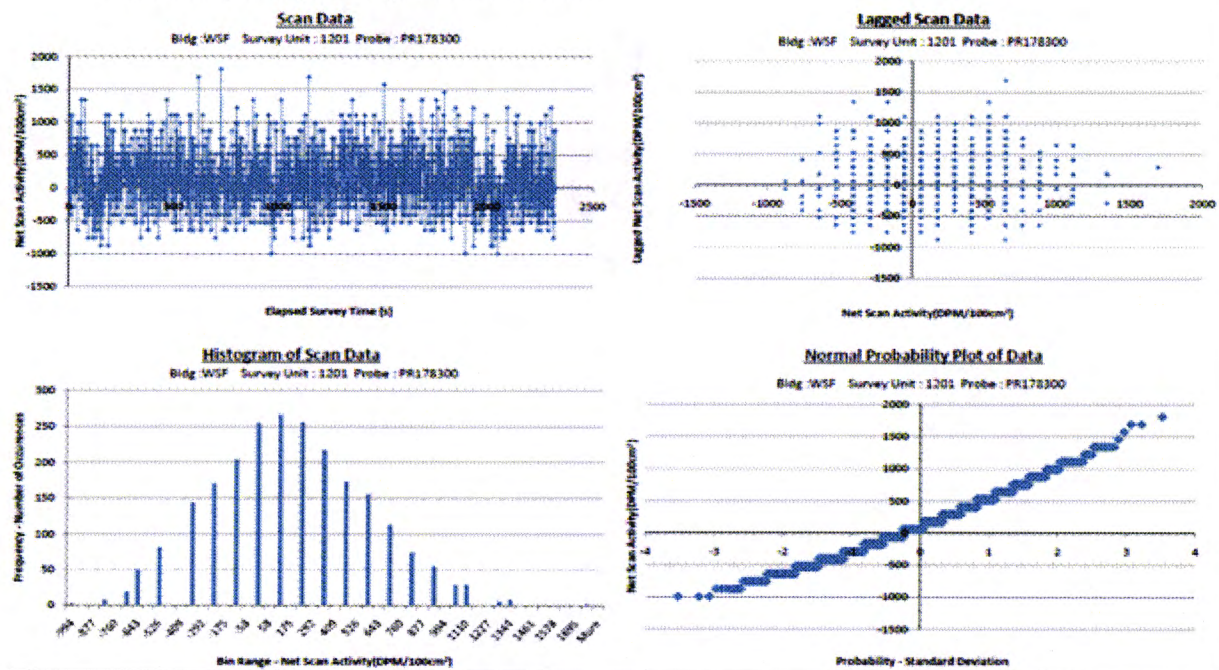
Logged data was downloaded and processed using data management software to perform analyses and reporting. Reporting includes graphical (4-plot) presentation, as well as summary statistics functions. The data management software produced 4-plot graphical output of scan data to enhance visualization. The 4-Plot is described in the NIST e-Handbook of Statistical Methods (<http://www.itl.nist.gov/div898/handbook/index.htm>). A 4-plot consists of the following:

- A **run sequence plot** presents logged data in chronological order, providing a time history of the survey data.
- A **lag plot** checks whether a data set or time series is random or not. Random data should not exhibit any identifiable structure in the lag plot.
- A **histogram plot** graphically summarizes the distribution of a univariate data set, showing center (i.e., the location) of the data, spread (i.e., the scale) of the data, skewness of the data, presence of outliers, and presence of multiple modes.
- A **probability plot** is a goodness-of-fit test used to verify the distributional model. The normal probability plot is a graphical technique for assessing whether or not a data set is approximately normally distributed. The data is plotted against a theoretical normal distribution in such a way that the points should form an



approximate straight line. Departures from this straight line indicate departures from normality.

An example 4-plot is provided below.



## 12.3 Functional Checks

Instrument functional checks were performed at least daily when in use. The background, source check, and field measurement count times for radiation detection instrumentation were specified by procedure to ensure measurements were statistically valid. Background readings were taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions.

## 12.4 Counting Times and Minimum Detectable Concentrations (MDCs)

Minimum counting times for background determinations and measurement of total and removable contamination were chosen to provide MDCs that met the Data Quality Objectives (DQOs) specified in the plan. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100cm<sup>2</sup>. Count times and scanning rates were determined using the following equations:

### 12.4.1 Beta Static Counting MDC

Static counting MDC at a 95% confidence level was calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):



$$MDC_{static} = \frac{3 + 3.29 \sqrt{B_R \cdot t_S \cdot \left(1 + \frac{t_S}{t_B}\right)}}{t_S \cdot E_{tot} \cdot \frac{A}{100}}$$

Where:

- $MDC_{static}$  = minimum detectable concentration (dpm/100cm<sup>2</sup>)  
 $B_R$  = background count rate (counts per minute)  
 $t_B$  = background count time (minutes)  
 $t_S$  = sample count time (minutes)  
 $E_{tot}$  = total detector efficiency for radionuclide emission of interest (cpm/dpm)  
 $A$  = detector probe area (cm<sup>2</sup>)

A typical static MDC calculation for the Ludlum Model 43-37 gas flow proportional detector is shown below:

$$MDC_{STATIC} = \frac{3 + 3.29 \sqrt{(1500)(0.1) \left(1 + \frac{0.1}{0.1}\right)}}{(0.1)(0.08) \frac{582}{100}} = 1288 \text{ dpm/100cm}^2$$

#### 12.4.2 Beta Ratemeter Scanning MDC

Scanning MDC at a 95% confidence level was calculated using the following equation, which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d' \sqrt{b_i \left(\frac{60}{i}\right)}}{\sqrt{p} \cdot E_{tot} \cdot \frac{A}{100 \text{ cm}^2}}$$

Where:

- $MDC_{scan}$  = minimum detectable concentration (dpm/100cm<sup>2</sup>)  
 $d'$  = desired performance variable (1.38)  
 $b_i$  = background counts during the residence interval (counts)  
 $i$  = residence interval (seconds)  
 $p$  = surveyor efficiency (0.5)  
 $E_{tot}$  = total detector efficiency for radionuclide emission of interest (cpm/dpm)  
 $A$  = detector probe area (cm<sup>2</sup>)

A typical  $MDC_{scan}$  calculation for the Ludlum 43-37 gas flow proportional detector is shown below:

$$i = 13.3 \text{ cm} \cdot \frac{\text{inch}}{2.54 \text{ cm}} \cdot \frac{\text{sec}}{20 \text{ inch}} = 0.26 \text{ sec}$$



$$b_i = 0.26 \text{ sec} \cdot \frac{1,500 \text{ counts}}{\text{minute}} \cdot \frac{\text{minute}}{60 \text{ sec}} = 6.5 \text{ counts}$$

$$MDC_{SCAN} = \frac{1.38\sqrt{6.5}\left(\frac{60}{0.26}\right)}{(\sqrt{0.5})(0.08)\left(\frac{582}{100}\right)} = 2458 \text{ dpm/100cm}^2$$

#### 12.4.3 Gamma Ratemeter Scanning MDC

Gamma scans were conducted within the parameters used to calculate NUREG 1507 Table 6.4 values. The scan sensitivity for a 2" x 2" sodium iodide detector is 6.4 pCi/g for Cs-137 and 3.4 pCi/g for Co-60.

#### 12.4.4 Smear Counting MDC

Smear counting MDC at a 95% confidence level was calculated using the following equation, which is an expansion of NUREG 1507, Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{SMEAR} = \frac{3 + 3.29\sqrt{B_R \cdot t_s \cdot \left(1 + \frac{t_s}{t_b}\right)}}{t_s \cdot E}$$

Where:

- MDC<sub>smear</sub> = minimum detectable concentration (dpm/100cm<sup>2</sup>)
- B<sub>R</sub> = background count rate (counts per minute)
- t<sub>b</sub> = background count time (minutes)
- t<sub>s</sub> = sample count time (minutes)
- E<sub>tot</sub> = instrument efficiency for radionuclide emission of interest (cpm/dpm)

Typical MDC calculations for LSC smears are shown below.

$$^3\text{H MDC}_{SMEAR} = \frac{3 + 3.29\sqrt{(20)(1)\left(1 + \frac{1}{1}\right)}}{(1)(0.60)} = 40 \text{ dpm}$$

$$^{14}\text{C MDC}_{SMEAR} = \frac{3 + 3.29\sqrt{(15)(1)\left(1 + \frac{1}{1}\right)}}{(1)(0.80)} = 26 \text{ dpm}$$



$$\text{OPEN MDC}_{\text{SMEAR}} = \frac{3 + 3.29 \sqrt{(45)(1) \left(1 + \frac{1}{1}\right)}}{(1)(0.9)} = 38 \text{ dpm}$$

#### 12.4.5 Uncertainty

The uncertainty for each beta total surface activity measurement was calculated using equation 6-15 from MARSSIM:

$$\sigma = 1.96 \sqrt{\frac{C_{s+b}}{T_{s+b}^2} + \frac{C_b}{T_b^2}}$$

Where:

- $\sigma$  = uncertainty
- 1.96 = multiplier to achieve a 95% confidence level
- $C_{s+b}$  = gross sample counts
- $T_{s+b}$  = sample count time (min.)
- $C_b$  = gross background counts
- $T_b$  = background count time (min.)

Uncertainties presented with total surface activity results are additionally corrected for detection efficiency and probe area for presentation in the same units as total surface activity results.

Counting uncertainties for samples analyzed by the contract laboratory are presented in the laboratories analytical reports.

#### 12.5 Instrumentation Specifications

The instrumentation used for facility surveys is summarized in the following tables.

**Table 12-1: Instrumentation Specifications**

Detector Model	Detector Type	Detector Area (cm <sup>2</sup> )	Meter Model	Window Thickness (mg/cm <sup>2</sup> )	Typical Efficiency
Ludlum 43-37 Floor Monitor	Gas Flow Proportional	582	Ludlum 2241-3	0.8	8 % (C-14)
Ludlum 44-10	Gamma Scintillation	N/A	Ludlum 2221	N/A	N/A
Packard TriCarb (or Equivalent)	Liquid Scintillation	N/A	N/A	N/A	60% (H-3) 80% (C-14) 90% (Open)



**Table 12-2: Typical Instrument Operating Parameters and Sensitivities**

Measurement Type	Detector Model	Max. Scan Rate (in/s)	Count Time (s)	Background (cpm)	MDC (dpm/100cm <sup>2</sup> )
Surface Scans	Ludlum 43-37	20	N/A	1,500	2,458 (C-14)
Total Surface Activity	Ludlum 43-37	N/A	6	1,500	1,288 (C-14)
Surface Soil Exposure Rate	Ludlum 43-10	0.5 m/s	N/A	10,000	N/A
Removable Activity	Packard TriCarb	N/A	60	20 (H-3) 15 (C-14) 45 (Open)	40 (H-3) 26 (C-14) 38 (Open)

## 12.6 Efficiency Determination

MARSSIM methodology for building structures uses ISO-7503-1 methodology that takes into account the texture of the surface and the  $2\pi$  detector efficiency. Under MARSSIM, the default surface efficiency for beta emitters with maximum energies less than 400 KeV is conservatively set at 0.25. For measurements taken on building structures, the  $2\pi$  C-14 efficiency and a surface efficiency of 0.25 were conservatively used even though the results are compared to the DSV for Co-60 that has a higher detection efficiency.

## 13 SURVEY DESIGN

Surveys were designed according to MARSSIM recommendations and conducted by performing the appropriate combination of scan surveys, total activity measurements, removable activity measurements, and soil samples as discussed further in this section. All surveys were performed according to written instructions. Survey data was documented on survey maps and/or associated data information sheets.

Surveys protocols are summarized below:

### Incineration Site

- Surface scans of 100% of accessible concrete pad surfaces
- Static measurements and smears on a systematic grid pattern
- Smears inside drain openings
- GPS-based gamma scans of soil surfaces surrounding the pads
- Surface soil sampling around pads on a systematic grid pattern
- Samples analyzed for C-14, H-3, and gamma spectroscopy

### Animal Burial Travel path

- Surface soil sampling
- 12 judgmental locations
- Samples analyzed for C-14 and H-3



MURR Barn Area

- GPS-based gamma scans of soil surfaces surrounding the pad
- Surface soil sampling around the pad - judgmental locations
- Samples analyzed for C-14, H-3, and gamma spectroscopy

Lagoon sampling conducted November 2013

- Sludge thickness measurement, sludge sample, and soil sample at each location
- 12 locations in Cattle Lagoon and in the ETL Lagoon on a systematic grid pattern, 3 judgmental locations in Cattle Lagoon and Swine Lagoon
- Samples analyzed for C-14 and H-3

Lagoon sampling conducted March 2014

- Additional sludge and soil samples at judgmental locations in the Cattle Lagoon and ETL Lagoon to bound the lateral extent of residual radioactivity
- Additional soil depth samples at locations with soil sample results above the MDC in the Cattle Lagoon and ETL Lagoon to bound the vertical extent of residual radioactivity
- Cattle Lagoon samples analyzed for C-14, ETL Lagoon samples analyzed for H-3

Area Around Cattle Lagoon

- Surface soil sampling on north and west sides
- 12 locations in areas cleared by MU
- Samples analyzed for C-14 and H-3

### **13.1 Background Determination**

Reference background areas or paired background comparisons were not necessary for this survey design. Material and ambient background levels were not significant in comparison to the DCGLs. Ambient background was determined for each survey to calculate the actual survey MDCs and associated counting errors. Because the nuclides of concern do not exist in significant quantities in soils, no background soil samples were obtained.

For total surface activity measurements, ambient background levels were generally determined by performing a six-second timed count with the probe at waist level and away from survey unit surfaces. Ambient background was subtracted from each total activity measurement. Material background, the contribution from naturally-occurring radioactivity in the concrete slabs, was not accounted for (subtracted) since it was a small fraction of the DCGL.

The liquid scintillation counter was set up to report results in net dpm in each channel (background subtraction on).



### 13.2 Data Quality Objectives (DQO)

The DQO process as described in MARSSIM was used throughout the design and implementation of surveys. The following is a list of the DQOs for the survey design:

- Static measurements of structural surfaces were taken to achieve an  $MDC_{static}$  of less than 5,000 dpm/100 cm<sup>2</sup>
- Scanning of structural surfaces was conducted at a rate to achieve an  $MDC_{scan}$  of less than 5,000 dpm/100 cm<sup>2</sup>
- Removable contamination measurements were counted to achieve an  $MDC_{smear}$  of less than 200 dpm/100 cm<sup>2</sup> in each liquid scintillation counter (LSC) channel.
- Soil and sludge samples were counted to achieve an MDC of less than 1 pCi/g each for C-14, H-3, Co-60, and Cs-137.
- Individual measurements were made to a 95% confidence interval.
- Decision error probability rates were set at 0.05 for both  $\alpha$  and  $\beta$ .
- The null hypothesis ( $H_0$ ) and alternative hypothesis ( $H_A$ ) were that of NUREG 1505 scenario A:
  - $H_0$  was that the survey unit does not meet the release criteria
  - $H_A$  was that the survey unit meets the release criteria
- Surveys were conducted using quality assurance criteria such that the data may be used as FSS data to the maximum extent possible.

### 13.3 Area Classifications

Based on the facility operational history and previous survey results, facility areas were classified as impacted areas or non-impacted areas.

#### 13.3.1 Non-Impacted Areas

Non-impacted areas are areas without residual radioactivity from licensed activities.

There is no history of outdoor activities using radioactive materials. Surface soils of outside grounds, the ETL Lagoon, and the Swine Lagoon are considered non-impacted based on history. However, these areas were surveyed to confirm non-impacted status. Because drains from the cattle barns were directed to the cattle lagoon, it is considered impacted.

Soils around the MURR Barn, Incinerator Building, and Waste Storage Building were scanned for gamma emitters and sampled to verify that reactor materials were not spread outside the buildings.

#### 13.3.2 Impacted Areas

Impacted areas are those areas with a potential for residual radioactivity from licensed activities. All areas with a history of containing radioactive materials were considered impacted.



There were no Class 1 or Class 2 areas. Based on the release criteria, historical operations, and survey data provided by MU, all areas with a history of radioactive materials usage were classified as Class 3. Class 3 areas are areas that meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

The Incinerator Building and Waste Storage Building concrete pads were considered Class 3 because they were previously surveyed by MU with no elevated activity identified.

The Cattle Lagoon is considered impacted because manure from the barns was drained to the lagoon, including manure from cows that were used for research involving C-14. No elevated activity was detected during surveys of the barn and clinic structural surfaces or drains. Lagoons are not classified according to MARSSIM because they are evaluated based on a site-specific dose model.

### 13.4 Survey Units

A survey unit is a geographical area of specified size and shape for which a separate decision was made whether or not that area met the release criteria. Survey units were homogeneous in construction, contamination potential, and contamination distribution. Recommended maximum survey unit sizes for building structures, based on floor area, are Class 1: up to 100 m<sup>2</sup>, Class 2: 100 m<sup>2</sup> to 1,000 m<sup>2</sup> and Class 3: no limit. Recommended maximum survey unit sizes for land areas are Class 1: up to 2,000 m<sup>2</sup>, Class 2: 2,000 m<sup>2</sup> to 10,000 m<sup>2</sup> and Class 3: no limit.

Each survey unit is assigned a unique identification number as presented in the tables below.

**Table 13-1: Building Structural Survey Units**

<b>Survey Unit</b>	<b>Description</b>
INB-1301	Incinerator Building Concrete Pad
WSB-1301	Waste Storage Building Concrete Pad

**Table 13-2: Building Systems Survey Units**

<b>Survey Unit</b>	<b>Description</b>
INB-DR01	Incinerator Building Drains
WSB-DR01	Waste Storage Building Drains



**Table 13-3: Outside Grounds Survey Units**

Survey Unit	Description
G301	Surface Soils Surrounding the MURR Barn
G302	Surface Soils Surrounding the Cattle Lagoon
G303	Surface Soils on the Travel Path From the Clinic to The Burial Grounds
G304	Surface Soils Surrounding the Incinerator and Waste Storage Building Concrete Pads

**Table 13-4: Lagoon Survey Units**

Survey Unit	Description
L001	ETL Lagoon
L002	Cattle Lagoon
L003	Swine Lagoon

### 13.5 Surface Scans

Scanning was used to identify locations that exceed the investigation level. Scan surveys for building structural surfaces were conducted by moving the detector probe at a distance of about  $\frac{1}{8}$  inch from the surface at the prescribed scan rate and listening for an increase in the audible response. Outdoor gamma scans were conducted by moving the sodium iodide detector in a serpentine motion while walking at a rate of approximately 20 inches per second and listening to the audible response. It is not possible to scan for C-14 or H-3 in soils. While scanning, in addition to the surveyor listening to the audible output, integrated counts were recorded every second by datalogging instrumentation.

Chase performed data-logged gamma scan walkover surveys of accessible surface soils with a 2 in x 2 in NaI detector using GPS-based datalogging equipment to graphically represent the spatial variability of surface gamma exposure rates and to determine if any spatial dependencies exist. Surface gamma exposure rates and their associated spatial coordinates were recorded once every second by the GPS system to produce an electronic record of the gamma radiation levels encountered and their locations during surface scans. Scan survey results were color-coded and superimposed on an aerial photo of the property to provide a visual representation of the spatial distribution of site surface gamma exposure rates.

The table below summarizes the percentage of surfaces scanned.

**Table 13-5: Scan Survey Area Coverage**

Surface	Scan Coverage
Floors	100%
Soils	100%



### 13.6 Total Surface Activity Measurements

Total surface activity (static) measurements were taken at each identified structural surface sample location. Scaler count times were determined to achieve the detection sensitivities stated in the DQOs. Field measurements were converted to an activity concentration using the following equation:

$$\text{Activity (dpm/100cm}^2\text{)} = \frac{\text{cpm}_{\text{sample}} - \text{cpm}_{\text{background}}}{E_{\text{total}} \cdot \frac{A}{100\text{cm}^2}}$$

Where:

- cpm<sub>sample</sub> = sample count rate in counts per minute
- cpm<sub>background</sub> = background count rate in counts per minute
- E<sub>tot</sub> = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency)
- A = active area of the detector in cm<sup>2</sup>

Static measurements for total surface activity were performed by conducting a six-second timed count on the surface to be measured. Static measurements were used for survey unit statistical analyses and to determine compliance with release criteria. Due to small geometry, system internals were inaccessible and no direct measurements were performed.

### 13.7 Soil Samples

Surface soil (15 cm depth) samples were collected at each statistically-determined sample location and sent to Teledyne Brown Engineering (TBE), an independent laboratory for analysis. A column of soil was collected at each location about 10 cm in diameter and 15 cm deep and homogenized.

For lagoon sampling, a sample of the sludge and soil was collected into an acetate sleeve using a two-inch diameter core sampler with extension rods and slide hammer. After noting the sludge thickness, the sludge and soils were separated and samples collected for laboratory analysis. Samples were homogenized over the entire thickness of the sample.

Soil samples were analyzed by Teledyne Brown Engineering in Knoxville, TN using Chain of Custody (COC) procedures. The COC maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field.

Chase collected judgmental surface soil samples at areas with the highest probability for contamination, such as near obvious drainage paths.



### 13.8 Determination of the Number of Samples Required for the Sign Test

The minimum number of samples required for the Sign Test was calculated using equations in Section 5 of MARSSIM. A conservative estimate of the standard deviation of measurements (1,000 dpm/100cm<sup>2</sup> for structural surfaces and 2 pCi/g for soils) was used for calculations. The Lower Bound Gray Region was set at one half of the DCGL. The calculation performed to determine the required number of samples is provided below.

#### 13.8.1 Determination of the Relative Shift

The number of required samples depended on the ratio involving the activity level measured relative to the variability in the concentration. This ratio is called the Relative Shift,  $D/\sigma_s$  and is defined in MARSSIM as:

$$\Delta/\sigma_s = \frac{DCGL - LBGR}{\sigma_s}$$

Where:

DCGL = derived concentration guideline level

LBGR = concentration at the lower bound of the gray region (LBGR).  
The LBGR is the average concentration to which the survey unit should be cleaned in order to have an acceptable probability of passing the test

$\sigma_s$  = an estimate of the standard deviation of the residual radioactivity in the survey unit

The actual calculations are provided below:

Building Surfaces (beta):

$$\Delta/\sigma_s = \frac{7,100 \text{ dpm/100cm}^2 - 3,550 \text{ dpm/100cm}^2}{1,000 \text{ dpm/100cm}^2} = 3.5$$

Soils (C-14)<sup>2</sup>:

$$\Delta/\sigma_s = \frac{12 \text{ pCi/g} - 6 \text{ pCi/g}}{2 \text{ pCi/g}} = 3$$

Since MARRSIM Table 5.5 does not include relative shifts above 3 and the number of samples required decreases with an increasing relative shift, the relative shift was conservatively set at 3.

---

<sup>2</sup> Because the cattle lagoon is the only impacted soils area, C-14 is the only nuclide of concern.



### 13.8.2 Determination of Acceptable Decision Errors

A decision error is the probability of making an error in the decision on a survey unit by passing a unit that should fail ( $\alpha$  decision error) or failing a unit that should pass ( $\beta$  decision error). MARSSIM uses the terminology  $\alpha$  and  $\beta$  decision errors; this is the same as the more common terminology of Type I and Type II errors, respectively. The applicable decision errors (Type I Type II errors) were selected in accordance with the established Data Quality Objectives at 0.05 for both Type I and Type II errors.

### 13.8.3 Determination of Number of Samples

It was assumed that the contaminant was not present in background at significant levels compared to the DCGLs. Using this methodology, the Sign Test was chosen for the statistical evaluation of survey data.

The number of samples for a particular survey unit, employing the Sign Test, was determined from MARSSIM Table 5.5, which is based on the following equation (MARSSIM equation 5-2):

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign}P - 0.5)^2}$$

Where:

- N = number of samples needed in the survey unit
- $Z_{1-\alpha}$  = percentile represented by the decision error  $\alpha$
- $Z_{1-\beta}$  = percentile represented by the decision error  $\beta$
- SignP = estimated probability that a random measurement will be less than the DCGL when the survey unit median is actually at the LBGR

Note: SignP is determined from MARSSIM Table 5.4

MARSSIM recommends increasing the calculated number of measurements by 20% to ensure sufficient power of the statistical tests and to allow for possible data losses. MARSSIM Table 5.5 values include this additional 20%. The following calculation was made to determine this number for building surfaces and soils of outside grounds:

$$N = \frac{(1.645 + 1.645)^2}{4(0.998650 - 0.5)^2} = 11$$

$Z_{1-\alpha}$  and  $Z_{1-\beta}$  are equal to 1.645 using the error rate of 0.05 from MARSSIM Table 5.2. SignP is equal to 0.998650 from MARSSIM Table 5.4. Adding an additional 20% to account for data losses resulted in a value of 14.



Therefore, the determined number of samples per survey unit for the final status was 14.

### 13.9 Determination of Sample Locations

MARSSIM recommends random sampling (random x, random y) for Class 3 areas. However, in this survey design, Class 3 areas are sampled on a systematic grid pattern in the same manner as MARSSIM recommends for Class 1 and Class 2 areas. Survey unit sample locations was accomplished by first determining sample spacing and then systematically plotting the sample locations from a randomly generated start location. The random starting point of the grid provided an unbiased method for obtaining measurement locations to be used in the statistical tests. A square grid was used in this survey design. The use of a systematic grid allows the decision-maker to draw conclusions about the size of the potential areas of elevated activity based on the area between measurement locations.

Sampling locations were established in a unique pattern beginning with the random start location and the determined sample spacing. After determining the number of samples needed in the survey unit, sample spacing for a square grid is determined from MARSSIM equation 5-8:

$$L = \sqrt{\frac{A}{N}}$$

Where:

L = sample spacing interval

A = the survey unit area

N = number of samples needed in the survey unit

Maps were generated of the survey unit's surfaces included in the statistical tests. A random starting point was determined using computer-generated random numbers coinciding with the x and y coordinates of the total survey unit. A grid was plotted across the survey unit surfaces based on the random start location and the determined sample spacing. A measurement location was plotted at each intersection of the grid plot.

Samples in non-impacted areas were taken at judgmental locations, except that Lagoon L001 and incinerator facility surface soils G304 were taken on a systematic grid pattern.

Sample location maps for building structures are presented in Appendix C. Sample location maps for surface soils and lagoons are presented in Appendix D. Soil sample GPS coordinates are presented in Appendix E.

### 13.10 Removable Contamination Measurements

Removable contamination measurements were collected by wiping an area of approximately 100 cm<sup>2</sup> using paper smears or cotton swabs. The smears/swabs were



counted to achieve the detection sensitivities stated in the DQOs. The liquid scintillation counter (LSC) was setup for triple channel counting as follows:

Channel 1 ( $^3\text{H}$ ):	2 – 18.6 keV
Channel 2 ( $^{14}\text{C}$ ):	18.6 – 156 keV
Channel 3 (all others):	0 - 2000 keV

Removable contamination measurements (smears) were collected on building structural surfaces at each sample location. Additionally, removable contamination measurements were collected for building drain openings. An area of approximately 100 cm<sup>2</sup> was wiped. LSC results are reported in net dpm/100cm<sup>2</sup> (with background subtraction on).

### 13.11 Surveys of Building Mechanical System Internals

Surveys of drain systems were performed. Survey design for these systems is out of the scope of MARSSIM. For the purpose of identifying potential residual contamination within drains; scans and removable contamination surveys were taken at system inlets to the extent possible due to geometric considerations. 100% of accessible drain openings were sampled.

## 14 SURVEY DOCUMENTATION AND DATA MANAGEMENT

### 14.1 Survey Packages

Each survey unit was surveyed using a survey package approved by the Project Manager and specifying the survey protocol to be followed. Packages contained the following elements to ensure the DQOs were met:

- Survey protocol instructions such as the number of samples, sample spacing, sample locations, areas to be scanned, etc.
- Random number generators to determine survey locations
- Instrumentation to be used
- Scan rates, static count times, and/or minimum sample volumes
- Scaled survey unit maps
- Checklists for the survey technician

### 14.2 Location Codes

To ensure proper data management and organization, each static and removable activity measurement location was assigned a unique alpha-numeric location code consisting of a sequence of identifiers to indicate specific information about that location.

#### Soil and Sludge Samples

Each solid sample was assigned a unique alpha-numeric location code consisting of the Chase project number followed by the survey unit number and the sequence number. For lagoon samples, the location code is followed by "SL" for sludge and "SO" for soil. Soil samples also include a depth range in inches. For example, sample L002-001-SL is the sludge sample from cattle lagoon location 1, L002-001-SO-0306 is the soil sample at the



3"-6" depth from cattle lagoon location 1.<sup>3</sup> Where additional judgmental locations were added to L001 and L002, a "J" was used as the first character in the sample number.

#### Building Structural Surfaces

Each total and removable activity measurement location was assigned a unique alphanumeric location code consisting of a sequence of identifiers to indicate specific information about that location, such as the building, survey unit, structural surface, structural material, and a numerically sequenced location number within the survey unit. This system was used so that survey data could be properly entered and organized in the Final Status Survey Database. A breakdown of the location code and specific code components are provided in the table below.

**Table 14-1: Building Structure Location Code Description**

A unique location code was assigned to each individual survey location to ensure proper data management of the survey results. The following format was used to ensure consistency throughout the final status survey process:

#### **BBB-RRRR-SS-M-LLL**

Where:

BBB: = Building Code. This field represents the building number. (3 characters)

INB = Incinerator Building      WSB = Waste Storage Building

RRRR: = Survey Unit Number. This is the assigned survey unit number.  
(4 characters)

SS: = Structural Surface Code. This field represents the structural surface such as floor, wall, ceiling, etc. (2 characters)

F1 = Floor      D2 = Floor Drains

M: = Structural Material Code. This field represents the type of structural material on which a particular measurement is taken. (1 character)

C = Concrete

LLL: = Numerical Identifier. This field represents the survey location number. The field "001" means survey point location number 1. Numerical identifiers are unique within a survey unit. (3-characters)

<sup>3</sup> Depth ranges were added to the location codes when depth samples were taken in March 2014. Sample results from the soil layer without a depth range are 0"-3" by default. For example, Location L002-001-SO is the soils layer 0"-3" sample.



## **15 DATA QUALITY ASSESSMENT (DQA)**

The statistical guidance contained in Section 8 of MARSSIM was used to determine if areas were acceptable for unrestricted release, and whether additional surveys or sample measurements were needed.

### **15.1 Data Validation**

Field data was reviewed and validated to ensure:

- Completeness of forms
- The type of survey was correctly assigned to the survey unit
- The MDCs for measurements met the established data quality objectives
- Independent calculations were performed for a representative sample of data sheets and survey areas
- Instrument calibrations and daily functional checks were performed accurately and at the required frequency

Additionally, all structural surfaces final status survey data was entered into the Final Status Survey Database. This provided the means to sort survey data, verify activity calculations, and to compute the associated MDC and counting errors. Once data entry for a survey unit was complete, a verification report was printed and compared to original data sheets to ensure correct data entry.

### **15.2 Preliminary Data Review**

A preliminary data review was performed for each survey unit to identify any patterns, relationships or potential anomalies. Additionally, measurement data was reviewed and compared with the DCGLs and investigation levels to identify areas of elevated activity and confirm the correct classification of survey units.

The following preliminary data reviews were performed for each survey unit:

- Calculations of the survey unit mean median, maximum, minimum, and standard deviation for each type of reading.
- Comparison of the actual standard deviation to the assumed standard deviation used for calculating the number of measurements to ensure a sufficient number of samples was obtained.
- Comparison of survey data with applicable investigation levels.
- Review of graphical outputs

### **15.3 Review of Graphical Data**

Graphical data includes 4-Plots of all scan data and color-coded map overlays of surface soil gamma scan data.



#### Building Structural Surfaces

No areas of elevated activity were identified during scan surveys of building concrete pad surfaces. Building structural surfaces 4-Plot graphs are presented in Appendix F.

#### Surface Soils

4-Plot graphs of all gamma scan data are presented in Appendix G. GPS overlay maps are presented in Appendix H. Spatial dependencies are evident in gamma scan results due to variations in the concentrations of naturally-occurring radioactive materials. To demonstrate this, K-40 sample results were placed on the overlay maps and presented in Appendix I. Surface exposure rate variations around the MURR Barn correlate with the locations of trees that were removed (see Figure 15-1 below). Surface exposure rate variations around the incinerator facility correlate with the locations of burial trenches where fill materials with differing concentrations of naturally occurring materials may have been placed.



**Figure 15-1: Historical Photo of MURR Barn**



Outdoor gamma scans and soil sample results confirm that surface soils of outside grounds are not impacted by building operations.

#### 15.4 Structural Surface Data Summary

The final status database reports for building structural surfaces are provided in Appendix J. The final status database reports for building drains are provided in Appendix K.

Static measurement and smear data summaries are presented below. The total activity results had a slight positive bias, likely due to the naturally occurring radioactivity in concrete.

**Table 15-1: Structural Surfaces Total Beta Surface Activity (Static Measurements)**

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 5,000?
		(dpm/100 cm <sup>2</sup> )					
INB-1301	14	1,425	1,111	383	837	1,995	NO
WSB-1301	15	1,592	1,087	325	1,051	2,252	NO

**Table 15-2: Building Structural Surfaces Removable <sup>3</sup>H Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-1301	14	8	6	0	16	NO
WSB-1301	15	11	8	1	33	NO

**Table 15-3: Building Structural Surfaces Removable <sup>14</sup>C Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-1301	14	4	3	0	9	NO
WSB-1301	15	1	4	0	17	NO

**Table 15-4: Building Structural Surfaces Removable Channel 3 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-1301	14	5	5	0	14	NO
WSB-1301	15	2	5	0	17	NO



**Table 15-5: Building Drains Removable  $^3\text{H}$  Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-DR01	2	2	3	0	4	NO
WSB-DR01	2	15	3	13	17	NO

**Table 15-6: Building Drains Removable  $^{14}\text{C}$  Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-DR01	2	3	1	2	3	NO
WSB-DR01	2	1	1	0	1	NO

**Table 15-7: Building Drains Removable Channel 3 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of 200?
		(dpm/100 cm <sup>2</sup> )				
INB-DR01	2	3	4	0	6	NO
WSB-DR01	2	3	4	0	6	NO

### 15.5 Surface Soil Sample Data Summary

Surface soils were sampled to verify non-impacted status. All surface soil sample results were less than MDC except for naturally-occurring radioactive materials and Cs-137. Naturally-occurring radioactivity in the uranium and thorium decay series, and K-40 were detected in concentrations consistent with background levels. Cs-137 was detected in some samples at concentrations consistent with environmental levels from fallout (a very small fraction of the Cs-137 DSV); the highest result was 0.36 pCi/g.

Soil sample analytical reports are presented in Appendix L.

### 15.6 Lagoon Sample Data Summary

Lagoon sludge and soil sample analytical reports are presented in Appendix M and summarized below. Sample location maps are presented in Appendix D.



### 15.6.1 ETL Lagoon (L001)

Samples of the ETL Lagoon (L001) collected in November 2013 had several H-3 results above the MDC, but a small fraction of the H-3 DSV (<4%). All C-14 results were below the MDC, so the lagoon is considered non-impacted for C-14.

Additional sampling was conducted in March of 2014 with the goal of bounding the extent of residual radioactivity. Depth samples were taken at two locations with detectable radioactivity (>MDC) in the soils layer to bound the vertical extent of residual radioactivity. The soils in the lagoon were so hard that refusal of the sampler (to the point of breaking stainless steel sample tube extensions) was reached prior to collecting the desired sample depths. Four judgmental sample locations were added to bound the lateral extent of residual radioactivity.

Analytical results show the highest concentration of H-3 at 3.6 pCi/g, or 3.3% of the H-3 DSV. Depth samples indicate a decreasing trend with depth in the soil layer and additional sample locations indicate that H-3 is detectable to the east shoreline. The table below shows each sample location where a sample result was above the MDC.

**Table 15-8: ETL Lagoon H-3 Sample Results >MDC**

Location	Depth (in.)	H-3 (pCi/g)		DSV Fraction
		Result	MDC	
L001-003	SL (1")	<b>2.19</b>	0.619	2.0%
	0-2	<b>2.14</b>	0.639	1.9%
	2-6	<b>1.48</b>	0.526	1.3%
L001-004	SL (1")	<b>1.85</b>	0.629	1.7%
	0-3	-0.161	<b>0.652</b>	0.4%
L001-007	SL (2")	<b>3.6</b>	0.865	3.3%
	0-3	<b>1.16</b>	0.893	1.1%
	3-6	0.466	<b>0.504</b>	0.4%
L001-008	SL (3")	<b>3.1</b>	0.965	2.8%
	0-3	0.0287	<b>0.956</b>	0.0%
L001-009	SL (2")	-0.365	<b>0.989</b>	-0.3%
	0-3	<b>1.32</b>	0.951	1.2%
L001-J14	SL (6")	0.379	<b>0.536</b>	0.3%
	0-3	<b>0.749</b>	0.529	0.7%
L001-J15	SL (0")	N/A	N/A	N/A
	0-1	<b>0.607</b>	0.531	0.6%
	1-2	0.167	<b>0.482</b>	0.2%
L001-J16	SL (6")	<b>0.817</b>	0.543	0.7%
	0-3	<b>2.14</b>	0.519	1.9%



The table below presents summary statistics for the ETL lagoon sludge and soil samples, including all judgmental samples and all sample depths.

**Table 15-9: ETL Lagoon Sample Results Summary**

Survey Unit	# of Samples	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of MDC?
L001 (H-3)	33	0.6	1.08	-0.0692	3.6	YES

### 15.6.2 Cattle Lagoon (L002)

Samples of the Cattle Lagoon (L002) collected in November 2013 had several C-14 results above the MDC, but a minor fraction of the C-14 DSV. All H-3 results were below the MDC, so the lagoon is considered non-impacted for H-3.

Additional sampling was conducted in March of 2014 with the goal of bounding the extent of residual radioactivity. Depth samples were taken at three locations that had detectable radioactivity (>MDC) in the soils layer to bound the vertical extent of residual radioactivity. Eight judgmental sample locations were added to bound the lateral extent of residual radioactivity. Judgmental samples along the west edge of the lagoon were placed to continue the systematic grid pattern of the original samples, even though the east-west sample spacing was shorter.

Analytical results show the highest concentration of C-14 at 4.43 pCi/g, or 37% of the C-14 DSV. Depth samples bounded the vertical extent of residual radioactivity except for location L002-002 where the deepest result is very low (1.18 pCi/g) with a decreasing trend, and additional sample locations bounded the lateral extent of residual radioactivity. The table below shows each sample location where a sample result was above the MDC.

**Table 15-10: Cattle Lagoon C-14 Sample Results >MDC**

Location	Depth (in.)	C-14 (pCi/g)		DSV Fraction
		Result	MDC	
L002-001	SL (1")	0.494	<b>0.904</b>	4.1%
	0-3	<b>1.29</b>	0.855	10.8%
	3-6	-0.004	<b>0.793</b>	0.0%
L002-002	SL (12")	0.716	<b>0.888</b>	6.0%
	0-3	<b>3.8</b>	0.76	31.7%
	3-6	<b>1.58</b>	0.791	13.1%
	6-9	<b>4.29</b>	1.09	35.8%
	9-12	-0.213	<b>0.889</b>	0.0%
	12-15	<b>1.59</b>	0.841	13.3%



Location	Depth (in.)	C-14 (pCi/g)		DSV Fraction
		Result	MDC	
	15-17	<b>1.18</b>	0.840	9.8%
L002-003	SL (3")	<b>4.43</b>	0.814	36.9%
	0-3	<b>1.76</b>	0.804	14.7%
	3-6	0.139	<b>0.961</b>	0.0%
L002-004	SL (2")	<b>2.74</b>	0.836	22.8%
	0-3	0.46	<b>0.707</b>	3.8%
L002-J13	SL (3")	<b>1.65</b>	0.894	13.8%
	0-3	0	<b>0.894</b>	0.0%

All sample results on the east side of the lagoon are less than MDC. For the purpose of evaluating the residual radioactivity in the lagoon using a dose model, a section of the lagoon was designated as the contaminated zone that includes the west side of the lagoon bounded by sample locations L002-005, -006, -007, and -008. Judgmental locations L002-J16, -J18, -J20, and -J22 are included to continue the systematic grid pattern west of the original samples, therefore, they are included in the summary statistics. All sample results that are not included in the statistical summary had results less than the MDC. Judgmental location J13 with results above the MDC was conservatively included in the data summary.

All sample results were included in the calculation vs. the average of all the samples at a location because this provides the least favorable statistics (higher mean and higher standard deviation). The table below presents summary statistics for the Cattle Lagoon sludge and soil samples in the contaminated zone, including all sample depths.

**Table 15-11: Cattle Lagoon Sample Results Summary**

Survey Unit	# of Samples/ Locations	Mean	Standard Deviation	Min.	Max.	Any Result Exceeding Investigation Level of MDC?
L002 (C-14)	33 / 13	0.77	1.37	-0.986	4.43	YES

### 15.6.3 Swine Lagoon (L003)

All sample results from the Swine Lagoon (L003) were less than the MDC, confirming the non-impacted classification.



### 15.7 Determining Compliance for Building Structural Surfaces

All removable contamination measurements collected during the final status surveys were less than the applicable investigation level and significantly less than the removable DCGL, so compliance is determined based on total activity measurements.

All total surface activity measurements were compared directly to the DCGL and investigation levels to determine if an area required further surveillance. All total surface activity measurement collected at MARSSIM-calculated locations were less than the investigation levels and significantly less than the DCGL.

Because all measurements are less than the DCGL, performance of the Sign test is not necessary. Therefore, the null hypothesis can be rejected and the survey units meet the release criteria and are suitable for release for unrestricted use.

The standard deviation for each survey unit was less than the standard deviation used for preliminary calculation of the minimum number of samples required for the Sign test. Therefore, 11 measurements are required for each survey unit.

The results of the data quality assessment and calculations of the dose from each structural surface survey unit are presented in the table below.

**Table 15-12: Structural Surfaces Total Beta Surface Activity Dose Calculations**

<b>Survey Unit</b>	<b>Standard Deviation (dpm/100 cm<sup>2</sup>)</b>	<b># of Samples</b>	<b>Mean (dpm/100 cm<sup>2</sup>)</b>	<b>Calculated Annual TEDE<sup>4</sup> (mrem/yr)</b>
INB-1301	383	14	1,425	5.0
WSB-1301	325	15	1,592	5.6
			<b>Maximum:</b>	<b>5.6</b>

### 15.8 Mechanical System Survey Data Analysis

Results of drain system removable activity measurements were compared directly with the investigation level and removable DCGL. Direct measurements were not possible due to the small geometry of the drain internals. All removable activity measurements were less than the investigation level and removable DCGL, therefore drains meet the release criterion and are suitable for release.

### 15.9 Determining Compliance for Lagoon Soils and Sludges

For lagoons, compliance with the unrestricted release criteria is demonstrated using a dose model calculated with RESRAD v.6.5 dose modeling software. MARSSIM is only

<sup>4</sup> The TEDE shown is calculated by multiplying 25 mrem/yr by the ratio of the mean total surface activity to the Co-60 DCGL of 7,100 dpm/100cm<sup>2</sup>.



applicable to surface soils and screening is not applicable to sludges, sub surface soils, or soils where surface ponding occurs. However, MARSSIM protocols are used to provide a statistical basis for the sampling protocols used to collect information used to develop the dose model. Even though the lagoons are not suitable for a screening approach, DSVs were conservatively used as limits for lagoon samples. A site-specific dose model was developed for the Cattle Lagoon and the ETL Lagoon to demonstrate that doses from potential future uses are below the unrestricted release criteria.

Three scenarios were developed for modeling:

- **Scenario 1:** The berms are excavated away from the lagoon and graded to match surrounding contours, exposing the contaminated zone as surface soils.
- **Scenario 2:** The berms are collapsed into the lagoon and graded to provide a 1 m thick cover over the contaminated zone.
- **Scenario 3:** The berms are excavated away from the lagoon, and then the contaminated zone is excavated and spread onto the ground surface at a different location (this scenario is bound by Scenario 2 because the contaminated zone would mix with other soils during excavation reducing the concentration of radioactivity).

RESRAD default parameter values were retained, except for contaminated zone geometry. For the Cattle Lagoon, two contaminated zones were input; 1) a contaminated zone that includes results from systematic grid locations in the west side of the lagoon as presented in Table 15-11 (45 m x 92 m x 0.08 m), and 2) a contaminated zone that is bound by samples with results less than MDC, but does not include the results of the bounding samples to calculate the mean soil concentration (30 m x 92 m x 0.15 m). For the ETL Lagoon, only one contaminated zone was input that includes the entire lagoon (46 m x 46 m x 0.15 m). RESRAD inputs and results are summarized in the tables below.

**Table 15-13: Cattle Lagoon Dose Modeling Inputs and Results**

RESRAD 6.5 File	CZ Area (m <sup>2</sup> )	CZ Depth (m)	Cover Depth (m)	Length Parallel to Aquifer (m)	Dose <sup>5</sup> (mrem/yr per pCi/g)	C-14 Concentration (pCi/g)	Annual Dose (mrem)
Sinclair1	4,140	0.08	0	92	0.069	0.77	0.05
Sinclair2	2,760	0.15	0	92	0.074	1.52	0.11
Sinclair3	4,140	0.08	1	92	0.15	0.77	0.12
Sinclair4	2,760	0.15	1	92	0.23	1.52	0.35

<sup>5</sup> The maximum annual dose from RESRAD 6.5 output reports.



Table 15-14: ETL Lagoon Dose Modeling Inputs and Results

RESRAD 6.5 Run	CZ Area (m <sup>2</sup> )	CZ Depth (m)	Cover Depth (m)	Length Parallel to Aquifer (m)	Dose <sup>6</sup> (mrem/yr per pCi/g)	H-3 Concentration (pCi/g)	Annual Dose (mrem)
Sinclair5	2,116	0.15	0	46	0.0023	0.6	0.001
Sinclair6	2,116	0.15	1	46	0.0035	0.6	0.002

Even if the maximum soil result were conservatively used as the average, the maximum calculated annual dose would be approximately 1 mrem/yr which is a small fraction of the unrestricted release criterion of 25 mrem/yr.

The diffusion coefficient  $K_d$  is a very sensitive parameter in the dose model. The RESRAD default diffusion coefficient  $K_d$  is 0 for both C-14 and H-3, which is extremely conservative. To demonstrate the conservatism of the dose model, a  $K_d$  value of 1 cm<sup>3</sup>/g for C-14 was input into the Cattle Lagoon model resulting in the highest dose for each scenario. This value was selected to correspond with the value listed for carbon in clay in the Data Collection Handbook. This caused the calculated dose to be reduced by a factor of five.

The results of dose modeling using these conservative assumptions are a very small fraction of the unrestricted release criterion, such that a more refined model is not necessary to demonstrate compliance. RESRAD output reports are presented in Appendix N.

## 16 CONCLUSION

This report provides data to confirm that surface soils of outside grounds are not impacted by licensed operations and that the remaining structures from the Incinerator Building and Waste Storage Buildings meet the unrestricted release criteria.

Dose modeling conducted using data collected from lagoon sludges and soils indicate that the lagoons are suitable for unrestricted release. Because residual radioactivity is bound to a shallow depth in lagoon soils, groundwater contamination from lagoon soils is not of concern.

<sup>6</sup> The maximum annual dose from RESRAD 6.5 output reports.



## 17 REFERENCES

- NRC Regulations
- The University of Missouri - Columbia US Nuclear Regulatory Commission Broad Scope Type A radioactive materials license No. 24-00513-32
- NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," August 2000
- NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998
- NUREG 1757, Volume 1, Revision 2, "Consolidated NMSS Decommissioning Guidance, Decommissioning Process for Materials Licensees," September, 2006
- NUREG 1757, Volume 2, Revision 1, "Consolidated NMSS Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria," September, 2006
- "Decommissioning Health Physics, A Handbook for MARSSIM Users," Abelquist, 2001
- "Handbook of Health Physics and Radiological Health", 3rd Edition, 1998
- ISO-7503-1, "Evaluation of Surface Contamination – Part 1: Beta Emitters and Alpha Emitters." 1988
- NUREG 1556, Volume 7, Table Q.2, "Acceptable Surface Contamination Levels for Equipment," December 1999
- "University of Missouri – Columbia Sinclair Farm Phase 4 Radiological Survey Plan," October 22, 2013
- Letter from NRC Region III to Susan Langhorst dated August 7, 1997 concurring with the release of the MU Sinclair Farm waste burial site.
- "University of Missouri – Columbia, Sinclair Farm Phase 1 Final Status Report," Chase Environmental, June 2011
- "University of Missouri – Columbia, Sinclair Farm Phase 2 Final Status Report," Chase Environmental, January 2012
- "University of Missouri – Columbia, Sinclair Farm Phase 3 Final Status Report," Chase Environmental, June 2012
- "Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil," Argonne National Laboratory, April 1993



Note: Sinclair Farm buildings shown on this photo have been demolished.



**Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sinclair Farm

Site Map

Page: A.1 of A.1



# SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

SEC Corporate  
2800 Solway Road  
Knoxville, TN 37931



## Model 2241-3 CALIBRATION FORM

Serial number : 253356	Customer Name : Chase
Previous due date : 9/20/2013	P.O Number : 102624
Date : 8/15/2013	Technician : Thomas Thompson
Reason For Calibration : Repair	

INSTRUMENT(S) USED DURING CALIBRATION		
Model Number: 500-2	Serial Number: 190580	Calibration Due date: 1/25/2014
Model Number:	Serial Number:	Calibration Due date:

Instrument Condition	
As Found	As Left
OK	OK

Threshold	
As Found	As Left
9.7	4

Battery Indicator
SAT

Detector #	Set Voltage		High Voltage Range	
	As Found	As Left	As Found	As Left
1	1788	1725	SAT	SAT
2	1839	1850	SAT	SAT
3	1239	1100	SAT	SAT
4	1340	1225	SAT	SAT

SCA/RATE Switch
SAT

Digital Scaler				
Target	As Found	%Error	As Left	%Error
250	250	0.00%	250	0.00%
2,500	2,501	0.04%	2,501	0.04%
25,000	25,015	0.06%	25,015	0.06%
250,000	250,152	0.06%	250,152	0.06%

Reproducibility		
x.1 or x1 Scale		
250	250	250
x1 or x10 Scale		
2500	2500	2500
x10 or x100 Scale		
25K	25K	25K
x100 or x1000 Scale		
250K	250K	250K

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

Married with:	Model: 43-68	Serial Number: PR289219
	Model: 43-37	Serial Number: PR281040
	Model:	Serial Number:
	Model:	Serial Number:

### Comments :

Instrument calibrated per SEC-IS-423.

Det 1 B 43-68 PR239219 Det 2 B 43-37 PR281040 Det 3 A 43-68 PR239219 Det 4 A PR281040

Soldered broken speaker wire.

Date instrument is due for next calibration : 8/15/2014

Performed by : <u>Thomas Thompson</u>	Date: 8-15-13	Reviewed by: <u>Thomas Thompson</u>	Date: 8/16/13
Printed name : Thomas Thompson			



**Calibration Certificate****Calibration Certificate for 43-37, Serial # PR281040, Bar Code # ,Property # Chase50**

Date: 08/15/13

Date Last Cal. Expires: 09/20/14

Technician: Thomas Thompson

Location: 9999,

Reason For Calibration: Short Cycled

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2241-3 SERIAL #: 253356 CAL DUE 08/15/14

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
<b>Efficiencies from last calibration</b>					
Pu-239: 20.88 %	4079-02	Pu-239	29000 dpm	14,700 cpm	3/8/2011
Tc-99: 18.54 %	4072-02	Tc-99	28300 dpm	17,700 cpm	3/8/2011
Th-230: 24.14 %	4071-02	Th-230	40300 dpm	20,500 cpm	3/8/2011
	4076-02	Sr-90	12100 dpm	8,490 cpm	3/8/2011
	DX 295	C-14	67800 dpm	25,920 cpm	5/3/1994
SrY-90: 36.05 %					

**AS FOUND DATA** AS FOUND Instrument Condition: SAT  
Calibration Setpoints

HV (Alpha): 1350 V HV (Beta): 1850 V Threshold: 4 mV

	Alpha	Beta	AF Efficiencies
Back ground:	5 CPM	917 CPM	
Pu-239:	6597 CPM	N/A	22.73%
Tc-99:	N/A	8360 CPM	26.30%
Th-230:	8506 CPM	N/A	21.09%
SrY-90:	N/A	5366 CPM	36.77%

☒ is the As Found Data within 20% of the efficiency from the last cal.?**AS LEFT Instrument Condition: SAT****AS LEFT DATA after repair, HV adjust or Plateau**

HV (Alpha): 1225 V HV (Beta): 1850 V Threshold: 4 mV

	Alpha	Beta	AL Efficiencies
Back ground:	4 CPM	885 CPM	
Pu-239:	6267 CPM	N/A	21.60%
Tc-99:	N/A	8339 CPM	26.34%
Th-230:	7807 CPM	N/A	19.36%
SrY-90:	N/A	5665 CPM	39.50%

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: C-14 9122 9114 9333 Average: 9189.7 ☒ Are the Individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Pu-239

Response Background

HV (Alpha)	CPM A ch.	CPM B ch.	Net Eff.
1200	5835	4	20.11%
1225	6320	7	21.77%
1250	6439	6	22.18%
1275	6351	4	21.89%

**PLATEAU DATA**

Beta Source: Tc-99

Response Background

HV (Beta)	CPM B ch.	CPM B ch.	Net Eff.
1750	6951	809	21.70%
1775	7868	946	24.46%
1800	8208	866	25.94%
1825	8557	1074	26.44%
1850	8781	1121	27.07%
1875	8607	1043	26.73%

**2 Pi Efficiencies:**Pu-239  
42.61%Tc-99  
42.11%Th-230  
38.06%SrY-90  
56.30%**Comments:** Married as a set with: Model: 2241-3 Serial #: 253356 Bar Code #:

Calibrated with 10' cable

☒ Does Instrument Meet Final Acceptance Criteria?☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

08/15/14

Performed by:

Reviewed by:

Date:

8/16/13





# SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

## C-14 SOURCE CALIBRATION FORM

Probe Model Number : 44-37  
Probe Serial Number : PR281040  
Date of Calibration : 8/15/2013

Customer Name : Chase Environmental  
Technician : Thomas Thompspon

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	253356
Model Number:		Serial Number:	
		Calibration Due Date:	8/15/2014
		Calibration Due Date:	

NIST Traceable Source(s) used :

Activity(s)

Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> G-14 DX-295	432	25,920	0.0305405	67,800	5/3/1994

### Data

Instrument condition : Sat  
High Voltage: 1850

Background: 885

C-14 Count: 9189.7

2 $\pi$  Efficiency: 32.04%

4 $\pi$  Efficiency: 12.25%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253356

Date instrument is due for next calibration : 8/15/2014  
Performed by : Thomas Thompspon Reviewed by : Thomas Thompspon Date : 12/26/13  
Printed Name : Thomas Thompspon  
Entered in computer inventory by : Thomas Thompspon Date : 12/26/13





# Safety and Ecology Corporation

SEC PROCEDURE # SEC-IS-403 Rev 3

2800 Solway Road, Knoxville, TN 37931

## Calibration Certificate

Page 1 of 1

6/28/2013

Calibration Certificate for 2221, Serial # 147481, Bar Code #, Property # Chase19

Date: 06/28/13

Date Last Cal. Expires: 04/16/14

Technician: Thomas Thompson

Location: 9999,

Reason For Calibration: Short Cycled

### EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2

SERIAL #: 190580

CAL DUE: 07/28/13

MODEL:

SERIAL #:

CAL DUE:

### AS FOUND DATA

Geotropism: SAT

AS FOUND Instrument Condition: SAT

AS LEFT Instrument Condition: SAT

#### HIGH VOLTAGE

AS FOUND HV

AS LEFT HV

☒ New Batteries?

AF Mechanical Zero: 0

(+/- 10% tolerance)

500 V:

502 V

AF V

Threshold ratio: 100-10mV

AL Mechanical Zero: 0

1000 V:

999 V

AF V

AF THRESHOLD: 10.2 mV

AF HV Reading: 1001 V

1500 V:

1494 V

AF V

AL THRESHOLD: 10 mV

AL HV Reading: 1000 V

### RATE METER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	0	100.00%	100	0.00%
	250	0	100.00%	250	0.00%
	400	0	100.00%	400	0.00%
x1 or x10	1000	0	100.00%	1000	0.00%
	2500	0	100.00%	2500	0.00%
	4000	0	100.00%	4000	0.00%
x10 or x100	10K	0	100.00%	10	0.00%
	25K	0	100.00%	25	0.00%
	40K	0	100.00%	40	0.00%
x100 or x1000	100K	0	100.00%	100	0.00%
	250K	0	100.00%	250	0.00%
	400K	0	100.00%	400	0.00%

☐ Is the As Found Data Within 20% of the Set Point?

### DIGITAL SCALER

AF 250:	250	% ERR: 0.00%	AL 250:	AF	% ERR: 0.00%
AF 2500:	2497	% ERR: 0.12%	AL 2500:	AF	% ERR: 0.12%
AF 25K:	24.97 K	% ERR: 0.12%	AL 25K:	AF K	% ERR: 0.12%
AF 250K:	249.6 K	% ERR: 0.16%	AL 250K:	AF K	% ERR: 0.16%

☒ Is the As Found Data Within 20% of the Set Point?

### LOG SCALE

AF 200:	0	% ERR: #####	AL 200:	200	% ERR: 0.00%
AF 2000:	0	% ERR: #####	AL 2000:	2000	% ERR: 0.00%
AF 20K:	0 K	% ERR: #####	AL 20K:	20 K	% ERR: 0.00%
AF 200K:	0 K	% ERR: #####	AL 200K:	200 K	% ERR: 0.00%

☐ Is the As Found Data Within 20% of the Set Point?

### REPRODUCIBILITY

x.1 or x1 Scale:	250	250	250
x1 or x10 Scale:	2500	2500	2500
x10 or x100 Scale:	.25 K	25 K	25 K
x100 or x1000 Scale:	250 K	250 K	250 K

☒ Are the Individual Counts Within 10% of the Average?☒ Fast / Slow Response Function Properly?

Audio Response: SAT

Audio Divide: SAT

Push Buttons: SAT

Lamp: SAT

Scaler/Digital: SAT

Comments: Married as a set with:

Model: 44-10

Serial #: PR181831

Bar Code #:

Calibrated with window OUT. Calibrated with 5' cable. Replaced meter movement.

☒ Does Instrument Meet Final Acceptance Criteria?☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

06/28/14

Performed by:

Printed Name:

Thomas Thompson

Reviewed by:

Date:

7/2/13





**Safety and Ecology Corporation** SEC PROCEDURE # SEC-IS-415 Rev 3  
2800 Solway Road, Knoxville, TN 37931  
**Calibration Certificate**

Page 1 of 1

6/28/2013

**Calibration Certificate for 44-10, Serial # PR181831, Bar Code #, Property # Chase18**

Date: 06/28/13  
Location: 9999,

Date Last Cal. Expires: 04/18/14

Technician: Thomas Thompson  
Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

MODEL: 2221 SERIAL #: 147481 CAL DUE: 06/28/14  
MODEL: SERIAL #: CAL DUE:

**NIST TRACEABLE SOURCES USED**

SOURCE	ISOTOPE	ACTIVITY	2 $\pi$	ASSAY DATE
99-0292	Cs-137	7.03 uCi		1/30/2012

Efficiency from Last Calibration: 0.68% HV From Last Calibration: 1000 V Calibration Threshold: 10 mV

**AS FOUND DATA**

AS FOUND Instrument Condition: SAT

HV: 1000 V

Center: 108047

Background: 4542

Probe Efficiency: Cs-137 0.66%

**1 MINUTE COUNTS (CPM)**

**AS LEFT DATA after repair of HV adjust**

AS LEFT Instrument Condition: SAT

HV: 1000 V

Center: 107775

Background: 4375

Probe Efficiency: Cs-137 0.66%

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

☒ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Cs-137 108412 108730 108325 Average: 108489 ☒ Are the Individual counts within 10% of the average?

AS Found Efficiency is within 10% of the last calibration and uniformity is 10%. The efficiency may be used for the Plateau Data and proceed to Counting Geometry. No probes are to be used from source. All other probes are in contact with surface unless otherwise specified.

**PLATEAU AND SET POINT DATA (CPM)**

High Voltage	Source Response	Background	HV	CENTER	Background	Efficiency
950	104975	4334	1000 V	108383	4414	Cs-137 0.67%
975	106687	4377				
1000	108892	4317				
1025	108383	4299				
1050	108861	4331				
1075	109346	4428				
1100	110183	4577				
1125	109267	4458				
1150	109941	4560				

**Comments:** Married as a set with: Model: 2221 Serial #: 147481 Bar Code #:  
Calibrated with 5' cable. Calculated efficiencies with window OUT.

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

06/28/14

Performed by:

Reviewed by:

Date: 7/2/13

Printed Name: Thomas Thompson





Safety and Ecology Corporation  
2800 Solway Road, Knoxville, TN 37931

SEC PROCEDURE # SEC-IS-422 Rev 2

Page 1 of 1

### Calibration Certificate

4/22/2013

Calibration Certificate for 2241, Serial # 196627, Bar Code #, Property # Chase23

Date: 04/22/13

Date Last Cal. Expires: 06/26/13

Technician: Jeffrey Knight

Location: 102624,

Reason For Calibration: Due for Calibration

#### EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2

SERIAL #: 132896

CAL. DUE: 07/28/13

MODEL:

SERIAL #:

CAL DUE:

#### AS FOUND DATA

AS FOUND Instrument Condition: SAT

AS LEFT Instrument Condition: SAT

☐ New Batteries?

Battery Check: SAT

High Voltage (+/- 10% tolerance)	AS FOUND High Voltage	AS LEFT High Voltage
500 V:	500	AF
1000 V:	1000	AF
1500 V:	1500	AF

AS FOUND HV Setting: 937 V

AS LEFT HV Setting: 1150 V

AS FOUND THRESHOLD: 9.8 mV

AS LEFT THRESHOLD: 10.0 mV

#### REPRODUCIBILITY

x.1 or x1 Scale:	250	250	250
x1 or x10 Scale:	2500	2500	2500
x10 or x100 Scale:	25 K	25 K	25 K
x100 or x1000 Scale:	250 K	250 K	250 K

☒ Are the Individual Counts Within 10% of the Average?

☒ Fast / Slow Response Switch Functions Properly?

Audio Response: SAT

#### DIGITAL SCALER

AF 250: 250	% ERR: 0.00%	AL 250: AF	% ERR: 0.00%
AF 2500: 2504	% ERR: 0.16%	AL 2500: AF	% ERR: 0.16%
AF 25K: 25.07 K	% ERR: 0.28%	AL 25K: AF K	% ERR: 0.28%
AF 250K: 250.8 K	% ERR: 0.32%	AL 250K: AF K	% ERR: 0.32%

☒ Is the As Found Data Within 20% of the Set Point?

Push Buttons: SAT

Lamp: SAT

Audio/Divide: SAT

Comments: Married as a set with:

Model: 44-10.

Serial #: PR202100

Bar Code #:

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

04/22/14

Performed by:   
Printed Name: Jeffrey Knight

Reviewed by:

Date: 4/24/13





**Safety and Ecology Corporation**  
2800 Solway Road, Knoxville, TN 37931  
**Calibration Certificate**

SEC PROCEDURE # SEC-IS-415 Rev 3

Page 1 of 1

4/22/2013

**Calibration Certificate for 44-10, Serial # PR202100, Bar Code # ,Property # Chase24**

Date: 04/22/13

Date Last Cal. Expires: 06/26/13

Technician: Jeffrey Knight

Location: 102624,

Reason For Calibration: Due for Calibration

**EQUIPMENT USED DURING CALIBRATION**

MODEL: 2241 SERIAL #: 196627 CAL DUE: 04/22/14  
MODEL: SERIAL #: CAL DUE:

**NIST TRACEABLE SOURCES USED**

SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
99-0292	Cs-137	7.03 uCi		1/30/2012

Efficiency from Last Calibration: 0.63% HV From Last Calibration: 950 V Calibration Threshold: 10 mV

**AS FOUND DATA**

AS FOUND Instrument Condition: SAT

HV: 950 V

Center: 0

Background: 0

Probe Efficiency: Cs-137 0.60%

**1 MINUTE COUNTS (CPM)**

**AS LEFT DATA after repair of HV adjust**

AS LEFT Instrument Condition: SAT

HV: AF V

Center:

Background:

Probe Efficiency: Cs-137

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

☐ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Cs-137 98312 97024 98438 Average: 97925 ☒ Are the individual counts within 10% of the average?

If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments (Geometry - Nal probes are 43123 from sources. All other probes are in contact with source unless otherwise specified)

**PLATEAU AND SET POINT DATA (CPM)**

High Voltage	Source Response	Background	HV	CENTER	Background	Efficiency
950	75903	1397	1150 V	97542	3550	Cs-137 0.60%
975	84912	1898				
1000	88352	2105				
1025	91469	2561				
1050	94324	2857				
1100	100081	3235				
1150	107504	3713				
1200	108359	3650				

**Comments:** Married as a set with: Model: 2241

Serial #: 196627

Bar Code #:

AF: No response - replaced PMT (used).

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument Is Due For Next Calibration:

04/22/14

Performed by:

Reviewed by:

Date: 4/24/13

Printed Name: Jeffrey Knight





Calibration Certificate for 44-10, Serial # PR202100, Bar Code #, Property # Chase24

Date: 12/10/13  
Location: 9999,

Date Last Cal. Expires: 04/22/14

Technician: Thomas Thompson  
Reason For Calibration: Other (See Comments)

EQUIPMENT USED DURING CALIBRATION

MODEL: 2221 SERIAL #: 147481 CAL DUE: 06/28/14  
MODEL: SERIAL #: CAL DUE:

NIST TRACEABLE SOURCES USED

SOURCE	ISOTOPE	ACTIVITY	2 $\pi$	ASSAY DATE
99-0292	Cs-137	7.03 uCi		1/30/2012

Efficiency from Last Calibration: 0.60 % HV From Last Calibration: 1150 V Calibration Threshold: 10 mV

AS FOUND DATA

AS FOUND Instrument Condition: SAT  
HV: 1150 V  
Center: 93925  
Background: 4102  
Probe Efficiency: Cs-137 0.58%

1 MINUTE COUNTS (CPM)

AS LEFT DATA after repair of HV adjust

AS LEFT Instrument Condition: SAT  
HV: AF V  
Center:  
Background:  
Probe Efficiency: Cs-137

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

☒ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Cs-137 93653 94224 94070 Average: 93982 ☒ Are the individual counts within 10% of the average?

\* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified.

PLATEAU AND SET POINT DATA (CPM)

High Voltage	Source Response	Background	HV	CENTER	Background	Efficiency
N/A			V			Cs-137

Comments: Married as a set with: Model: 2221 Serial #: 147481 Bar Code #:  
As found efficiencies are within 5% of previous calibration with 2241 196627.

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

12/10/14

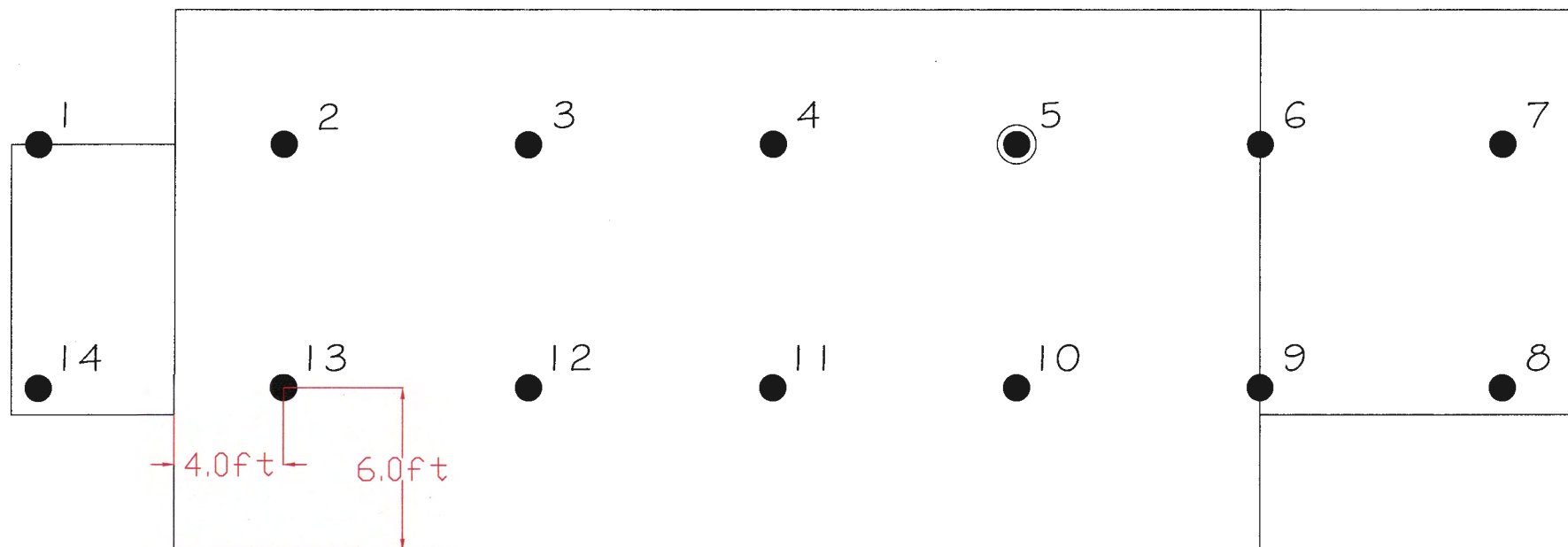
Performed by:


Reviewed by:

Date: 12/11/13

Printed Name: Thomas Thompson





 Random Start Location  
 Spacing = 9ft



**Mizzou**  
 University of Missouri - Columbia

Missouri University  
 Sinclair Farm Phase 4  
 Final Status Report

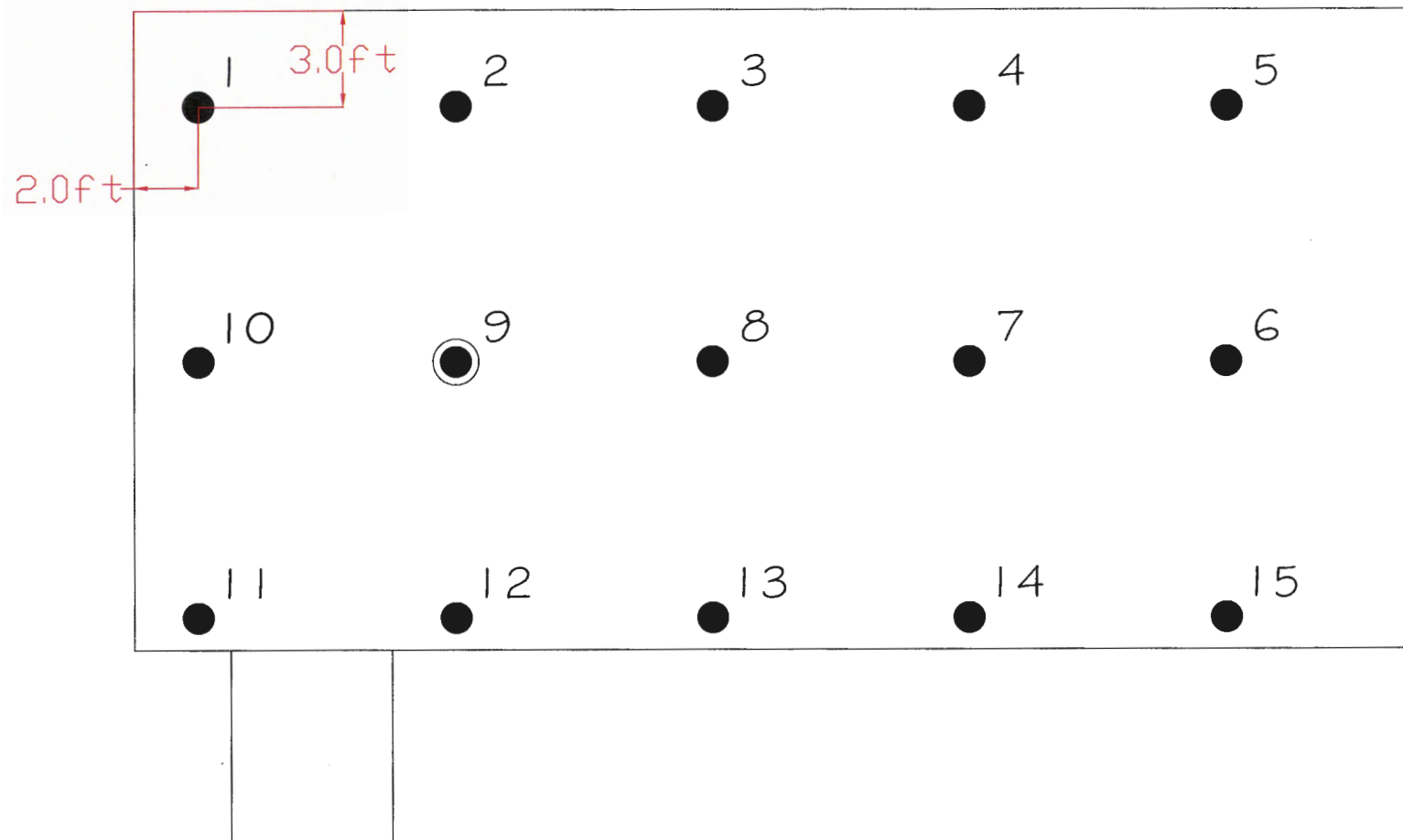



Building: INB

Survey Unit: 1301

Page: C.1 of C.2





 Random Start Location  
 Spacing = 8ft



**Mizzou**  
 University of Missouri - Columbia

Missouri University  
 Sinclair Farm Phase 4  
 Final Status Report



Building: WSB

Survey Unit: 1301

Page: C.2 of C.2





**Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report

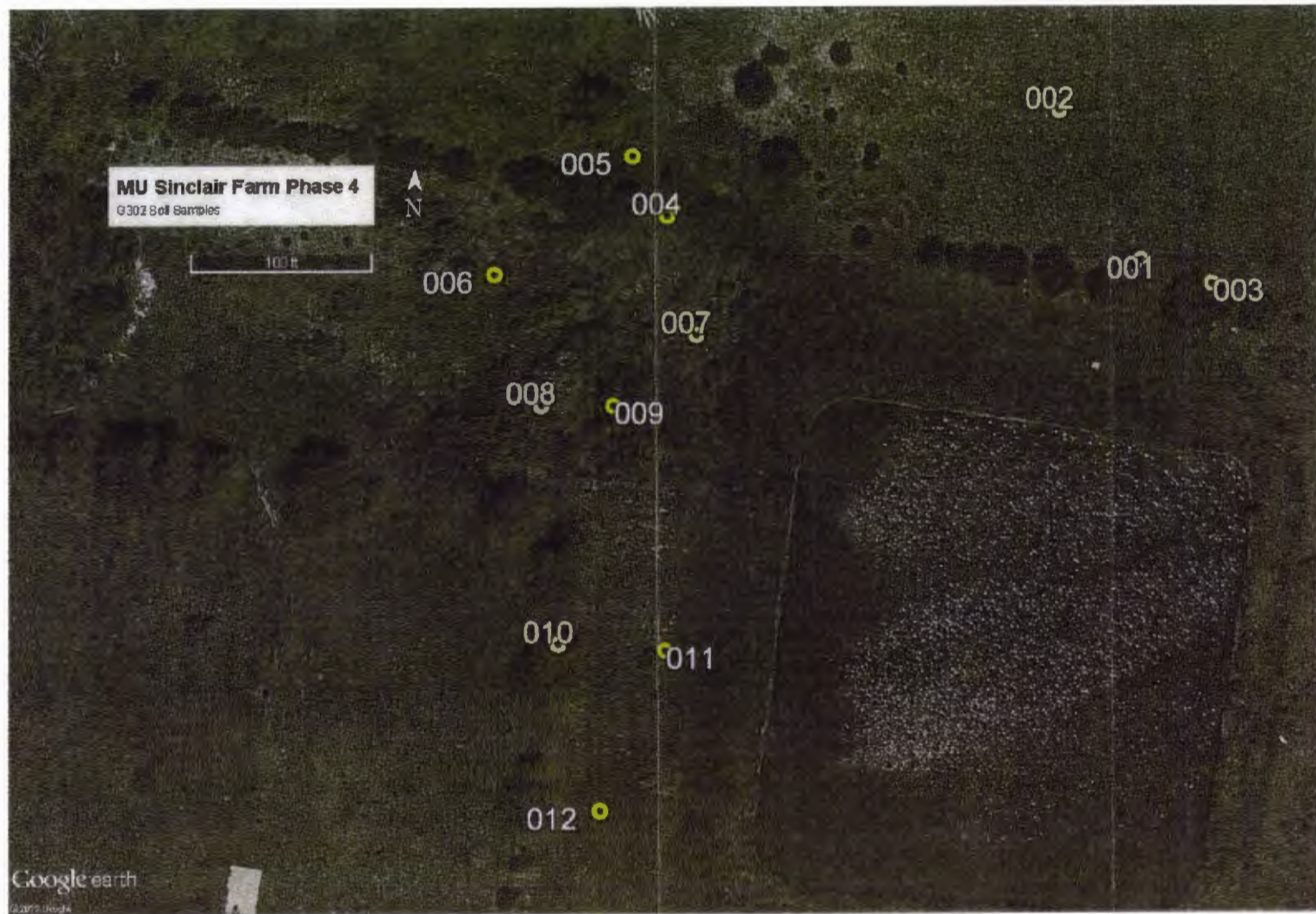


Sample Locations

Survey Unit: G301

Page: D.1 of D.7





**MU Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sample Locations

Survey Unit: G302

Page: D.2 of D.7





**MU Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sample Locations

Survey Unit: G303

Page: D.3 of D.7





**Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report

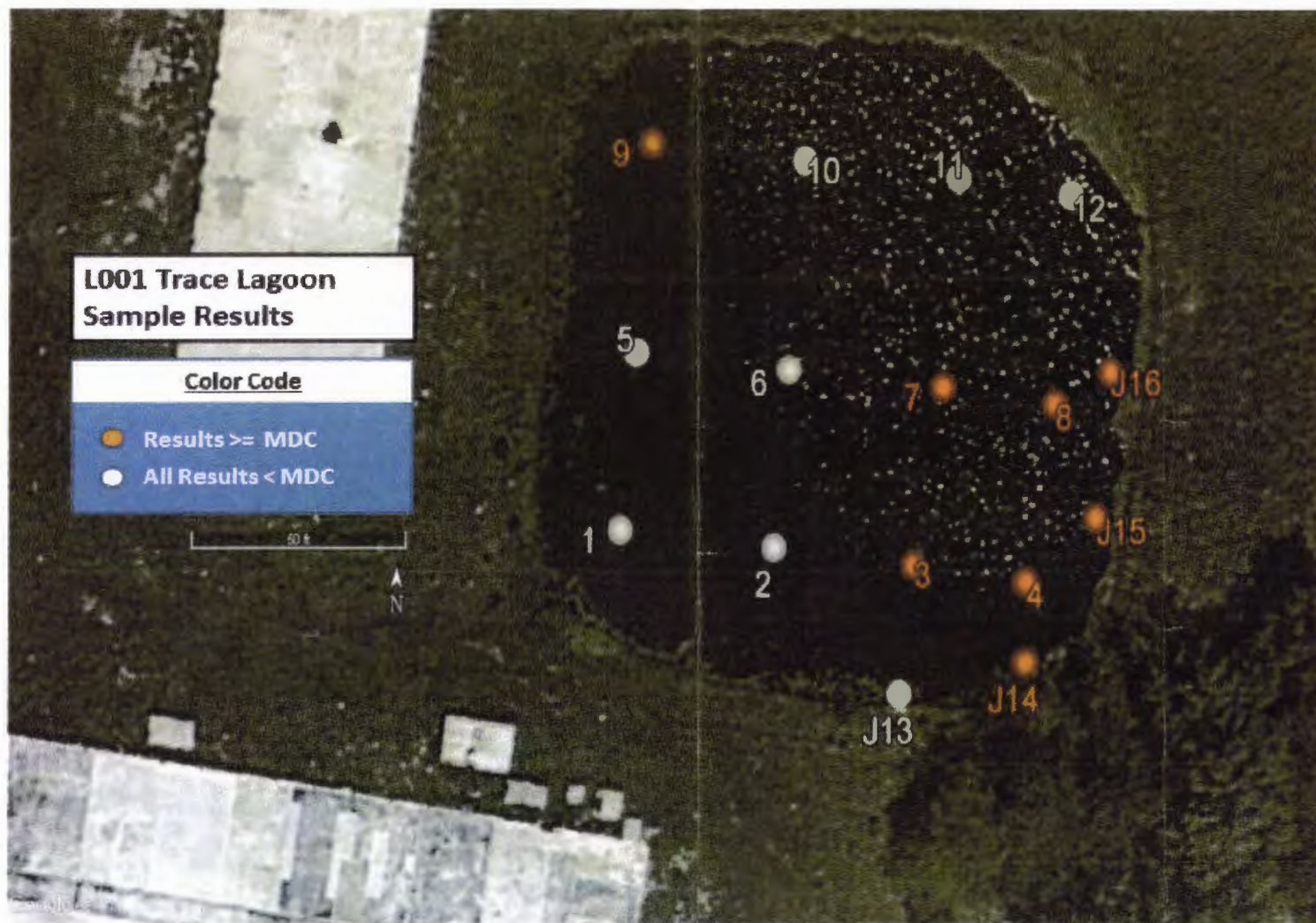


Sample Locations

Survey Unit: G304

Page: D.4 of D.7





**Mizzou**  
University of Missouri • Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sample Locations

Survey Unit: L001

Page: D.5 of D.7



# **L002 Cattle Lagoon Sample Results**

## **Color Code**

- Results  $\geq$  MDC
- All Results  $<$  MDC



**Mizzou**  
University of Missouri • Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sample Locations

Survey Unit: L002

Page: D.6 of D.7



# **L003 Swine Lagoon Sample Results**

## **Color Code**

- Results  $\geq$  MDC
- All Results  $<$  MDC



Google earth  
12/14/2009



**Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report



Sample Locations

Survey Unit: L003

Page: D.7 of D.7



## APPENDIX E, SOIL SAMPLE GPS CORDINATES

**Table E.1: G301 Soil Sample Locations**

<b>Sample #</b>	<b>Location (UTM - 15S)</b>
G301-001	554387 m E , 4304609 m N
G301-002	554390 m E , 4304633 m N
G301-003	554387 m E , 4304643 m N
G301-004	554392 m E , 4304661 m N
G301-005	554387 m E , 4304666 m N
G301-006	554396 m E , 4304665 m N
G301-007	554390 m E , 4304647 m N
G301-008	554405 m E , 4304648 m N
G301-009	554408 m E , 4304637 m N
G301-010	554403 m E , 4304628 m N
G301-011	554407 m E , 4304623 m N
G301-012	554396 m E , 4304607 m N

**Table E.2: G302 Soil Sample Locations**

<b>Sample #</b>	<b>Location (UTM - 15S)</b>
G302-001	554055 m E , 4304645 m N
G302-002	554041 m E , 4304670 m N
G302-003	554067 m E , 4304641 m N
G302-004	553975 m E , 4304652 m N
G302-005	553969 m E , 4304662 m N
G302-006	553946 m E , 4304642 m N
G302-007	553980 m E , 4304632 m N
G302-008	553954 m E , 4304620 m N
G302-009	553966 m E , 4304620 m N
G302-010	553957 m E , 4304580 m N
G302-011	553975 m E , 4304579 m N
G302-012	553964 m E , 4304552 m N



**Table E.3: G303 Soil Sample Locations**

<b>Sample #</b>	<b>Location (UTM - 15S)</b>
G303-001	553657 m E , 4304328 m N
G303-002	553771 m E , 4304376 m N
G303-003	553833 m E , 4304416 m N
G303-004	553865 m E , 4304497 m N
G303-005	553884 m E , 4304523 m N
G303-006	553964 m E , 4304512 m N
G303-007	554003 m E , 4304509 m N
G303-008	554053 m E , 4304503 m N
G303-009	554148 m E , 4304492 m N
G303-010	554189 m E , 4304501 m N
G303-011	554176 m E , 4304505 m N
G303-012	554185 m E , 4304487 m N

**Table E.4: G304 Soil Sample Locations**

<b>Sample #</b>	<b>Location (UTM - 15S)</b>
G304-001	553615 m E , 4304317 m N
G304-002	553624 m E , 4304320 m N
G304-003	553634 m E , 4304323 m N
G304-004	553612 m E , 4304326 m N
G304-005	553621 m E , 4304329 m N
G304-006	553631 m E , 4304333 m N
G304-007	553609 m E , 4304336 m N
G304-008	553618 m E , 4304339 m N
G304-009	553627 m E , 4304342 m N
G304-010	553605 m E , 4304345 m N
G304-011	553615 m E , 4304348 m N
G304-012	553624 m E , 4304351 m N



**Table E.5: Environmental Trace Lagoon Sample Locations**

<b>Sample #</b>	<b>Location (UTM - 15S)</b>	<b>Water Depth (ft)</b>	<b>Sludge Thickness (in)</b>
L001-001	554517 m E, 4304889 m N	4.0	1
L001-002	554528 m E, 4304888 m N	4.5	1
L001-003	554537 m E, 4304887 m N	4.0	6
L001-004	554546 m E, 4304886 m N	1.0	1
L001-005	554518 m E, 4304900 m N	6.5	2
L001-006	554529 m E, 4304899 m N	6.0	1
L001-007	554540 m E, 4304898 m N	3.0	3
L001-008	554548 m E, 4304897 m N	3.0	3
L001-009	554519 m E, 4304913 m N	6.5	2
L001-010	554530 m E, 4304912 m N	6.0	1
L001-011	554541 m E, 4304911 m N	6.0	2
L001-012	554549 m E, 4304910 m N	2.0	1
L001-J13	554537 m E, 4304879 m N	1.0	6
L001-J14	554546 m E, 4304881 m N	1.0	6
L001-J15	554551 m E, 4304890 m N	1.0	0
L001-J16	554552 m E, 4304899 m N	1.0	6



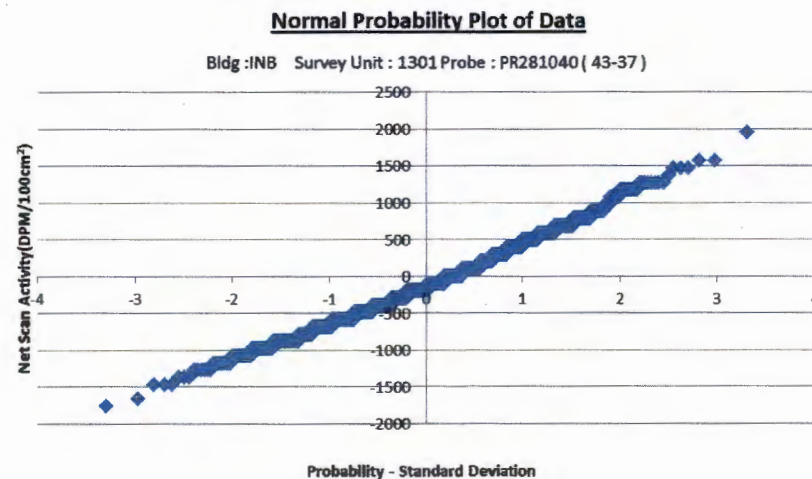
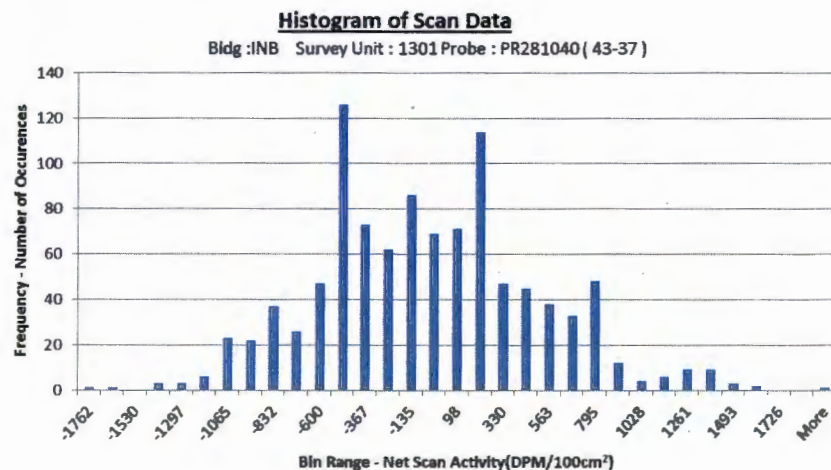
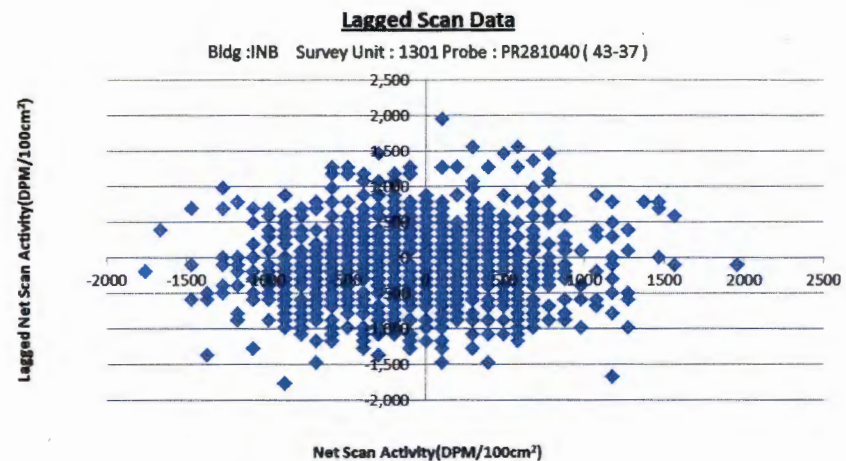
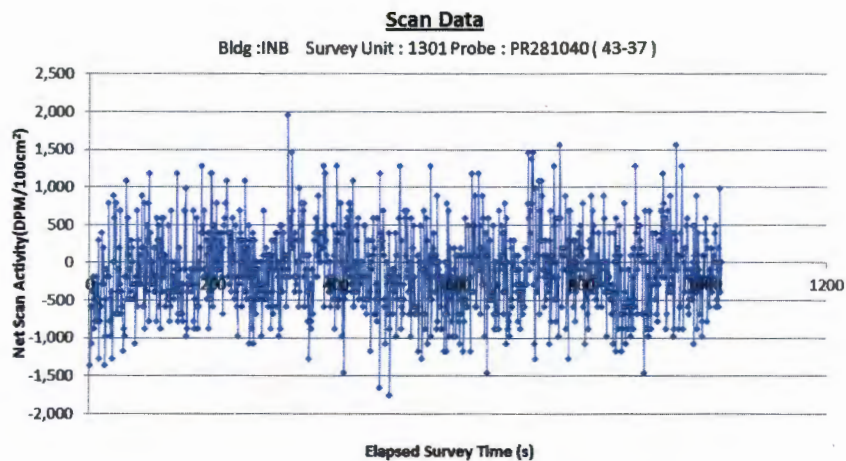
**Table E.6: Cattle Lagoon Sample Locations**

Sample #	Location (UTM - 15S)	Water Depth (ft)	Sludge Thickness (in)
L002-001	554017 m E, 4304614 m N	3.0	1
L002-002	554016 m E, 4304594 m N	6.0	12
L002-003	554013 m E, 4304570 m N	6.5	3
L002-004	554009 m E, 4304548 m N	6.5	2
L002-005	554041 m E, 4304610 m N	2.0	6
L002-006	554038 m E, 4304590 m N	6.0	1
L002-007	554035 m E, 4304567 m N	5.5	6
L002-008	554033 m E, 4304545 m N	6.0	2
L002-009	554063 m E, 4304606 m N	2.0	1
L002-010	554060 m E, 4304587 m N	6.0	4
L002-011	554058 m E, 4304564 m N	6.0	4
L002-012	554056 m E, 4304542 m N	6.5	2
L002-J13	554022 m E, 4304562 m N	6.0	3
L002-J14	554063 m E, 4304571 m N	6.0	4
L002-J15	554061 m E, 4304547 m N	6.0	12
L002-J16	554000 m E, 4304616 m N	0.5	1
L002-J17	554006 m E, 4304602 m N	6.0	2
L002-J18	553996 m E, 4304591 m N	0.5	1
L002-J19	554003 m E, 4304578 m N	6.0	3
L002-J20	553995 m E, 4304566 m N	0.5	1
L002-J21	554001 m E, 4304556 m N	6.0	3
L002-J22	553992 m E, 4304545 m N	0.5	2
L002-J23	554005 m E, 4304539 m N	0.5	1

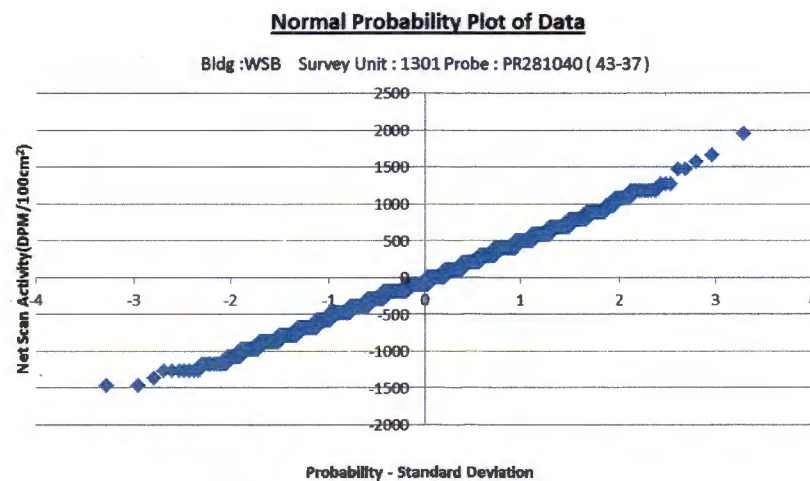
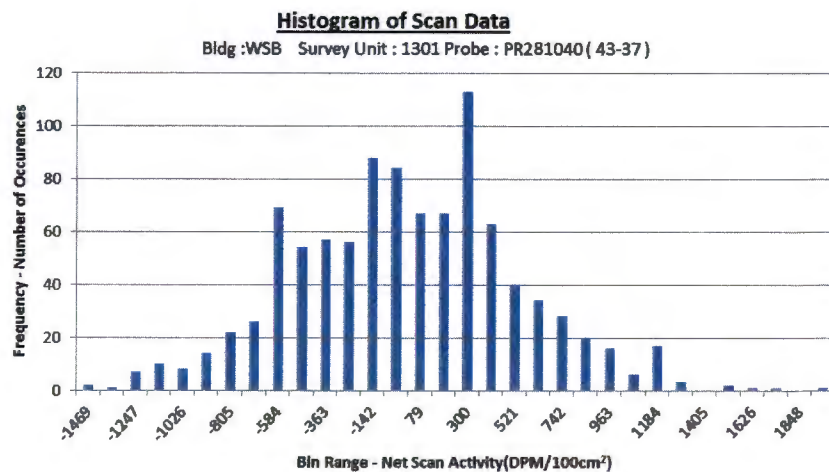
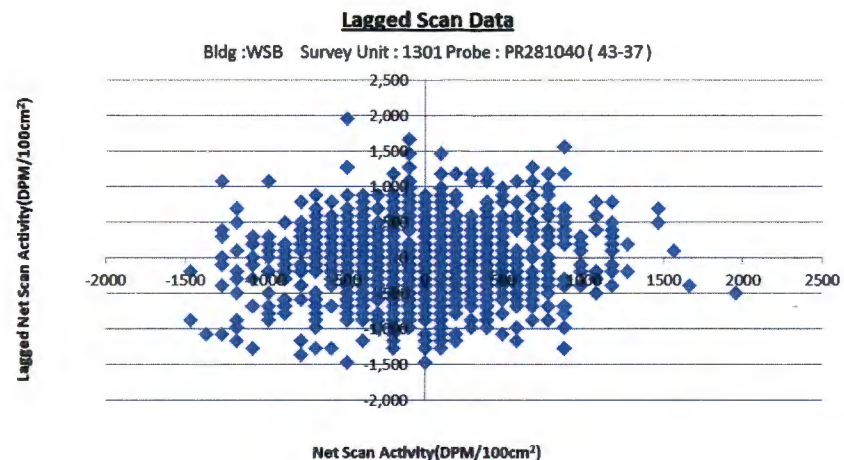
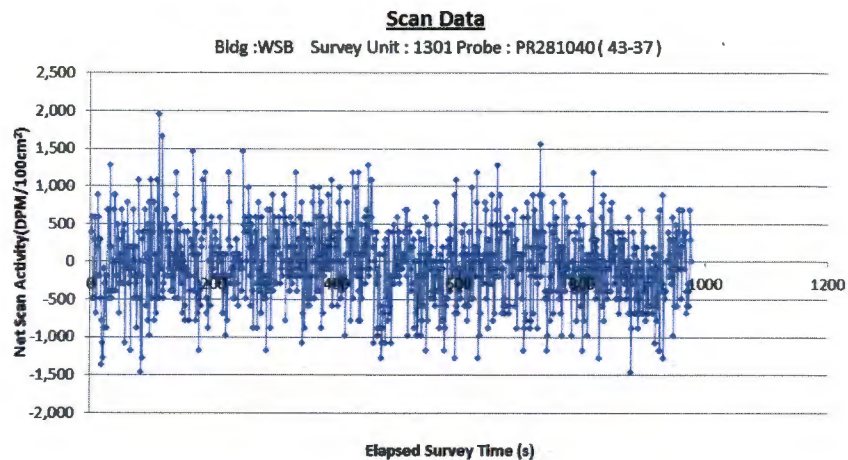
**Table E.7: Swine Lagoon Sample Locations**

Sample #	Location (UTM - 15S)	Water Depth (ft)	Sludge Thickness (in)
L003-001	554136 m E, 4304436 m N	2.0	18
L003-002	554093 m E, 4304454 m N	1.0	2
L003-003	554076 m E, 4304424 m N	5.0	14











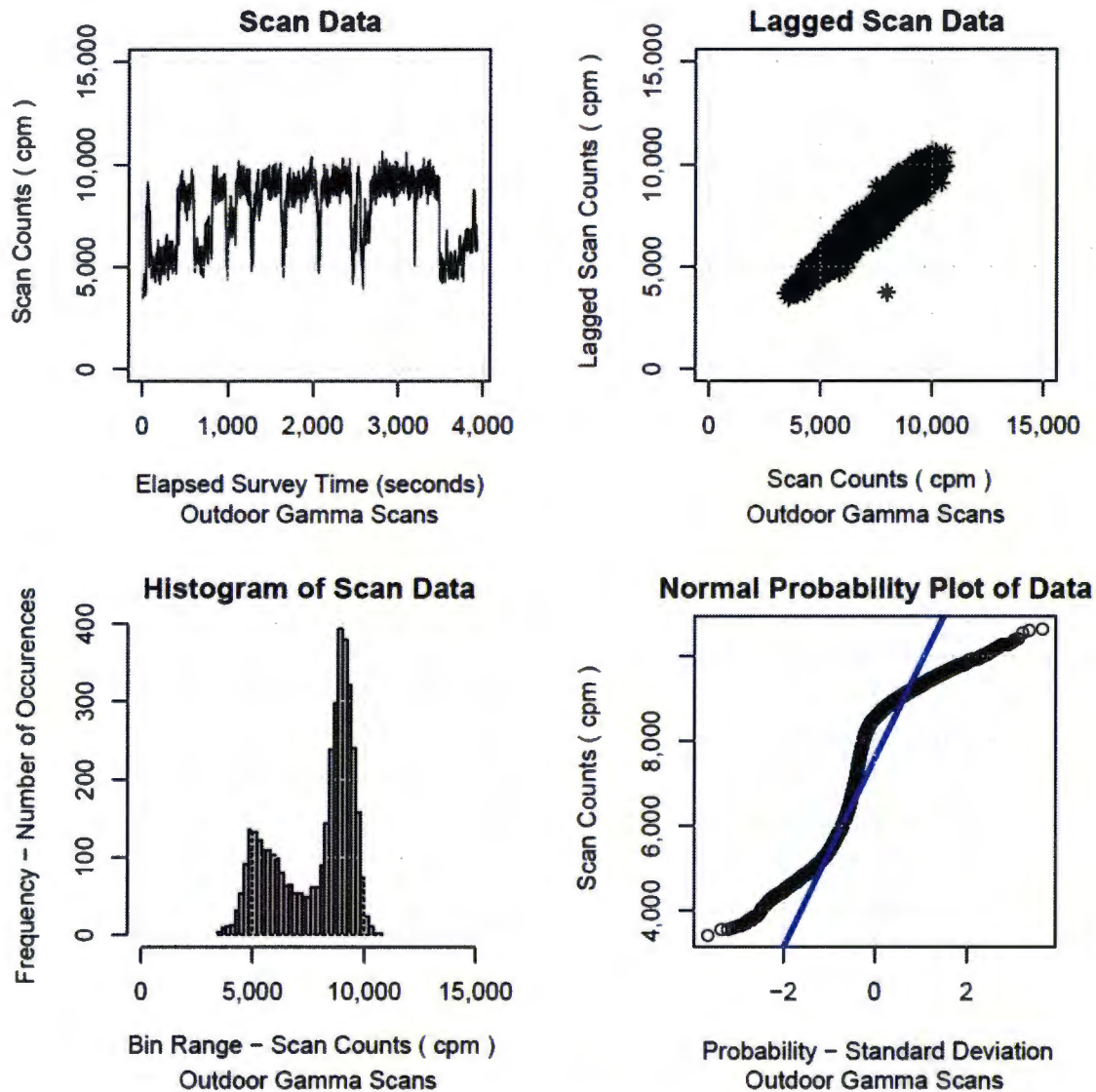


Figure 1: Survey Unit G301 Gamma Scan 4-Plot



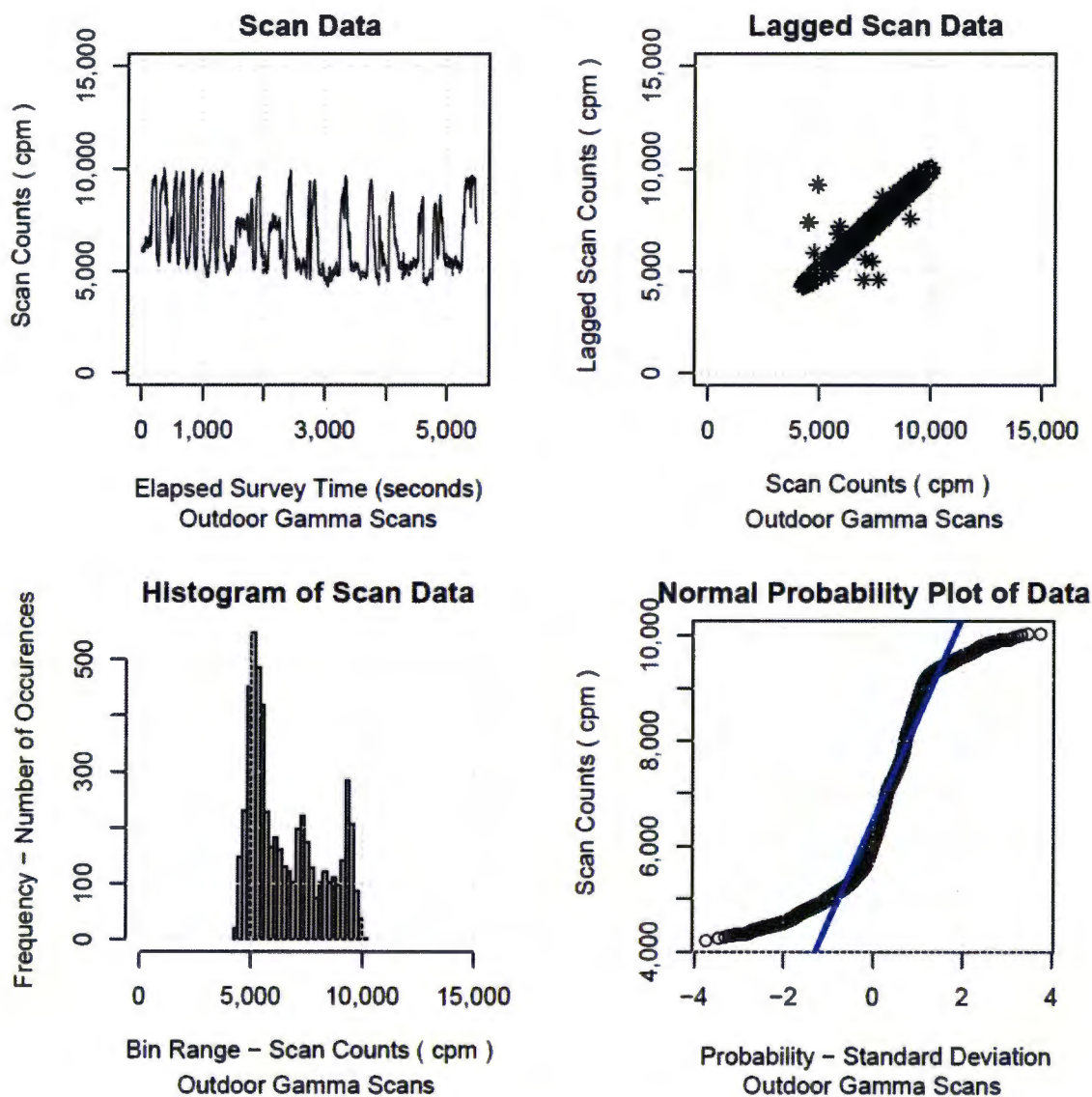
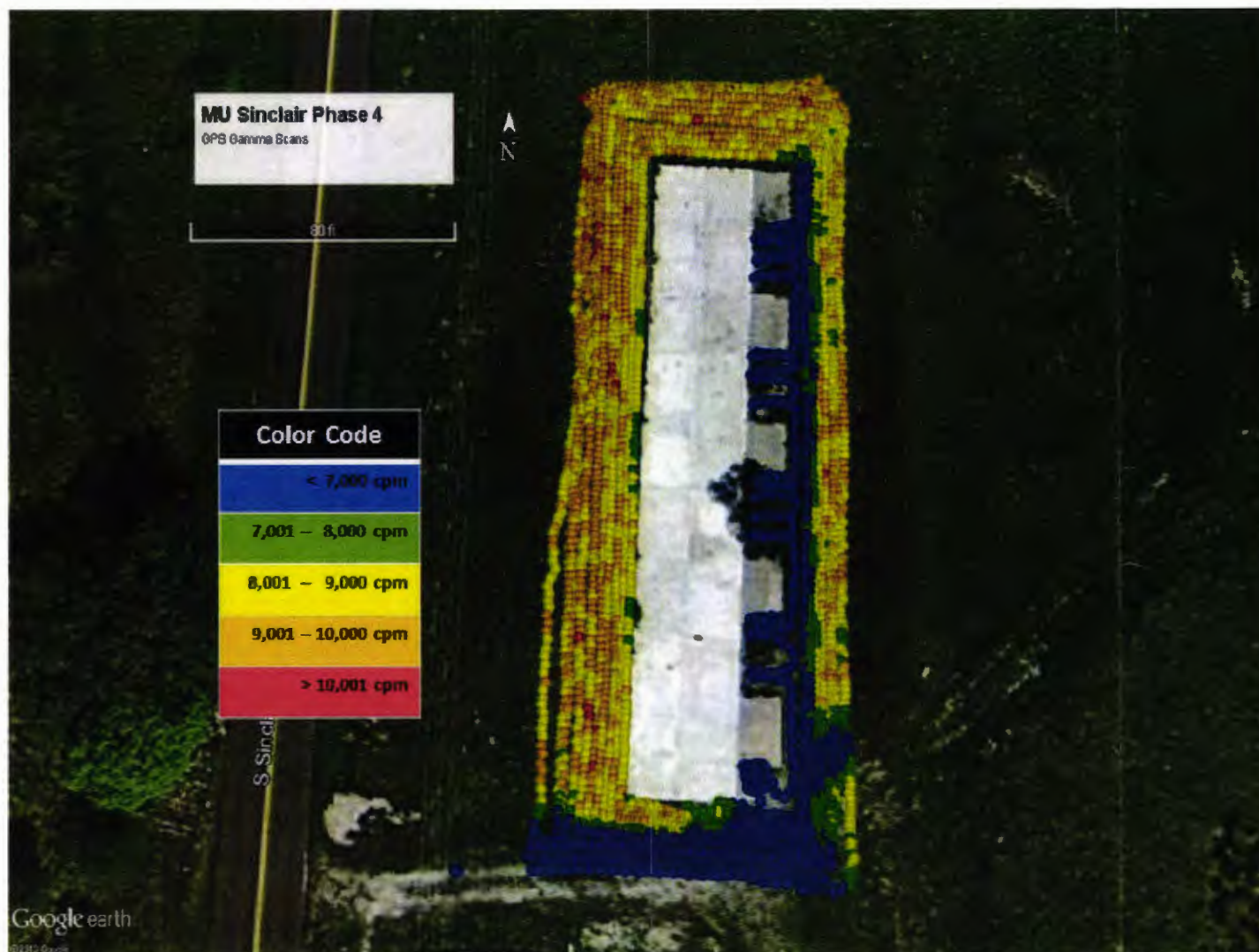


Figure 2: Survey Unit G304 Gamma Scan 4-Plot





**Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report

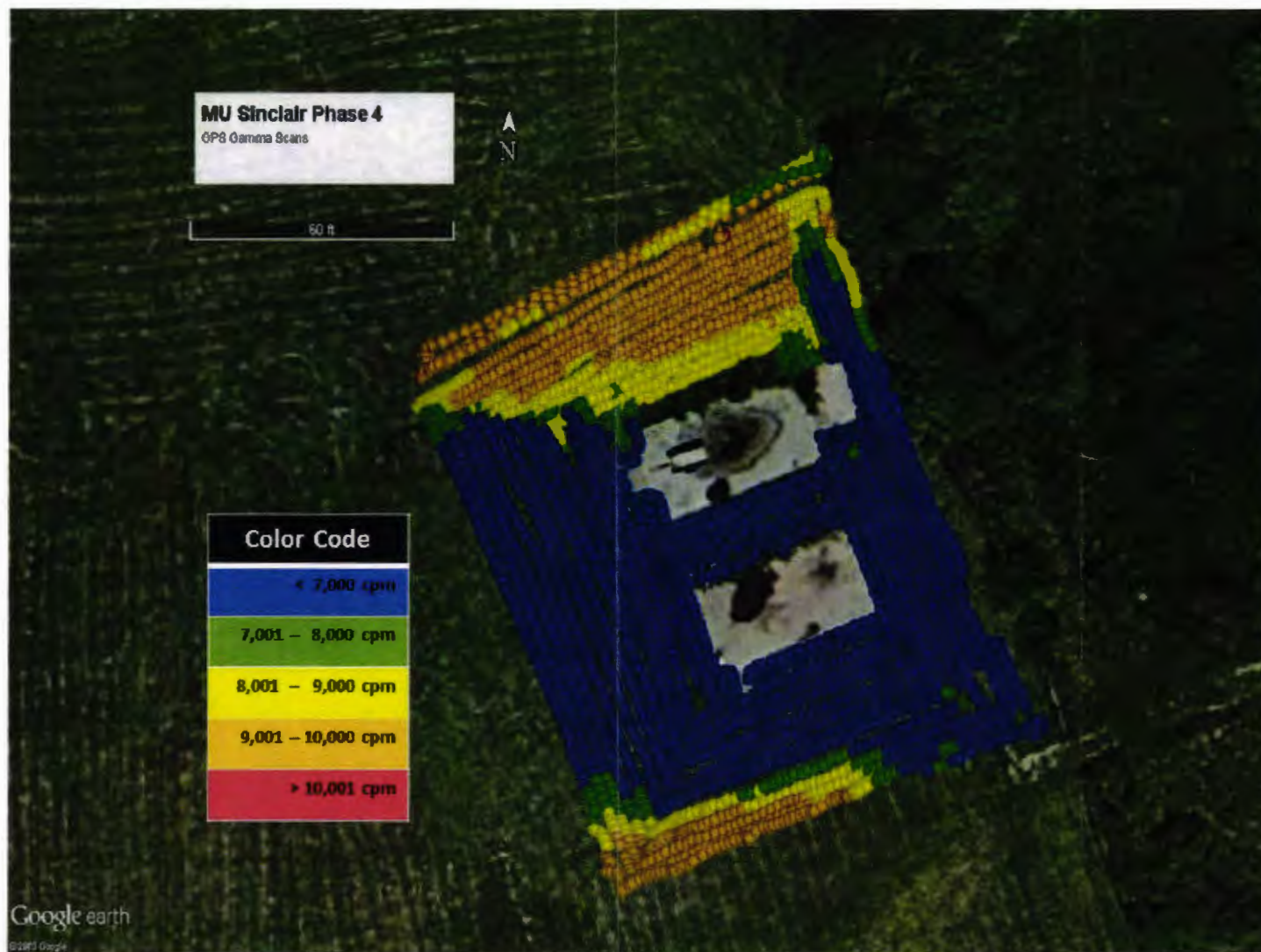


GPS Gamma Scans

Survey Unit: G304

Page: H.1 of H.2





**MU Mizzou**  
University of Missouri - Columbia

Missouri University  
Sinclair Farm Phase 4  
Final Status Report

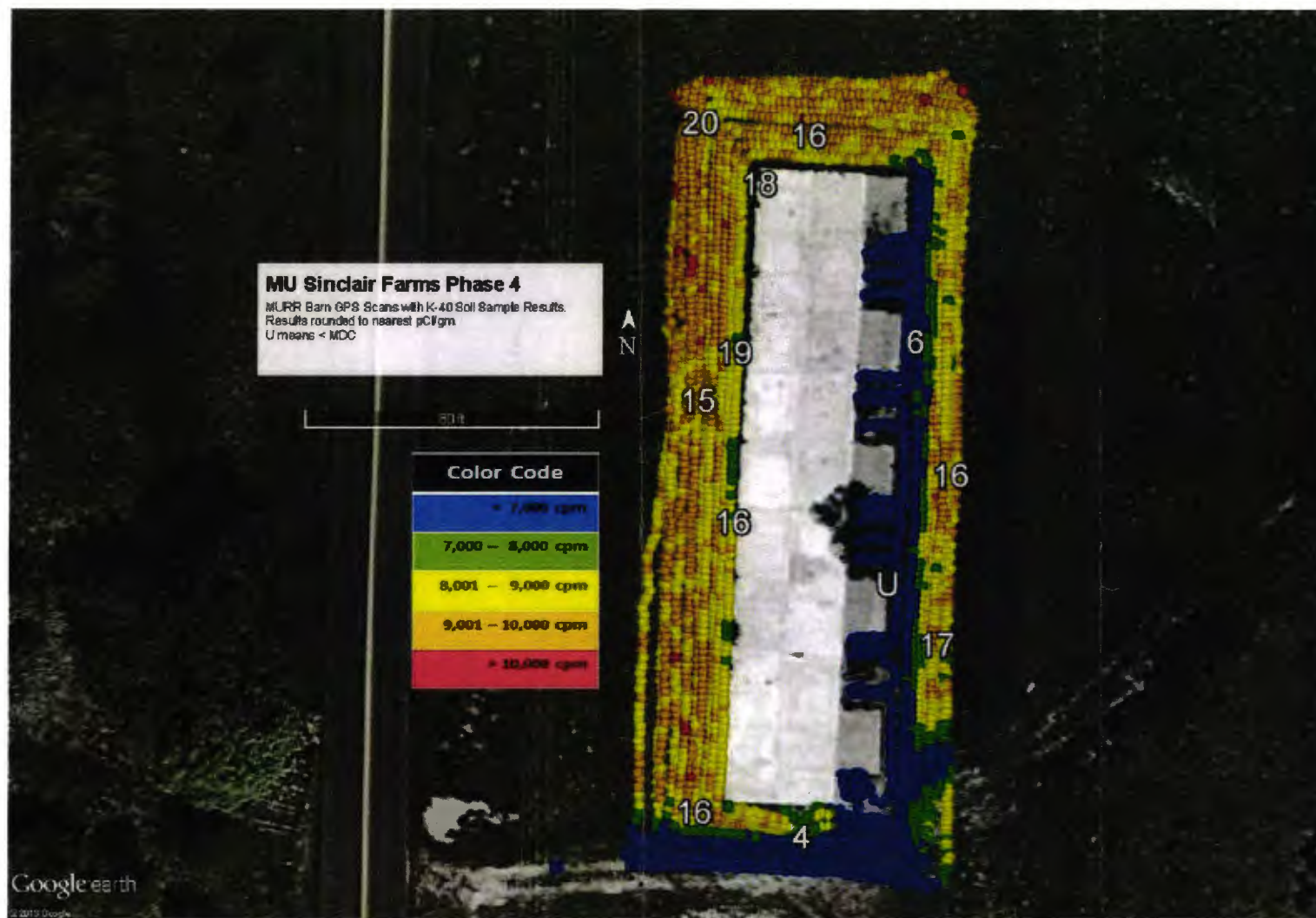


GPS Gamma Scans

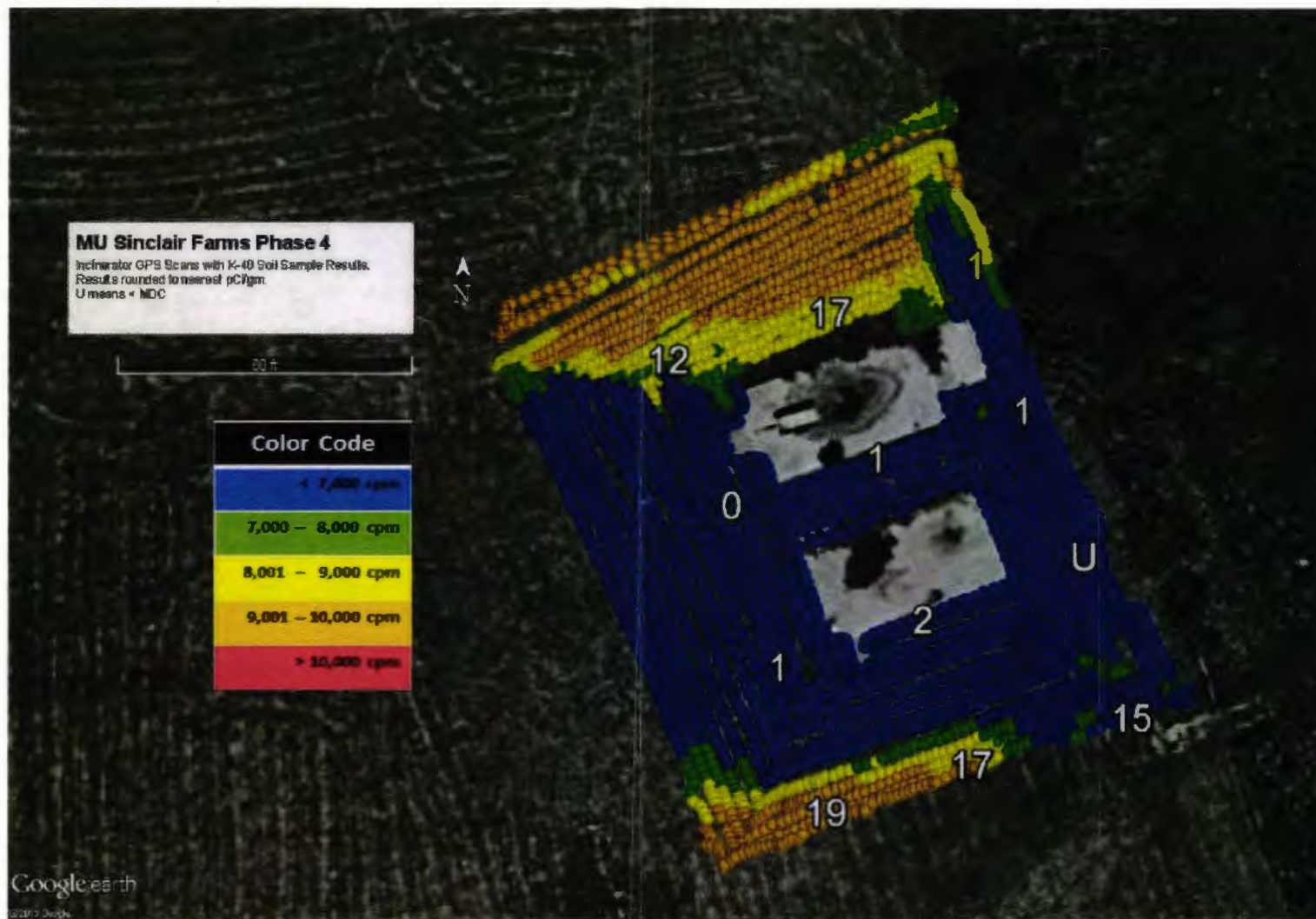
Survey Unit: G304

Page: H.2 of H.2











## Structural Surfaces Survey Results

Building: INB

Survey Unit: 1301

Class: 3

### Total Activity Measurements

### Removable Activity Measurements

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>A</u>	<u>MDC</u>	<u>B</u>	<u>MDC</u>	<u>C</u>	<u>MDC</u>
INB-1301-F1-C-001	<b>1,802 +/- 733</b>	1,111	16	40	6	26	13	38
INB-1301-F1-C-002	<b>1,330 +/- 706</b>	1,111	5	40	6	26	0	38
INB-1301-F1-C-003	987 +/- 686	1,111	0	40	0	26	0	38
INB-1301-F1-C-004	<b>1,287 +/- 704</b>	1,111	0	40	2	26	0	38
INB-1301-F1-C-005	<b>1,652 +/- 725</b>	1,111	2	40	0	26	0	38
INB-1301-F1-C-006	<b>1,373 +/- 709</b>	1,111	11	40	5	26	9	38
INB-1301-F1-C-007	837 +/- 677	1,111	14	40	7	26	14	38
INB-1301-F1-C-008	<b>1,073 +/- 691</b>	1,111	11	40	9	26	7	38
INB-1301-F1-C-009	<b>1,995 +/- 744</b>	1,111	11	40	2	26	6	38
INB-1301-F1-C-010	<b>1,888 +/- 738</b>	1,111	12	40	5	26	10	38
INB-1301-F1-C-011	<b>1,523 +/- 717</b>	1,111	0	40	8	26	0	38
INB-1301-F1-C-012	<b>1,909 +/- 739</b>	1,111	10	40	0	26	6	38
INB-1301-F1-C-013	944 +/- 683	1,111	14	40	1	26	7	38
INB-1301-F1-C-014	<b>1,351 +/- 707</b>	1,111	8	40	0	26	0	38

Sample Count	14			
Average	1,425	8	4	5
Minimum	837	0	0	0
Maximum	1,995	16	9	14
Standard Deviation	383	6	3	5

Results reported in dpm/100cm<sup>2</sup>.

Results above MDC are in bold print. Results above investigation levels are in red print.

Removable Activity: CH A = 0-18 keV, CH B = 18-156 keV, CH C = 0-2,000 keV



## Structural Surfaces Survey Results

Building: WSB

Survey Unit: 1301

Class: 3

### Total Activity Measurements

### Removable Activity Measurements

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>A</u>	<u>MDC</u>	<u>B</u>	<u>MDC</u>	<u>C</u>	<u>MDC</u>
WSB-1301-F1-C-001	1,780 +/- 720	1,087	6	40	0	26	0	38
WSB-1301-F1-C-002	1,244 +/- 688	1,087	4	40	1	26	0	38
WSB-1301-F1-C-003	1,287 +/- 691	1,087	8	40	0	26	0	38
WSB-1301-F1-C-004	1,480 +/- 702	1,087	14	40	0	26	0	38
WSB-1301-F1-C-005	1,437 +/- 700	1,087	1	40	0	26	0	38
WSB-1301-F1-C-006	1,738 +/- 717	1,087	14	40	17	26	17	38
WSB-1301-F1-C-007	1,609 +/- 710	1,087	6	40	0	26	0	38
WSB-1301-F1-C-008	1,373 +/- 696	1,087	9	40	0	26	0	38
WSB-1301-F1-C-009	1,051 +/- 677	1,087	3	40	0	26	0	38
WSB-1301-F1-C-010	1,673 +/- 714	1,087	19	40	0	26	7	38
WSB-1301-F1-C-011	2,016 +/- 733	1,087	17	40	0	26	0	38
WSB-1301-F1-C-012	2,252 +/- 746	1,087	14	40	0	26	1	38
WSB-1301-F1-C-013	1,373 +/- 696	1,087	11	40	1	26	0	38
WSB-1301-F1-C-014	1,566 +/- 707	1,087	1	40	0	26	0	38
WSB-1301-F1-C-015	1,995 +/- 732	1,087	33	40	0	26	3	38
<b>Sample Count</b>	15							
<b>Average</b>	1,592		11		1		2	
<b>Minimum</b>	1,051		1		0		0	
<b>Maximum</b>	2,252		33		17		17	
<b>Standard Deviation</b>	325		8		4		5	

Results reported in dpm/100cm<sup>2</sup>.

Results above MDC are in bold print. Results above investigation levels are in red print.

Removable Activity: CH A = 0-18 keV, CH B = 18-156 keV, CH C = 0-2,000 keV



## System Survey Results

Building: INB

Survey Unit: DR01

Class: N/A

### Total Activity Measurements

### Removable Activity Measurements

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>A</u>	<u>MDC</u>	<u>B</u>	<u>MDC</u>	<u>C</u>	<u>MDC</u>
INB-DR01-D2-M-001	+/-		0	40	2	26	0	38
INB-DR01-D2-M-002	+/-		4	40	3	26	6	38
Static Count	0	Sample Count	2					
Average			2		3		3	
Minimum			0		2		0	
Maximum			4		3		6	
Standard Deviation			3		1		4	

Results reported in dpm/100cm<sup>2</sup>.

Results above MDC are in bold print. Results above investigation levels are in red print.

Removable Activity: CH A = 0-18 keV, CH B = 18-156 keV, CH C = 0-2,000 keV



## System Survey Results

Building: WSB

Survey Unit: DR01

Class: N/A

### Total Activity Measurements

### Removable Activity Measurements

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>A</u>	<u>MDC</u>	<u>B</u>	<u>MDC</u>	<u>C</u>	<u>MDC</u>
WSB-DR01-D2-M-001	+/-		13	40	0	26	0	38
WSB-DR01-D2-M-002	+/-		17	40	1	26	6	38
Static Count	0	Sample Count	2					
Average			15		1		3	
Minimum			13		0		0	
Maximum			17		1		6	
Standard Deviation			3		1		4	

Results reported in dpm/100cm<sup>2</sup>.

Results above MDC are in bold print. Results above investigation levels are in red print.

Removable Activity: CH A = 0-18 keV, CH B = 18-156 keV, CH C = 0-2,000 keV





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

12/21/2013

LIMS #: L56748  
Project ID#: CH085-3EUNIVMO-09  
Received: 11/06/2013  
Delivery Date: 12/06/2013  
P.O.#: SIGNED QUOTE  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G301-001	L56748-1	
C1309025-G301-002	L56748-2	
C1309025-G301-003	L56748-3	
C1309025-G301-004	L56748-4	
C1309025-G301-005	L56748-5	
C1309025-G301-006	L56748-6	
C1309025-G301-007	L56748-7	
C1309025-G301-008	L56748-8	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane

Knoxville, TN 37931-3133

865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G301-009	L56748-9	
C1309025-G301-010	L56748-10	
C1309025-G301-011	L56748-11	
C1309025-G301-012	L56748-12	

*Method Reference Numbers*

Matrix	Analysis	Method Reference
S	GAMMA	EPA 901.1

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



Sample ID: C1309025-G301-001

Collect Start: 11/03/2013 11:19

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 28.41

LIMS Number: L56748-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	2.56E-02	3.86E-01	<b>6.35E-01</b>	pCi/g		3.0016	g wet		11/22/13	30	M	U
-3	2003	-1.21E-01	5.63E-01	<b>9.36E-01</b>	pCi/g		3.0016	g wet		11/25/13	30	M	U
E-7	2007	-2.30E-03	4.86E-01	<b>8.02E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
-40	2007	<b>1.59E+01</b>	2.07E+00	7.85E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
IN-54	2007	-1.89E-03	5.46E-02	<b>9.16E-02</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
O-58	2007	-9.07E-03	5.34E-02	<b>8.82E-02</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
E-59	2007	2.06E-02	1.18E-01	<b>1.99E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
O-60	2007	1.25E-02	5.84E-02	<b>9.84E-02</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
N-65	2007	-1.90E-02	1.27E-01	<b>1.76E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
R-95	2007	9.13E-02	1.14E-01	<b>1.99E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
U-103	2007	-2.50E-02	5.66E-02	<b>8.87E-02</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
U-106	2007	5.29E-01	4.50E-01	<b>8.27E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
131	2007	1.08E-01	1.96E-01	<b>3.42E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
S-134	2007	3.09E-03	5.16E-02	<b>7.41E-02</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
S-137	2007	<b>1.91E-01</b>	8.99E-02	8.21E-02	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
A-140	2007	5.14E-02	4.05E-01	<b>6.73E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
E-141	2007	-5.91E-03	1.02E-01	<b>1.66E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
E-144	2007	-1.35E-02	3.03E-01	<b>4.95E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
L-208	2007	<b>1.22E+00</b>	3.04E-01	2.46E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
B-212	2007	<b>1.37E+00</b>	1.47E-01	1.32E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
I-214	2007	<b>1.35E+00</b>	2.04E-01	1.68E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
I-212	2007	1.82E+00	8.07E-01	<b>1.49E+00</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U*
B-214	2007	<b>1.51E+00</b>	2.08E-01	1.61E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
C-228	2007	<b>1.31E+00</b>	4.44E-01	3.43E-01	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	+
H-234	2007	3.13E+00	1.14E+00	<b>3.47E+00</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U
-235	2007	3.48E-01	3.19E-01	<b>5.50E-01</b>	pCi/g Dry		208.3	g dry	11/03/13 11:19	11/20/13	5160	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- high = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- [ = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G301-002**

Collect Start: 11/03/2013 11:23

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 22.01

LIMS Number: L56748-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.00E-01	3.95E-01	<b>6.35E-01</b>	pCi/g		3.0011	g wet		11/22/13	30	M	U
-3	2003	-1.03E-01	5.64E-01	<b>9.36E-01</b>	pCi/g		3.0011	g wet		11/25/13	30	M	U
E-7	2007	1.03E-01	4.70E-01	<b>7.87E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
-40	2007	<b>1.59E+01</b>	1.79E+00	7.31E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
IN-54	2007	3.68E-03	5.67E-02	<b>9.50E-02</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
O-58	2007	1.53E-02	5.23E-02	<b>9.02E-02</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
E-59	2007	-7.72E-02	1.45E-01	<b>2.23E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
O-60	2007	5.13E-02	5.79E-02	<b>1.06E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
N-65	2007	-4.80E-02	1.37E-01	<b>1.78E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
R-95	2007	3.85E-02	1.08E-01	<b>1.87E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
U-103	2007	-2.01E-02	6.93E-02	<b>1.11E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
U-106	2007	7.69E-03	4.47E-01	<b>7.25E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
131	2007	-9.39E-04	2.01E-01	<b>3.33E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
S-134	2007	1.18E-02	5.38E-02	<b>7.76E-02</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
S-137	2007	<b>1.62E-01</b>	9.32E-02	9.44E-02	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
A-140	2007	4.17E-01	4.29E-01	<b>7.63E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
E-141	2007	5.87E-02	1.10E-01	<b>1.83E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
E-144	2007	-1.79E-01	3.55E-01	<b>5.64E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
L-208	2007	<b>1.27E+00</b>	3.60E-01	2.41E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
B-212	2007	<b>1.25E+00</b>	1.49E-01	1.38E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
I-214	2007	<b>1.09E+00</b>	2.16E-01	1.66E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
I-212	2007	1.01E+00	7.30E-01	<b>1.37E+00</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
B-214	2007	<b>1.12E+00</b>	1.71E-01	1.60E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
C-228	2007	<b>1.25E+00</b>	3.64E-01	3.09E-01	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	+
H-234	2007	9.20E+00	7.70E+00	<b>1.36E+01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U
-235	2007	1.89E-01	3.51E-01	<b>5.87E-01</b>	pCi/g Dry		215	g dry	11/03/13 11:23	11/20/13	5159	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G301-003**

Collect Start: 11/03/2013 11:26

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 25.74

LIMS Number: L56748-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.62E-01	3.83E-01	<b>6.23E-01</b>	pCi/g		3.0611	g wet		11/22/13	30	M	U
-3	2003	2.44E-01	5.68E-01	<b>9.18E-01</b>	pCi/g		3.0611	g wet		11/25/13	30	M	U
E-7	2007	1.87E-01	3.57E-01	<b>6.26E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
-40	2007	<b>1.49E+01</b>	1.45E+00	4.92E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
IN-54	2007	2.92E-02	4.84E-02	<b>8.26E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
O-58	2007	-2.25E-03	4.44E-02	<b>7.14E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
E-59	2007	-2.63E-04	9.89E-02	<b>1.63E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
O-60	2007	-3.25E-03	4.69E-02	<b>7.52E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
N-65	2007	1.17E-02	1.06E-01	<b>1.52E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
R-95	2007	7.61E-02	8.64E-02	<b>1.53E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
U-103	2007	5.70E-03	4.77E-02	<b>8.10E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
U-106	2007	2.23E-01	3.92E-01	<b>6.79E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
I31	2007	7.64E-03	1.56E-01	<b>2.55E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
S-134	2007	-6.78E-03	4.44E-02	<b>6.26E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
S-137	2007	4.46E-03	4.48E-02	<b>7.43E-02</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
A-140	2007	1.22E-01	3.36E-01	<b>5.79E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
E-141	2007	1.60E-02	7.28E-02	<b>1.18E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
E-144	2007	-8.25E-02	2.27E-01	<b>3.60E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
L-208	2007	<b>1.07E+00</b>	2.67E-01	1.75E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
B-212	2007	<b>1.36E+00</b>	1.19E-01	9.77E-02	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
I-214	2007	<b>1.03E+00</b>	1.63E-01	1.28E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
I-212	2007	<b>1.21E+00</b>	7.30E-01	8.95E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
B-214	2007	<b>1.18E+00</b>	1.41E-01	1.31E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
C-228	2007	<b>1.28E+00</b>	2.83E-01	2.60E-01	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	+
H-234	2007	1.79E+00	8.83E-01	<b>4.14E+00</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U
-235	2007	1.30E-01	6.21E-02	<b>3.86E-01</b>	pCi/g Dry		240.4	g dry	11/03/13 11:26	11/20/13	5159	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- / = Low recovery
- I = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56748 Page 5 of 16

**bolded text indicates reportable value.**



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-G301-004</b>	Collect Start: 11/03/2013 11:29	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture: 25.66
LIMS Number: L56748-4		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.90E-01	3.92E-01	<b>6.35E-01</b>	pCi/g		3.0004	g wet		11/22/13	30	M U	
-3	2003	-2.90E-01	5.56E-01	<b>9.37E-01</b>	pCi/g		3.0004	g wet		11/25/13	30	M U	
E-7	2007	4.12E-01	4.49E-01	<b>7.92E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
-40	2007	<b>1.77E+01</b>	1.83E+00	5.87E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
IN-54	2007	2.79E-02	4.85E-02	<b>8.35E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
O-58	2007	-5.84E-02	5.07E-02	<b>6.90E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
E-59	2007	-4.75E-02	1.13E-01	<b>1.69E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
O-60	2007	-1.61E-02	3.83E-02	<b>5.93E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
N-65	2007	-1.16E-01	1.37E-01	<b>1.60E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
R-95	2007	3.73E-02	9.62E-02	<b>1.63E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
U-103	2007	-2.41E-02	5.81E-02	<b>9.14E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
U-106	2007	2.41E-03	4.09E-01	<b>6.65E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
131	2007	-9.42E-04	1.77E-01	<b>2.91E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
S-134	2007	1.65E-02	4.81E-02	<b>7.18E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
S-137	2007	3.67E-02	5.78E-02	<b>9.91E-02</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
A-140	2007	-1.20E-01	3.92E-01	<b>6.22E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
E-141	2007	3.77E-02	9.27E-02	<b>1.58E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
E-144	2007	3.77E-02	2.92E-01	<b>4.90E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
L-208	2007	<b>1.50E+00</b>	3.52E-01	2.14E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
B-212	2007	<b>1.48E+00</b>	1.45E-01	1.33E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
I-214	2007	<b>1.28E+00</b>	1.87E-01	1.54E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
I-212	2007	1.33E+00	6.89E-01	<b>1.31E+00</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U*	No
B-214	2007	<b>1.44E+00</b>	1.84E-01	1.45E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
C-228	2007	<b>1.72E+00</b>	4.30E-01	2.54E-01	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec +	Yes
H-234	2007	2.30E+00	3.12E+00	<b>5.41E+00</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	No
-235	2007	2.41E-01	1.13E-01	<b>5.00E-01</b>	pCi/g Dry		257.7	g dry	11/03/13 11:29	11/20/13	5159	Sec U	Yes

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- F = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: C1309025-G301-005	Collect Start: 11/03/2013 11:32	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture: 25.58
LIMS Number: L56748-5		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.72E-01	3.95E-01	6.32E-01	pCi/g		3.0145	g wet		11/22/13	30	M	U
-3	2003	-1.24E-01	5.60E-01	9.32E-01	pCi/g		3.0145	g wet		11/25/13	30	M	U
E-7	2007	5.22E-01	6.18E-01	1.10E+00	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
-40	2007	2.02E+01	2.19E+00	9.16E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
IN-54	2007	-1.27E-02	7.06E-02	1.13E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
O-58	2007	-1.10E-02	7.75E-02	1.24E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
E-59	2007	-7.10E-02	1.63E-01	2.58E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
O-60	2007	-7.05E-03	6.28E-02	1.02E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
N-65	2007	1.43E-01	1.60E-01	2.60E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
R-95	2007	5.67E-02	1.49E-01	2.52E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
U-103	2007	-3.56E-02	8.19E-02	1.32E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
U-106	2007	1.23E-01	6.57E-01	1.10E+00	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
131	2007	-2.56E-01	2.79E-01	4.23E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
S-134	2007	2.35E-02	7.66E-02	1.13E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
S-137	2007	-4.06E-02	7.51E-02	1.19E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
A-140	2007	3.90E-01	5.76E-01	1.01E+00	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
E-141	2007	8.09E-02	1.33E-01	2.29E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
E-144	2007	-2.39E-01	4.37E-01	7.18E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U No
L-208	2007	1.51E+00	3.67E-01	3.14E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
B-212	2007	1.63E+00	1.89E-01	1.88E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
I-214	2007	1.49E+00	2.85E-01	2.21E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
I-212	2007	2.43E+00	1.35E+00	1.48E+00	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
B-214	2007	1.55E+00	1.96E-01	2.31E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
C-228	2007	1.31E+00	5.38E-01	3.89E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	+ Yes
H-234	2007	2.83E+00	1.99E+00	7.34E+00	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U Yes
-235	2007	2.24E-01	1.47E-01	6.99E-01	pCi/g Dry		172.7	g dry	11/03/13 11:32	11/20/13	5160	Sec	U Yes

Flag Values  
J = Compound/Analyte not detected (< MDC) or less than 3 sigma  
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)  
J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma  
High = Activity concentration exceeds customer reporting value  
Spec = MDC exceeds customer technical specification  
Low = Low recovery  
High = High recovery

No = Peak not identified in gamma spectrum  
Yes = Peak identified in gamma spectrum  
\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

Bolded text indicates reportable value.



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: C1309025-G301-006

Collect Start: 11/03/2013 11:34

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 24.31

LIMS Number: L56748-6

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
P-14	2003	2.98E-02	3.70E-01	<b>6.08E-01</b>	pCi/g		3.1373	g wet		11/22/13	30	M	U
E-3	2003	4.80E-01	5.64E-01	<b>8.96E-01</b>	pCi/g		3.1373	g wet		11/25/13	30	M	U
E-7	2007	3.50E-01	6.35E-01	<b>1.04E+00</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
E-40	2007	<b>1.60E+01</b>	2.06E+00	7.12E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
IN-54	2007	2.51E-03	6.34E-02	<b>1.06E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
O-58	2007	1.67E-02	6.65E-02	<b>1.14E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
E-59	2007	-3.52E-02	1.51E-01	<b>2.37E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
O-60	2007	7.37E-03	5.02E-02	<b>8.36E-02</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
N-65	2007	-1.51E-01	1.77E-01	<b>2.10E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
R-95	2007	-5.96E-02	1.24E-01	<b>1.98E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
U-103	2007	1.22E-02	8.21E-02	<b>1.38E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
U-106	2007	-4.98E-01	6.05E-01	<b>9.40E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
131	2007	1.02E-01	2.76E-01	<b>4.66E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
S-134	2007	3.19E-02	6.60E-02	<b>9.91E-02</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
S-137	2007	2.38E-02	7.10E-02	<b>1.21E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
A-140	2007	2.88E-01	5.68E-01	<b>9.76E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
E-141	2007	1.08E-01	1.61E-01	<b>2.70E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
E-144	2007	1.60E-01	5.33E-01	<b>8.82E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
L-208	2007	<b>1.41E+00</b>	4.00E-01	2.92E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
B-212	2007	<b>1.43E+00</b>	1.63E-01	1.98E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
I-214	2007	<b>1.29E+00</b>	2.44E-01	2.08E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
I-212	2007	1.42E+00	1.05E+00	<b>1.25E+00</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
B-214	2007	<b>1.32E+00</b>	2.05E-01	2.41E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
C-228	2007	<b>1.63E+00</b>	4.75E-01	3.56E-01	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	+
H-234	2007	1.28E+00	2.38E+00	<b>1.98E+01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U
-235	2007	2.93E-01	1.63E-01	<b>8.57E-01</b>	pCi/g Dry		237.6	g dry	11/03/13 11:34	11/20/13	5159	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56748 Page 8 of 16

**Bolded text indicates reportable value.**



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G301-007**

Collect Start: 11/03/2013 11:38

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 25.49

LIMS Number: L56748-7

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.57E-01	3.87E-01	<b>6.19E-01</b>	pCi/g		3.0784	g wet		11/22/13	30	M	U
-3	2003	7.15E-02	5.57E-01	<b>9.13E-01</b>	pCi/g		3.0784	g wet		11/25/13	30	M	U
E-7	2007	-6.22E-02	5.22E-01	<b>8.39E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
-40	2007	<b>1.90E+01</b>	2.06E+00	7.97E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
IN-54	2007	1.87E-02	4.90E-02	<b>8.59E-02</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
O-58	2007	-8.26E-03	5.38E-02	<b>8.89E-02</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
E-59	2007	-4.94E-02	1.15E-01	<b>1.78E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
O-60	2007	-3.80E-03	6.18E-02	<b>1.01E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
N-65	2007	-8.99E-02	1.35E-01	<b>1.68E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
R-95	2007	1.72E-02	9.65E-02	<b>1.58E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
U-103	2007	-1.88E-02	5.97E-02	<b>9.38E-02</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
U-106	2007	1.63E-01	4.27E-01	<b>7.19E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
131	2007	-7.82E-02	2.10E-01	<b>3.35E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
S-134	2007	-2.42E-02	5.84E-02	<b>7.74E-02</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
S-137	2007	<b>2.19E-01</b>	1.00E-01	8.03E-02	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
A-140	2007	1.58E-01	4.14E-01	<b>6.97E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
E-141	2007	2.31E-02	9.04E-02	<b>1.54E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
E-144	2007	8.52E-02	3.04E-01	<b>5.19E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
L-208	2007	<b>1.32E+00</b>	3.65E-01	2.39E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
3-212	2007	<b>1.65E+00</b>	1.49E-01	1.28E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
I-214	2007	<b>1.50E+00</b>	1.89E-01	1.67E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
I-212	2007	9.52E-01	9.84E-01	<b>8.17E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
3-214	2007	<b>1.36E+00</b>	1.78E-01	1.63E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
C-228	2007	<b>1.75E+00</b>	4.15E-01	3.21E-01	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	+
I-234	2007	3.83E-01	3.46E+00	<b>5.60E+00</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U
-235	2007	1.54E-01	9.79E-02	<b>4.79E-01</b>	pCi/g Dry		188	g dry	11/03/13 11:38	11/20/13	5160	Sec	U

## Flag Values

- I = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- I\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



A Teledyne Technologies Company

Project Manager

Sample ID: C1309025-G301-008

Collect Start: 11/03/2013 11:42

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 20.14

LIMS Number: L56748-8

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.08E-01	3.82E-01	<b>6.14E-01</b>	pCi/g		3.1035	g wet		11/22/13	30	M	U
-3	2003	2.20E-01	4.68E-01	<b>7.34E-01</b>	pCi/g		3.1035	g wet		11/26/13	15	M	U
E-7	2007	2.08E-01	6.91E-01	<b>1.19E+00</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
-40	2007	<b>5.51E+00</b>	1.49E+00	1.10E+00	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	+
IN-54	2007	-2.21E-02	6.82E-02	<b>1.06E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
O-58	2007	-1.60E-02	7.57E-02	<b>1.20E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
E-59	2007	-7.36E-02	1.74E-01	<b>2.72E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
O-60	2007	1.20E-02	7.84E-02	<b>1.32E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
N-65	2007	-2.98E-01	1.80E-01	<b>2.35E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
R-95	2007	-2.62E-02	1.31E-01	<b>2.09E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
U-103	2007	-7.27E-03	8.00E-02	<b>1.33E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
U-106	2007	3.95E-01	6.80E-01	<b>1.19E+00</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
131	2007	-2.79E-02	2.73E-01	<b>4.39E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
S-134	2007	-1.27E-02	7.25E-02	<b>1.00E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
S-137	2007	-3.78E-02	8.43E-02	<b>1.35E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
A-140	2007	1.04E-01	6.11E-01	<b>1.03E+00</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
E-141	2007	6.23E-02	1.19E-01	<b>2.05E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
E-144	2007	3.22E-01	3.65E-01	<b>6.46E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
L-208	2007	3.66E-01	3.86E-01	<b>3.35E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
B-212	2007	3.45E-01	2.33E-01	<b>1.80E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
I-214	2007	<b>6.14E-01</b>	2.39E-01	2.08E-01	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	+
I-212	2007	3.83E-01	9.25E-01	<b>1.61E+00</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
B-214	2007	<b>5.68E-01</b>	2.03E-01	2.33E-01	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	+
H-234	2007	1.53E-01	3.89E+00	<b>6.60E+00</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U
-235	2007	5.86E-02	1.14E-01	<b>6.34E-01</b>	pCi/g Dry		100.5	g dry	11/03/13 11:42	11/20/13	5026	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- high = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: **C1309025-G301-009**

Collect Start: 11/03/2013 11:43

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 20.16

LIMS Number: L56748-9

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.90E-01	3.79E-01	<b>6.15E-01</b>	pCi/g		3.1002	g wet		11/22/13	30	M	U
-3	2003	-2.87E-01	5.38E-01	<b>9.06E-01</b>	pCi/g		3.1002	g wet		11/25/13	30	M	U
E-7	2007	1.50E-01	4.42E-01	<b>7.53E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
-40	2007	<b>1.62E+01</b>	1.89E+00	6.80E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
IN-54	2007	3.87E-02	5.35E-02	<b>9.63E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
O-58	2007	-5.17E-02	5.15E-02	<b>7.62E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
E-59	2007	1.51E-02	1.22E-01	<b>2.05E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
O-60	2007	-3.76E-02	4.92E-02	<b>6.82E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
N-65	2007	5.13E-02	1.39E-01	<b>2.11E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
R-95	2007	-4.77E-03	1.03E-01	<b>1.65E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
U-103	2007	-5.35E-02	5.72E-02	<b>8.52E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
U-106	2007	-1.14E-01	4.36E-01	<b>6.86E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
131	2007	3.15E-02	1.88E-01	<b>3.19E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
S-134	2007	1.29E-02	4.85E-02	<b>7.19E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
S-137	2007	-1.54E-02	5.88E-02	<b>9.26E-02</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
A-140	2007	-3.26E-01	4.08E-01	<b>6.14E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
E-141	2007	3.88E-02	9.43E-02	<b>1.57E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
E-144	2007	-9.16E-02	2.83E-01	<b>4.56E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
L-208	2007	<b>1.62E+00</b>	3.06E-01	2.33E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
B-212	2007	<b>1.58E+00</b>	1.62E-01	1.73E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
I-214	2007	<b>1.50E+00</b>	2.07E-01	1.51E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
I-212	2007	<b>2.10E+00</b>	9.83E-01	8.87E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
B-214	2007	<b>1.39E+00</b>	1.85E-01	1.50E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
C-228	2007	<b>1.46E+00</b>	4.04E-01	2.90E-01	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	+
H-234	2007	2.58E+00	1.02E+00	<b>3.29E+00</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U
-235	2007	1.48E-01	1.15E-01	<b>4.87E-01</b>	pCi/g Dry		236.1	g dry	11/03/13 11:43	11/20/13	5032	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- † = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G301-010**

Collect Start: 11/03/2013 11:48

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 10.43

LIMS Number: L56748-10

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.49E-01	3.90E-01	<b>6.25E-01</b>	pCi/g		3.0517	g wet		11/22/13	30	M	U
-3	2003	-1.51E-01	5.52E-01	<b>9.21E-01</b>	pCi/g		3.0517	g wet		11/25/13	30	M	U
E-7	2007	-4.70E-02	3.69E-01	<b>5.96E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
-40	2007	6.92E-01	7.61E-01	<b>2.65E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
IN-54	2007	-1.13E-02	3.72E-02	<b>5.90E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
O-58	2007	-3.84E-03	3.75E-02	<b>6.15E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
E-59	2007	1.64E-02	8.88E-02	<b>1.51E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
O-60	2007	1.99E-02	3.24E-02	<b>6.11E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
N-65	2007	-1.50E-01	1.16E-01	<b>1.52E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
R-95	2007	2.95E-02	7.03E-02	<b>1.25E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
U-103	2007	-3.11E-02	4.62E-02	<b>6.87E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
U-106	2007	-1.70E-01	3.75E-01	<b>5.67E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
131	2007	4.46E-02	1.68E-01	<b>2.86E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
S-134	2007	-3.27E-02	4.56E-02	<b>5.48E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
S-137	2007	-2.95E-03	4.07E-02	<b>6.49E-02</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
A-140	2007	2.37E-01	3.24E-01	<b>5.77E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
E-141	2007	5.86E-02	7.45E-02	<b>1.28E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
E-144	2007	-6.49E-03	2.49E-01	<b>4.05E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
L-208	2007	5.47E-03	1.28E-01	<b>2.21E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
B-212	2007	<b>2.12E-01</b>	8.85E-02	9.44E-02	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	+
I-214	2007	3.87E-01	1.24E-01	<b>2.50E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U*
I-212	2007	-1.11E-01	4.52E-01	<b>7.32E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
B-214	2007	<b>2.42E-01</b>	1.31E-01	1.37E-01	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	+
H-234	2007	-1.62E+00	5.87E+00	<b>9.67E+00</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U
-235	2007	8.84E-02	2.47E-01	<b>4.13E-01</b>	pCi/g Dry		213.7	g dry	11/03/13 11:48	11/20/13	5062	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56748 Page 12 of 16

**Bolded text indicates reportable value.**



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G301-011**

Collect Start: 11/03/2013 11:49

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 27.84

LIMS Number: L56748-11

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	9.80E-02	3.85E-01	<b>6.30E-01</b>	pCi/g		3.0275	g wet		11/22/13	30	M	U
-3	2003	-4.22E-01	5.45E-01	<b>9.28E-01</b>	pCi/g		3.0275	g wet		11/25/13	30	M	U
E-7	2007	6.48E-02	4.14E-01	<b>7.07E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
-40	2007	<b>1.72E+01</b>	1.74E+00	6.46E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
IN-54	2007	4.13E-02	4.96E-02	<b>8.73E-02</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
O-58	2007	-6.78E-02	5.63E-02	<b>7.77E-02</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
E-59	2007	-3.66E-03	1.25E-01	<b>2.06E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
O-60	2007	7.90E-02	5.58E-02	<b>1.07E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
N-65	2007	-3.04E-02	1.30E-01	<b>1.76E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
R-95	2007	2.27E-02	9.93E-02	<b>1.65E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
U-103	2007	-2.29E-02	5.18E-02	<b>8.36E-02</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
U-106	2007	1.76E-01	4.27E-01	<b>7.33E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
131	2007	7.66E-02	1.73E-01	<b>2.92E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
S-134	2007	-1.79E-02	5.00E-02	<b>6.83E-02</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
S-137	2007	-1.26E-02	5.19E-02	<b>8.34E-02</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
A-140	2007	-3.76E-02	3.91E-01	<b>6.48E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
E-141	2007	1.58E-02	8.81E-02	<b>1.43E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
E-144	2007	2.68E-01	2.95E-01	<b>4.80E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
L-208	2007	<b>1.29E+00</b>	2.93E-01	2.24E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
B-212	2007	<b>1.57E+00</b>	1.38E-01	1.17E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
I-214	2007	<b>1.30E+00</b>	1.78E-01	1.52E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
I-212	2007	1.39E+00	9.60E-01	<b>1.02E+00</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
B-214	2007	<b>1.49E+00</b>	1.79E-01	1.53E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
C-228	2007	<b>1.27E+00</b>	4.23E-01	2.41E-01	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	+
H-234	2007	2.82E+00	1.23E+00	<b>4.76E+00</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U
-235	2007	2.56E-01	8.50E-02	<b>4.65E-01</b>	pCi/g Dry		202.5	g dry	11/03/13 11:49	11/20/13	5033	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- , = Low recovery
- I = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/21/13 13:17

**L56748**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



A Teledyne Technologies Company

Project Manager

Sample ID: C1309025-G301-012

Collect Start: 11/03/2013 11:51

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 11.63

LIMS Number: L56748-12

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.44E+00	3.27E-01	<b>6.19E-01</b>	pCi/g		3.0809	g wet		11/22/13	30	M	U
-3	2003	-2.25E-01	5.44E-01	<b>9.12E-01</b>	pCi/g		3.0809	g wet		11/25/13	30	M	U
E-7	2007	-2.75E-01	4.25E-01	<b>6.36E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
-40	2007	<b>4.36E+00</b>	1.09E+00	6.44E-01	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	+
IN-54	2007	2.54E-02	4.95E-02	<b>8.60E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
O-58	2007	-3.83E-03	4.58E-02	<b>7.28E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
E-59	2007	1.90E-03	1.15E-01	<b>1.85E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
O-60	2007	-5.08E-03	4.34E-02	<b>7.13E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
N-65	2007	-1.11E-01	1.07E-01	<b>1.34E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
R-95	2007	-8.44E-02	8.62E-02	<b>1.14E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
U-103	2007	-7.04E-02	5.59E-02	<b>7.56E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
U-106	2007	1.32E-01	3.84E-01	<b>6.58E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
131	2007	9.85E-03	1.85E-01	<b>3.06E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
S-134	2007	7.95E-03	5.02E-02	<b>7.36E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
S-137	2007	1.18E-02	5.09E-02	<b>8.52E-02</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
A-140	2007	3.36E-01	4.10E-01	<b>7.33E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
E-141	2007	5.17E-02	8.74E-02	<b>1.52E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
E-144	2007	-8.62E-02	2.94E-01	<b>4.83E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
L-208	2007	<b>2.94E-01</b>	1.75E-01	2.01E-01	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	+
B-212	2007	<b>2.18E-01</b>	1.39E-01	1.49E-01	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	+
I-214	2007	<b>5.25E-01</b>	1.71E-01	1.40E-01	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	+
I-212	2007	5.73E-01	5.93E-01	<b>1.09E+00</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
B-214	2007	<b>4.60E-01</b>	1.38E-01	1.66E-01	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	+
H-234	2007	4.83E-01	2.94E+00	<b>5.00E+00</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U
-235	2007	-4.35E-02	2.79E-01	<b>4.62E-01</b>	pCi/g Dry		196.9	g dry	11/03/13 11:51	11/20/13	5032	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56748 Page 14 of 16

**Bolded text indicates reportable value.**



LS6748  
WH33B

WH 33B

L56748 Page 15 of 16



11/07/13 08:07

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37199

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUSINC-13

LIMS #L56748

Initiated By: KTHURMAN

Init Date: 11/06/13 Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

**Report of Analysis/Certificate of Conformance**

12/12/2013

LIMS #: L56751  
Project ID#: CH085-3EUNIVMO-09  
Received: 11/06/2013  
Delivery Date: 12/06/2013  
P.O.#: SIGNED QUOTE  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G302-001	L56751-1	
C1309025-G302-002	L56751-2	
C1309025-G302-003	L56751-3	
C1309025-G302-004	L56751-4	
C1309025-G302-005	L56751-5	
C1309025-G302-006	L56751-6	
C1309025-G302-007	L56751-7	
C1309025-G302-008	L56751-8	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane

Knoxville, TN 37931-3133

865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G302-009	L56751-9	
C1309025-G302-010	L56751-10	
C1309025-G302-011	L56751-11	
C1309025-G302-012	L56751-12	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

12/12/13 10:11

**L56751**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Sample ID: <b>C1309025-G302-001</b>	Collect Start: 11/03/2013 09:50	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-1			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	2.93E-01	3.85E-01	6.20E-01	pCi/g		3.0762	g wet		11/22/13	30	M	U
3	2003	-3.65E-01	5.39E-01	9.13E-01	pCi/g		3.0762	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-002</b>	Collect Start: 11/03/2013 09:52	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-2			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-2.10E+00	3.80E-01	7.34E-01	pCi/g		3.0079	g wet		11/22/13	30	M	U
3	2003	2.96E-01	5.80E-01	9.34E-01	pCi/g		3.0079	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-003</b>	Collect Start: 11/03/2013 10:00	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-3			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-1.92E+00	3.75E-01	7.16E-01	pCi/g		3.0832	g wet		11/22/13	30	M	U
3	2003	4.00E-01	5.70E-01	9.11E-01	pCi/g		3.0832	g wet		11/25/13	30	M	U

- Flag Values
- = Compound/Analyte not detected (< MDC) or less than 3 sigma
  - = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
  - \* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
  - igh = Activity concentration exceeds customer reporting value
  - pec = MDC exceeds customer technical specification
  - = Low recovery
  - = High recovery

No = Peak not identified in gamma spectrum  
Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

bolded text indicates reportable value.



# Report of Analysis

12/12/13 10:11



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L56751**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-G302-004</b>	Collect Start: 11/03/2013 10:01	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-4			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-2.54E-01	4.20E-01	<b>7.04E-01</b>	pCi/g		3.134	g wet		11/22/13	30	M	U
3	2003	-2.11E-01	5.35E-01	<b>8.97E-01</b>	pCi/g		3.134	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-005</b>	Collect Start: 11/03/2013 10:03	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-5			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-7.33E-01	4.15E-01	<b>7.20E-01</b>	pCi/g		3.0662	g wet		11/22/13	30	M	U
3	2003	2.15E-02	4.53E-01	<b>7.43E-01</b>	pCi/g		3.0662	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-G302-006</b>	Collect Start: 11/03/2013 10:05	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-6			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-6.89E-01	4.13E-01	<b>7.14E-01</b>	pCi/g		3.0925	g wet		11/22/13	30	M	U
3	2003	-1.39E-01	5.46E-01	<b>9.09E-01</b>	pCi/g		3.0925	g wet		11/25/13	30	M	U

## Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [ ] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [High] = Activity concentration exceeds customer reporting value
- [MDC] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/12/13 10:11

**L56751**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-G302-007</b>	Collect Start: 11/03/2013 10:09	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56751-7		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-1.23E-01	4.20E-01	<b>6.98E-01</b>	pCi/g		3.1631	g wet		11/22/13	30	M	U
3	2003	-3.41E-01	5.24E-01	<b>8.88E-01</b>	pCi/g		3.1631	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-008</b>	Collect Start: 11/03/2013 10:15	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56751-8		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-1.60E-01	4.20E-01	<b>7.00E-01</b>	pCi/g		3.1548	g wet		11/22/13	30	M	U
3	2003	-3.03E-01	5.27E-01	<b>8.91E-01</b>	pCi/g		3.1548	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-009</b>	Collect Start: 11/03/2013 10:16	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56751-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	1.34E-02	4.21E-01	<b>6.93E-01</b>	pCi/g		3.046	g wet		11/22/13	30	M	U
3	2003	2.60E-01	4.75E-01	<b>8.79E-01</b>	pCi/g		3.046	g wet		11/25/13	30	M	U

Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [ ] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [h] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum  
Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/12/13 10:11



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L56751**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-G302-010</b>	Collect Start: 11/03/2013 10:21	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-10			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-8.32E-02	4.23E-01	7.00E-01	pCi/g		3.0159	g wet		11/22/13	30	M	U
3	2003	-8.12E-02	4.62E-01	8.87E-01	pCi/g		3.0159	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-011</b>	Collect Start: 11/03/2013 10:23	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-11			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	2.49E-02	4.22E-01	6.95E-01	pCi/g		3.0412	g wet		11/22/13	30	M	U
3	2003	6.66E-01	4.97E-01	8.80E-01	pCi/g		3.0412	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G302-012</b>	Collect Start: 11/03/2013 10:27	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56751-12			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-1.68E-01	4.18E-01	6.97E-01	pCi/g		3.0295	g wet		11/22/13	30	M	U
3	2003	-8.42E-01	4.18E-01	8.83E-01	pCi/g		3.0295	g wet		11/25/13	30	M	U

## Flag Values

- = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- \* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- igh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- = High recovery

olded text indicates reportable value.

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



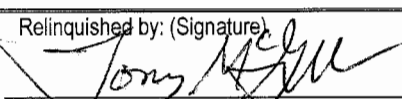
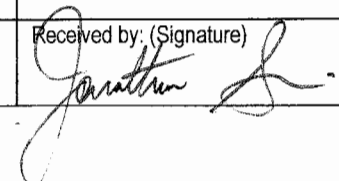
# Chain of Custody Record

No. C1309025-02

L56751  
WH33B

Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830

Project Name: MU Sinclair Farm Phase 4		Project Number: C1309025				Page 1 of 1  Purchase Order #: _____ N/A _____																
Send Report To: Dave Culp, dculp@chaseenv.com		Sampler (Print Name): Dave Culp																				
Address: 109 Flint Road		Sampler (Print Name): N/A																				
Oak Ridge, TN 37830		Shipment Method: Hand Deliver																				
Phone: 865-207-3664		Laboratory Receiving: Teledyne Brown																				
Fax: 865-481-8818																						
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested	C-14 / H-3	Gamma Spec Nuclide ID														Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
C1309025-G302-001	11-3-13	0950	Soil	1	X															Standard TAT, MDC < 1 pCi/g		
C1309025-G302-002	11-3-13	0952	Soil	1	X															"		
C1309025-G302-003	11-3-13	1000	Soil	1	X															"		
C1309025-G302-004	11-3-13	1001	Soil	1	X															"		
C1309025-G302-005	11-3-13	1003	Soil	1	X															"		
C1309025-G302-006	11-3-13	1005	Soil	1	X															"		
C1309025-G302-007	11-3-13	1009	Soil	1	X															"		
C1309025-G302-008	11-3-13	1015	Soil	1	X															"		
C1309025-G302-009	11-3-13	1016	Soil	1	X															"		
C1309025-G302-010	11-3-13	1021	Soil	1	X															"		
C1309025-G302-011	11-3-13	1023	Soil	1	X															"		
C1309025-G302-012	11-3-13	1027	Soil	1	X															"		

Relinquished by: (Signature) 	Received by: (Signature)	Date:	Time:	Sample Custodian Remarks (Completed By laboratory):	
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:	QA/QC level	Turnaround
Relinquished by: (Signature)		11/6/13	11:20	Level I	↑
				Level II	↑
				Level III	↑
				Other	↑
				Routine	↑
				24 Hour	↑
				1 Week	↑
				Other	_____



11/07/13 07:34

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37200

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUSINC-13

LIMS #L56751

Initiated By: KTHURMAN

Init Date: 11/06/13 Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes No NA	Comment
1 Shipping container custody seals present and intact.	NA	
2 Sample container custody seals present and intact.	NA	
3 Sample containers received in good condition	Y	
4 Chain of custody received with samples	Y	
5 All samples listed on chain of custody received	Y	
6 Sample container labels present and legible.	Y	
7 Information on container labels correspond with chain of custody	Y	
8 Sample(s) properly preserved and in appropriate container(s)	NA	
9 Other (Describe)	NA	
<b>For Hazardous Materials Only:</b>		
10 Paperwork shows TBE and shippers name, address and phone number	NA	
11 Paperwork shows sample quantity information	NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

11/26/2013

LIMS #: L56752

Project ID#: CH085-3EUNIVMO-09

Received: 11/06/2013

Delivery Date: 12/06/2013

P.O.#: SIGNED QUOTE

Release #:

SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter

Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G303-001	L56752-1	
C1309025-G303-002	L56752-2	
C1309025-G303-003	L56752-3	
C1309025-G303-004	L56752-4	
C1309025-G303-005	L56752-5	
C1309025-G303-006	L56752-6	
C1309025-G303-007	L56752-7	
C1309025-G303-008	L56752-8	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G303-009	L56752-9	
C1309025-G303-010	L56752-10	
C1309025-G303-011	L56752-11	
C1309025-G303-012	L56752-12	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

11/26/13 14:10



**L56752**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Sample ID: **C1309025-G303-001**

Collect Start: 11/03/2013 08:53

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-9.72E-02	4.24E-01	<b>7.04E-01</b>	pCi/g		3.0011	g wet		11/21/13	30	M	U
-3	2003	3.82E-01	4.89E-01	<b>8.92E-01</b>	pCi/g		3.0011	g wet		11/24/13	30	M	U

Sample ID: **C1309025-G303-002**

Collect Start: 11/03/2013 09:01

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.12E-02	4.15E-01	<b>6.86E-01</b>	pCi/g		3.0769	g wet		11/21/13	30	M	U
-3	2003	1.99E-01	4.68E-01	<b>8.70E-01</b>	pCi/g		3.0769	g wet		11/24/13	30	M	U

Sample ID: **C1309025-G303-003**

Collect Start: 11/03/2013 09:06

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	7.19E-02	4.29E-01	<b>7.03E-01</b>	pCi/g		3.0032	g wet		11/21/13	30	M	U
-3	2003	-3.60E-01	4.49E-01	<b>8.91E-01</b>	pCi/g		3.0032	g wet		11/24/13	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 14:10



**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L56752**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-G303-004</b>	Collect Start: 11/03/2013 09:09	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-4		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.02E-01	4.26E-01	<b>6.96E-01</b>	pCi/g		3.0331	g wet		11/21/13	30	M	U
I-3	2003	-1.73E-01	4.55E-01	<b>8.82E-01</b>	pCi/g		3.0331	g wet		11/24/13	30	M	U

Sample ID: <b>C1309025-G303-005</b>	Collect Start: 11/03/2013 09:14	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-5		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.37E-01	4.15E-01	<b>6.96E-01</b>	pCi/g		3.0349	g wet		11/21/13	30	M	U
I-3	2003	-1.32E-01	4.57E-01	<b>8.82E-01</b>	pCi/g		3.0349	g wet		11/24/13	30	M	U

Sample ID: <b>C1309025-G303-006</b>	Collect Start: 11/03/2013 09:17	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-6		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.77E-01	3.96E-01	<b>6.72E-01</b>	pCi/g		3.143	g wet		11/21/13	30	M	U
I-3	2003	-2.13E-02	4.46E-01	<b>8.52E-01</b>	pCi/g		3.143	g wet		11/24/13	30	M	U

## Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- F = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- U\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

11/26/13 14:10

**L56752**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-G303-007</b>	Collect Start: 11/03/2013 09:21	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-7		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.55E-01	4.29E-01	<b>7.00E-01</b>	pCi/g		3.0196	g wet		11/21/13	30	M	U
-3	2003	3.76E-01	4.85E-01	<b>8.86E-01</b>	pCi/g		3.0196	g wet		11/24/13	30	M	U

Sample ID: <b>C1309025-G303-008</b>	Collect Start: 11/03/2013 09:25	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-8		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.98E-01	4.29E-01	<b>6.97E-01</b>	pCi/g		3.0315	g wet		11/22/13	30	M	U
-3	2003	1.65E-01	4.73E-01	<b>8.83E-01</b>	pCi/g		3.0315	g wet		11/25/13	30	M	U

Sample ID: <b>C1309025-G303-009</b>	Collect Start: 11/03/2013 09:29	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56752-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.16E-01	4.29E-01	<b>7.01E-01</b>	pCi/g		3.0132	g wet		11/22/13	30	M	U
-3	2003	8.65E-01	5.10E-01	<b>8.88E-01</b>	pCi/g		3.0132	g wet		11/25/13	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 14:10



**L56752**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: **C1309025-G303-010**

Collect Start: 11/03/2013 09:33

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-10

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.00E-01	4.11E-01	<b>6.92E-01</b>	pCi/g		3.0511	g wet		11/22/13	30	M	U
I-3	2003	-2.26E-01	4.49E-01	<b>8.77E-01</b>	pCi/g		3.0511	g wet		11/25/13	30	M	U

Sample ID: **C1309025-G303-011**

Collect Start: 11/03/2013 09:36

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-11

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.03E-01	4.22E-01	<b>7.01E-01</b>	pCi/g		3.014	g wet		11/22/13	30	M	U
I-3	2003	4.99E-01	4.92E-01	<b>8.88E-01</b>	pCi/g		3.014	g wet		11/25/13	30	M	U

Sample ID: **C1309025-G303-012**

Collect Start: 11/03/2013 09:38

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56752-12

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.67E-01	4.16E-01	<b>6.94E-01</b>	pCi/g		3.0427	g wet		11/22/13	30	M	U
I-3	2003	-8.53E-01	5.23E-01	<b>9.24E-01</b>	pCi/g		3.0427	g wet		11/25/13	30	M	U

## Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- F = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- U\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



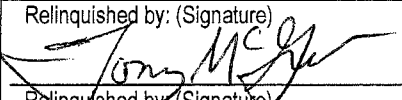
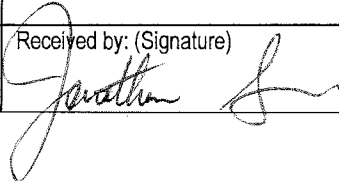
# Chain of Custody Record

No. C1309025-03

L56752  
WH33B

Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830

Project Name: MU Sinclair Farm Phase 4		Project Number: C1309025				Page 1 of 1  Purchase Order #: _____ N/A _____															
Send Report To: Dave Culp, dculp@chaseenv.com		Sampler (Print Name): Dave Culp																			
Address: 109 Flint Road		Sampler (Print Name): N/A																			
Oak Ridge, TN 37830		Shipment Method: Hand Deliver																			
Phone: 865-207-3664		Laboratory Receiving: Teledyne Brown																			
Fax: 865-481-8818																					
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested	C-14 / H-3	Gamma Spec Nuclide ID													Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
C1309025-G303-001	11-3-13	0853	Soil	1	X														Standard TAT, MDC < 1 pCi/g		
C1309025-G303-002	11-3-13	0901	Soil	1	X														"		
C1309025-G303-003	11-3-13	0906	Soil	1	X														"		
C1309025-G303-004	11-3-13	0909	Soil	1	X														"		
C1309025-G303-005	11-3-13	0914	Soil	1	X														"		
C1309025-G303-006	11-3-13	0917	Soil	1	X														"		
C1309025-G303-007	11-3-13	0921	Soil	1	X														"		
C1309025-G303-008	11-3-13	0925	Soil	1	X														"		
C1309025-G303-009	11-3-13	0929	Soil	1	X														"		
C1309025-G303-010	11-3-13	0933	Soil	1	X														"		
C1309025-G303-011	11-3-13	0936	Soil	1	X														"		
C1309025-G303-012	11-3-13	0938	Soil	1	X														"		

Relinquished by: (Signature) 		Received by: (Signature)		Date:	Time:	Sample Custodian Remarks (Completed By laboratory):	
Relinquished by: (Signature)		Received by: (Signature)		Date:	Time:		
Relinquished by: (Signature)		Received by: (Signature) 		Date: 11/6/13	Time: 11:20		

QA/QC level		Turnaround	
Level I	1	Routine	1
Level II	1	24 Hour	1
Level III	1	1 Week	1
Other	1	Other	_____



11/07/13 07:26

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37201

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L56752

Initiated By: KTHURMAN

Init Date: 11/06/13

Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

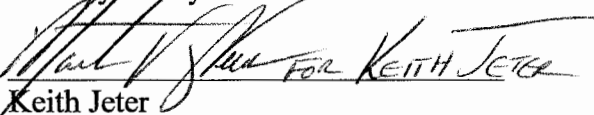
12/27/2013

LIMS #: L56754  
Project ID#: CH085-3EUNIVMO-09  
Received: 11/06/2013  
Delivery Date: 12/06/2013  
P.O.#: SIGNED QUOTE  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter

Operations Manager

Cross Reference Table

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G304-001	L56754-1	
C1309025-G304-002	L56754-2	
C1309025-G304-003	L56754-3	
C1309025-G304-004	L56754-4	
C1309025-G304-005	L56754-5	
C1309025-G304-006	L56754-6	
C1309025-G304-007	L56754-7	
C1309025-G304-008	L56754-8	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-G304-009	L56754-9	
C1309025-G304-010	L56754-10	
C1309025-G304-011	L56754-11	
C1309025-G304-012	L56754-12	

*Method Reference Numbers*

Matrix	Analysis	Method Reference
S	GAMMA	EPA 901.1

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Sample ID: C1309025-G304-001

Collect Start: 11/01/2013 11:05

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 28.68

LIMS Number: L56754-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.83E-01	4.15E-01	<b>6.98E-01</b>	pCi/g		3.0279	g wet		11/22/13	30	M	U
-3	2003	-1.69E-01	4.56E-01	<b>8.84E-01</b>	pCi/g		3.0279	g wet		11/25/13	30	M	U
E-7	2007	-2.08E-02	3.09E-01	<b>4.93E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
-40	2007	<b>1.89E+01</b>	1.18E+00	3.85E-01	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
IN-54	2007	2.73E-02	3.25E-02	<b>5.71E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
O-58	2007	-2.25E-02	3.48E-02	<b>5.31E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
E-59	2007	-4.12E-02	7.81E-02	<b>1.22E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
O-60	2007	1.21E-02	3.20E-02	<b>5.48E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
N-65	2007	6.96E-02	8.70E-02	<b>1.31E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
R-95	2007	5.52E-02	6.10E-02	<b>1.05E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
U-103	2007	-3.32E-03	3.86E-02	<b>6.12E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
U-106	2007	-3.04E-02	2.64E-01	<b>4.33E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
131	2007	2.97E-02	1.16E-01	<b>1.94E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
S-134	2007	9.87E-03	3.25E-02	<b>4.78E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
S-137	2007	<b>4.17E-01</b>	6.04E-02	5.32E-02	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
A-140	2007	1.85E-02	2.43E-01	<b>4.08E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
E-141	2007	7.05E-02	5.38E-02	<b>9.30E-02</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
E-144	2007	8.52E-02	1.78E-01	<b>2.73E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
208	2007	<b>1.35E+00</b>	1.90E-01	1.42E-01	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
212	2007	<b>1.34E+00</b>	8.41E-02	7.59E-02	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
214	2007	<b>1.23E+00</b>	1.21E-01	9.84E-02	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
212	2007	1.06E+00	7.14E-01	<b>6.30E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U
214	2007	<b>1.34E+00</b>	1.15E-01	9.14E-02	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
C-228	2007	<b>1.42E+00</b>	2.49E-01	1.89E-01	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	+
234	2007	4.14E+00	1.42E+00	<b>1.80E+00</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U*
-235	2007	2.16E-01	6.91E-02	<b>2.86E-01</b>	pCi/g Dry		246.47	g dry	11/01/13 11:05	11/18/13	13590	Sec	U

## Flag Values

- I = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- I\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-002**

Collect Start: 11/01/2013 11:12

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 26.36

LIMS Number: L56754-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.46E-01	3.99E-01	<b>6.70E-01</b>	pCi/g		3.1531	g wet		11/22/13	30	M	U
-3	2003	-1.20E+00	3.77E-01	<b>8.49E-01</b>	pCi/g		3.1531	g wet		11/25/13	30	M	U
E-7	2007	-2.18E-01	3.34E-01	<b>5.37E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
-40	2007	<b>1.70E+01</b>	1.22E+00	4.12E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
IN-54	2007	-3.53E-03	3.60E-02	<b>5.81E-02</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
O-58	2007	-2.56E-02	3.85E-02	<b>5.94E-02</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
E-59	2007	8.40E-02	8.50E-02	<b>1.53E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
O-60	2007	1.09E-02	3.09E-02	<b>5.33E-02</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
N-65	2007	5.55E-05	8.82E-02	<b>1.28E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
R-95	2007	-1.90E-02	6.80E-02	<b>1.09E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
U-103	2007	-9.29E-03	4.09E-02	<b>6.71E-02</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
U-106	2007	1.05E-01	2.96E-01	<b>4.98E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
131	2007	5.28E-02	1.41E-01	<b>2.40E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
S-134	2007	-2.16E-02	3.72E-02	<b>5.05E-02</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
S-137	2007	<b>3.59E-01</b>	7.16E-02	5.99E-02	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
A-140	2007	-1.61E-01	2.82E-01	<b>4.51E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
E-141	2007	7.03E-02	7.04E-02	<b>1.19E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
E-144	2007	-2.11E-02	2.65E-01	<b>3.78E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
L-208	2007	<b>1.24E+00</b>	1.89E-01	1.62E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
B-212	2007	<b>1.32E+00</b>	9.29E-02	9.16E-02	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
I-214	2007	<b>1.03E+00</b>	1.34E-01	1.07E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
I-212	2007	<b>2.09E+00</b>	6.68E-01	6.02E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
B-214	2007	<b>1.20E+00</b>	1.19E-01	1.15E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
C-228	2007	<b>1.12E+00</b>	2.71E-01	1.99E-01	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	+
H-234	2007	-3.20E+00	5.28E+00	<b>8.51E+00</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U
-235	2007	1.69E-01	2.25E-01	<b>3.77E-01</b>	pCi/g Dry		194.23	g dry	11/01/13 11:12	11/18/13	13589	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-003**

Collect Start: 11/01/2013 11:19

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 23.01

LIMS Number: L56754-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.61E-01	4.01E-01	<b>6.74E-01</b>	pCi/g		3.1348	g wet		11/22/13	30	M	U
-3	2003	-5.79E-01	4.17E-01	<b>8.54E-01</b>	pCi/g		3.1348	g wet		11/25/13	30	M	U
E-7	2007	-6.07E-02	2.32E-01	<b>3.79E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
-40	2007	<b>1.46E+01</b>	1.01E+00	3.51E-01	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
IN-54	2007	-3.67E-03	2.63E-02	<b>4.32E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
O-58	2007	-2.38E-02	2.73E-02	<b>4.28E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
E-59	2007	8.56E-03	6.66E-02	<b>1.09E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
O-60	2007	4.67E-03	2.74E-02	<b>4.60E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
N-65	2007	-5.33E-02	7.74E-02	<b>9.96E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
R-95	2007	-9.40E-03	5.11E-02	<b>8.45E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
U-103	2007	-1.10E-03	2.97E-02	<b>4.89E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
U-106	2007	1.09E-01	2.13E-01	<b>3.57E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
131	2007	-6.52E-02	9.17E-02	<b>1.50E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
S-134	2007	-1.66E-02	2.73E-02	<b>3.64E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
S-137	2007	2.63E-02	2.81E-02	<b>4.78E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
A-140	2007	7.03E-02	2.03E-01	<b>3.40E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
E-141	2007	1.68E-02	4.43E-02	<b>7.41E-02</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
E-144	2007	7.48E-02	1.55E-01	<b>2.36E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
L-208	2007	<b>1.26E+00</b>	1.45E-01	1.19E-01	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
3-212	2007	<b>1.16E+00</b>	6.76E-02	6.27E-02	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
I-214	2007	<b>1.10E+00</b>	1.07E-01	7.27E-02	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
I-212	2007	<b>1.34E+00</b>	5.58E-01	5.07E-01	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
3-214	2007	<b>1.07E+00</b>	8.32E-02	7.70E-02	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
C-228	2007	<b>1.38E+00</b>	1.63E-01	1.33E-01	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	+
I-234	2007	2.16E+00	5.18E-01	<b>2.38E+00</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U
-235	2007	1.72E-01	4.66E-02	<b>2.41E-01</b>	pCi/g Dry		247.53	g dry	11/01/13 11:19	11/18/13	13590	Sec	U

Flag Values

- I = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- I\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56754 Page 5 of 16



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-004**

Collect Start: 11/01/2013 11:27

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 22.78

LIMS Number: L56754-4

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.43E-01	4.12E-01	<b>6.72E-01</b>	pCi/g		3.1423	g wet		11/22/13	30	M	U
-3	2003	3.90E-02	4.50E-01	<b>8.52E-01</b>	pCi/g		3.1423	g wet		11/25/13	30	M	U
E-7	2007	3.62E-02	1.92E-01	<b>3.12E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
-40	2007	<b>1.40E+00</b>	4.12E-01	2.23E-01	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	+
IN-54	2007	-7.84E-03	1.94E-02	<b>3.07E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
O-58	2007	-1.54E-03	1.76E-02	<b>2.87E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
E-59	2007	7.36E-03	4.39E-02	<b>7.26E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
O-60	2007	-7.71E-04	1.52E-02	<b>2.53E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
N-65	2007	-2.52E-02	4.93E-02	<b>6.30E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
R-95	2007	-3.69E-02	3.74E-02	<b>5.63E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
U-103	2007	3.73E-03	2.28E-02	<b>3.70E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
U-106	2007	-1.06E-01	1.70E-01	<b>2.70E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
131	2007	-1.17E-02	7.69E-02	<b>1.24E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
S-134	2007	-3.70E-04	2.19E-02	<b>3.18E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
S-137	2007	1.85E-02	2.13E-02	<b>3.77E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
A-140	2007	-5.13E-02	1.57E-01	<b>2.59E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
E-141	2007	1.91E-02	3.44E-02	<b>5.90E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
E-144	2007	-1.78E-02	1.08E-01	<b>1.81E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
L-208	2007	1.08E-01	8.37E-02	<b>8.32E-02</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
B-212	2007	<b>1.46E-01</b>	5.32E-02	4.39E-02	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	+
I-214	2007	<b>3.64E-01</b>	7.72E-02	6.26E-02	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	+
I-212	2007	3.03E-01	2.36E-01	<b>4.32E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
B-214	2007	<b>3.55E-01</b>	6.57E-02	6.58E-02	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	+
C-228	2007	<b>1.99E-01</b>	1.21E-01	9.47E-02	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	+
H-234	2007	1.80E-01	4.24E-01	<b>1.85E+00</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U
-235	2007	7.25E-02	3.91E-02	<b>1.90E-01</b>	pCi/g Dry		296.28	g dry	11/01/13 11:27	11/18/13	13587	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-005**

Collect Start: 11/01/2013 11:38

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 14.32

LIMS Number: L56754-5

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.23E+00	3.74E-01	<b>7.31E-01</b>	pCi/g		3.0207	g wet		11/23/13	30	M	U
-3	2003	-2.14E-01	5.32E-01	<b>9.12E-01</b>	pCi/g		3.0207	g wet		11/25/13	15	M	U
E-7	2007	1.04E-01	1.76E-01	<b>2.95E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
-40	2007	<b>1.86E+00</b>	4.36E-01	2.63E-01	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
N-54	2007	1.42E-02	1.81E-02	<b>3.13E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
O-58	2007	-4.86E-03	1.92E-02	<b>3.12E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
E-59	2007	-2.03E-03	4.21E-02	<b>6.78E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
O-60	2007	7.71E-03	1.62E-02	<b>2.81E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
N-65	2007	-2.47E-02	4.72E-02	<b>6.10E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
R-95	2007	9.26E-03	3.41E-02	<b>5.75E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
U-103	2007	-4.26E-03	2.34E-02	<b>3.76E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
U-106	2007	-1.05E-01	1.59E-01	<b>2.56E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
131	2007	-3.59E-03	7.12E-02	<b>1.17E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
S-134	2007	3.17E-03	2.10E-02	<b>3.08E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
S-137	2007	3.01E-02	2.16E-02	<b>3.84E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
A-140	2007	7.97E-02	1.53E-01	<b>2.54E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
E-141	2007	7.76E-03	3.50E-02	<b>5.72E-02</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
E-144	2007	2.73E-02	1.10E-01	<b>1.80E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
L-208	2007	<b>1.49E-01</b>	8.79E-02	8.29E-02	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
B-212	2007	<b>1.99E-01</b>	4.26E-02	4.64E-02	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
I-214	2007	<b>4.82E-01</b>	7.65E-02	5.98E-02	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
I-212	2007	7.73E-02	2.44E-01	<b>4.13E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U No
B-214	2007	<b>5.34E-01</b>	6.55E-02	6.13E-02	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
C-228	2007	<b>1.84E-01</b>	8.89E-02	9.43E-02	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	+ Yes
H-234	2007	5.37E-01	4.59E-01	<b>1.70E+00</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U Yes
-235	2007	6.47E-02	3.71E-02	<b>1.85E-01</b>	pCi/g Dry		350.21	g dry	11/01/13 11:38	11/18/13	13589	Sec	U Yes

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- ! = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-006**

Collect Start: 11/01/2013 11:44

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 10.90

LIMS Number: L56754-6

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.44E-01	4.13E-01	<b>7.11E-01</b>	pCi/g		3.1034	g wet		11/23/13	30	M U	
-3	2003	-4.50E-02	5.34E-01	<b>8.88E-01</b>	pCi/g		3.1034	g wet		11/25/13	15	M U	
E-7	2007	7.82E-02	1.69E-01	<b>2.85E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
-40	2007	4.45E-01	3.57E-01	<b>2.63E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	Yes
IN-54	2007	-8.56E-03	1.59E-02	<b>2.56E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
O-58	2007	-5.77E-03	1.86E-02	<b>2.90E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
E-59	2007	5.07E-03	3.94E-02	<b>6.64E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
O-60	2007	1.73E-03	1.53E-02	<b>2.57E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
N-65	2007	1.73E-03	3.21E-02	<b>4.64E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
R-95	2007	-5.74E-03	3.51E-02	<b>5.59E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
U-103	2007	1.42E-02	2.19E-02	<b>3.73E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
U-106	2007	4.41E-02	1.64E-01	<b>2.71E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
131	2007	3.87E-02	7.07E-02	<b>1.20E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
S-134	2007	-2.35E-03	2.12E-02	<b>2.94E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
S-137	2007	8.96E-03	1.84E-02	<b>3.09E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
A-140	2007	2.91E-02	1.50E-01	<b>2.48E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
E-141	2007	-1.77E-02	3.61E-02	<b>5.95E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
E-144	2007	-4.71E-02	1.17E-01	<b>1.93E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
L-208	2007	5.62E-02	7.18E-02	<b>9.32E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	Yes
B-212	2007	5.17E-02	3.79E-02	<b>4.92E-02</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	Yes
I-214	2007	<b>2.53E-01</b>	7.47E-02	5.81E-02	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec +	Yes
I-212	2007	-5.35E-02	2.18E-01	<b>3.47E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	No
B-214	2007	<b>2.62E-01</b>	6.36E-02	5.87E-02	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec +	Yes
H-234	2007	4.31E-01	5.26E-01	<b>4.29E+00</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	Yes
-235	2007	4.20E-02	3.21E-02	<b>2.02E-01</b>	pCi/g Dry		381.16	g dry	11/01/13 11:44	11/18/13	13588	Sec U	Yes

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-007**

Collect Start: 11/01/2013 11:55

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 8.16

LIMS Number: L56754-7

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.50E-01	3.89E-01	<b>6.73E-01</b>	pCi/g		3.2803	g wet		11/23/13	30	M	U
-3	2003	6.77E-01	5.74E-01	<b>8.40E-01</b>	pCi/g		3.2803	g wet		11/25/13	15	M	U
E-7	2007	2.40E-02	1.22E-01	<b>2.00E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
-40	2007	<b>3.48E-01</b>	1.95E-01	1.69E-01	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	+
IN-54	2007	2.58E-03	1.18E-02	<b>1.96E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
O-58	2007	-4.85E-03	1.45E-02	<b>2.30E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
E-59	2007	-5.99E-04	2.65E-02	<b>4.40E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
O-60	2007	1.48E-02	1.57E-02	<b>2.28E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
N-65	2007	-1.60E-02	2.97E-02	<b>3.89E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
R-95	2007	-1.27E-03	2.40E-02	<b>3.93E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
U-103	2007	-2.41E-03	1.53E-02	<b>2.43E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
U-106	2007	-1.80E-04	1.16E-01	<b>1.93E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
131	2007	-2.92E-02	4.91E-02	<b>7.80E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
S-134	2007	-6.05E-03	1.44E-02	<b>2.02E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
S-137	2007	1.77E-03	1.29E-02	<b>2.17E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
A-140	2007	-1.12E-01	1.05E-01	<b>1.53E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
E-141	2007	-3.59E-03	2.32E-02	<b>3.74E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
E-144	2007	4.02E-02	7.34E-02	<b>1.22E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
L-208	2007	1.69E-03	4.14E-02	<b>6.96E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
3-212	2007	-7.22E-04	2.34E-02	<b>4.02E-02</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
I-214	2007	<b>1.90E-01</b>	5.37E-02	3.96E-02	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	+
I-212	2007	-2.53E-02	1.44E-01	<b>2.33E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
3-214	2007	<b>2.13E-01</b>	4.36E-02	4.20E-02	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	+
I-234	2007	3.18E-01	3.28E-01	<b>1.11E+00</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U
-235	2007	2.53E-02	7.53E-02	<b>1.23E-01</b>	pCi/g Dry		397.1	g dry	11/01/13 11:55	11/18/13	13590	Sec	U

## Flag Values

- ! = Compound/Analyte not detected (< MDC) or less than 3 sigma
- \* = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- !\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**bolded text indicates reportable value.**



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-G304-008</b>	Collect Start: 11/01/2013 12:13	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture: 8.98	
LIMS Number: L56754-8			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.37E-01	4.12E-01	<b>7.00E-01</b>	pCi/g		3.1522	g wet		11/23/13	30	M	U
-3	2003	<b>7.15E-01</b>	4.57E-01	6.38E-01	pCi/g		3.1522	g wet		11/26/13	15	M	+
E-7	2007	1.31E-02	2.07E-01	<b>3.34E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
-40	2007	<b>1.25E+00</b>	4.87E-01	3.57E-01	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	+
IN-54	2007	-7.61E-03	2.03E-02	<b>3.23E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
O-58	2007	-9.13E-03	2.41E-02	<b>3.66E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
B-59	2007	-1.51E-02	5.45E-02	<b>8.48E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
O-60	2007	-3.26E-03	2.12E-02	<b>3.40E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
N-65	2007	2.12E-02	4.61E-02	<b>7.18E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
R-95	2007	-1.65E-02	4.37E-02	<b>6.69E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
U-103	2007	-2.61E-02	2.72E-02	<b>3.86E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
U-106	2007	1.94E-02	1.81E-01	<b>3.03E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
131	2007	6.53E-03	7.97E-02	<b>1.32E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
S-134	2007	-6.96E-03	2.45E-02	<b>3.37E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
S-137	2007	1.57E-02	2.33E-02	<b>4.10E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
A-140	2007	1.05E-01	1.72E-01	<b>3.05E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
E-141	2007	2.62E-02	3.78E-02	<b>6.54E-02</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
E-144	2007	1.63E-01	1.16E-01	<b>2.10E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
C-208	2007	1.35E-01	1.37E-01	<b>1.15E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
B-212	2007	<b>8.15E-02</b>	5.07E-02	5.54E-02	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	+
I-214	2007	<b>3.09E-01</b>	7.92E-02	7.00E-02	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	+
I-212	2007	1.91E-01	2.92E-01	<b>5.09E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
B-214	2007	<b>2.19E-01</b>	7.77E-02	6.94E-02	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	+
C-228	2007	<b>1.78E-01</b>	1.18E-01	1.30E-01	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	+
H-234	2007	7.10E-02	7.14E-01	<b>1.21E+00</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U
-235	2007	-4.70E-02	1.25E-01	<b>2.03E-01</b>	pCi/g Dry		344.35	g dry	11/01/13 12:13	11/18/13	7200	Sec	U

Flag Values  
 J = Compound/Analyte not detected (< MDC) or less than 3 sigma  
 . = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)  
 J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma  
 fgh = Activity concentration exceeds customer reporting value  
 pec = MDC exceeds customer technical specification  
 . = Low recovery  
 f = High recovery

No = Peak not identified in gamma spectrum  
 Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56754 Page 10 of 16

**bolded text indicates reportable value.**



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-009**

Collect Start: 11/01/2013 12:20

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 9.48

LIMS Number: L56754-9

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.63E-01	4.19E-01	<b>7.13E-01</b>	pCi/g		3.0976	g wet		11/23/13	30	M	U
-3	2003	-7.78E-02	5.32E-01	<b>8.90E-01</b>	pCi/g		3.0976	g wet		11/25/13	15	M	U
E-7	2007	1.05E-01	1.64E-01	<b>2.89E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
-40	2007	<b>6.10E-01</b>	3.59E-01	2.09E-01	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	+
IN-54	2007	-1.28E-02	1.67E-02	<b>2.40E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
O-58	2007	4.13E-04	1.62E-02	<b>2.64E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
E-59	2007	-1.01E-02	3.90E-02	<b>6.29E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
O-60	2007	-1.05E-03	1.95E-02	<b>3.20E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
N-65	2007	-6.35E-03	3.51E-02	<b>4.85E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
R-95	2007	8.94E-03	2.89E-02	<b>4.93E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
U-103	2007	-3.31E-02	2.01E-02	<b>2.71E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
U-106	2007	1.89E-03	1.51E-01	<b>2.49E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
131	2007	-4.36E-02	6.15E-02	<b>9.66E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
S-134	2007	1.81E-03	1.76E-02	<b>2.55E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
S-137	2007	-9.16E-03	1.80E-02	<b>2.77E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
A-140	2007	-2.08E-02	1.34E-01	<b>2.18E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
E-141	2007	1.94E-02	3.43E-02	<b>5.78E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
E-144	2007	3.24E-02	1.07E-01	<b>1.78E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
L-208	2007	3.26E-02	5.69E-02	<b>1.03E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
B-212	2007	3.13E-02	3.53E-02	<b>6.05E-02</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
I-214	2007	<b>2.24E-01</b>	5.47E-02	4.92E-02	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	+
I-212	2007	1.19E-01	2.18E-01	<b>3.79E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
B-214	2007	<b>1.56E-01</b>	5.40E-02	5.74E-02	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	+
H-234	2007	-1.74E+00	2.28E+00	<b>3.62E+00</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U
-235	2007	1.28E-01	1.09E-01	<b>1.89E-01</b>	pCi/g Dry		417.13	g dry	11/01/13 12:20	11/18/13	7200	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: **C1309025-G304-010**

Collect Start: 11/01/2013 12:27

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 27.45

LIMS Number: L56754-10

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	2.48E-01	4.48E-01	7.26E-01	pCi/g		3.039	g wet		11/23/13	30	M	U
-3	2003	<b>1.24E+01</b>	1.30E+00	9.07E-01	pCi/g		3.039	g wet		11/25/13	15	M	+
E-7	2007	9.66E-02	2.83E-01	<b>4.79E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
-40	2007	<b>1.24E+01</b>	1.06E+00	3.17E-01	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
IN-54	2007	1.08E-03	3.22E-02	<b>5.36E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
O-58	2007	-1.89E-02	3.01E-02	<b>4.69E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
E-59	2007	-5.66E-02	7.69E-02	<b>1.15E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
O-60	2007	1.33E-02	3.25E-02	<b>5.63E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
N-65	2007	-1.71E-03	7.95E-02	<b>1.10E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
R-95	2007	5.43E-02	5.91E-02	<b>1.06E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
U-103	2007	1.64E-02	3.65E-02	<b>6.20E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
U-106	2007	-6.79E-02	3.01E-01	<b>4.80E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
131	2007	5.10E-02	1.09E-01	<b>1.89E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
S-134	2007	-2.31E-02	3.69E-02	<b>4.85E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
S-137	2007	<b>1.13E-01</b>	5.07E-02	6.09E-02	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
A-140	2007	4.50E-03	2.32E-01	<b>3.81E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
E-141	2007	1.45E-03	5.39E-02	<b>9.04E-02</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
E-144	2007	-4.41E-02	1.64E-01	<b>2.75E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
L-208	2007	<b>8.77E-01</b>	1.61E-01	1.31E-01	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
B-212	2007	<b>9.79E-01</b>	8.06E-02	7.35E-02	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
I-214	2007	<b>1.00E+00</b>	1.32E-01	9.03E-02	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
I-212	2007	<b>1.04E+00</b>	6.17E-01	6.20E-01	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
B-214	2007	<b>9.49E-01</b>	1.03E-01	9.39E-02	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
C-228	2007	<b>9.63E-01</b>	2.64E-01	1.94E-01	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	+
H-234	2007	1.37E+00	6.80E-01	<b>2.95E+00</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U
-235	2007	1.11E-01	5.39E-02	<b>2.97E-01</b>	pCi/g Dry		278.83	g dry	11/01/13 12:27	11/18/13	7200	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-011**

Collect Start: 11/01/2013 12:36

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 26.05

LIMS Number: L56754-11

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.65E-01	4.17E-01	<b>6.95E-01</b>	pCi/g		3.1745	g wet		11/23/13	30	M	U
-3	2003	<b>1.17E+00</b>	6.34E-01	8.68E-01	pCi/g		3.1745	g wet		11/25/13	15	M	+
E-7	2007	4.01E-01	3.94E-01	<b>6.83E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
-40	2007	<b>1.69E+01</b>	1.50E+00	6.36E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
IN-54	2007	3.59E-02	4.27E-02	<b>7.58E-02</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
O-58	2007	-4.57E-02	4.71E-02	<b>7.00E-02</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
E-59	2007	-6.05E-02	1.05E-01	<b>1.59E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
O-60	2007	2.60E-02	4.07E-02	<b>7.38E-02</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
N-65	2007	-3.34E-02	1.13E-01	<b>1.50E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
R-95	2007	6.36E-02	8.87E-02	<b>1.56E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
U-103	2007	-4.24E-03	5.07E-02	<b>8.05E-02</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
U-106	2007	1.51E-02	3.57E-01	<b>6.00E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
131	2007	3.22E-02	1.70E-01	<b>2.80E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
S-134	2007	1.47E-02	4.64E-02	<b>6.99E-02</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
S-137	2007	<b>2.31E-01</b>	8.63E-02	6.60E-02	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
A-140	2007	3.73E-01	3.47E-01	<b>6.30E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
E-141	2007	5.31E-02	8.05E-02	<b>1.39E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
E-144	2007	-1.01E-01	2.59E-01	<b>4.29E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
L-208	2007	<b>1.16E+00</b>	2.78E-01	2.17E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
B-212	2007	<b>1.40E+00</b>	1.31E-01	1.12E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
I-214	2007	<b>1.21E+00</b>	1.89E-01	1.43E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
I-212	2007	<b>2.16E+00</b>	1.08E+00	8.52E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
B-214	2007	<b>1.28E+00</b>	1.41E-01	1.46E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
C-228	2007	<b>1.77E+00</b>	3.18E-01	2.09E-01	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	+
H-234	2007	1.78E+00	1.19E+00	<b>4.43E+00</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U
-235	2007	2.32E-01	9.53E-02	<b>4.35E-01</b>	pCi/g Dry		239.15	g dry	11/01/13 12:36	11/18/13	7200	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- / = Low recovery
- I = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/27/13 09:24

**L56754**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

Project Manager

Sample ID: **C1309025-G304-012**

Collect Start: 11/01/2013 12:44

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture: 9.06

LIMS Number: L56754-12

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.09E-01	4.39E-01	<b>7.28E-01</b>	pCi/g		3.0332	g wet		11/23/13	30	M	U
-3	2003	-5.05E-02	4.18E-01	<b>6.97E-01</b>	pCi/g		3.0332	g wet		11/26/13	15	M	U
E-7	2007	1.89E-01	2.36E-01	<b>4.06E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
-40	2007	<b>1.15E+00</b>	4.89E-01	3.20E-01	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	+
IN-54	2007	-8.11E-03	2.44E-02	<b>3.90E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
O-58	2007	1.65E-02	2.40E-02	<b>4.23E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
E-59	2007	3.74E-03	5.17E-02	<b>8.43E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
O-60	2007	-1.98E-03	2.20E-02	<b>3.61E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
N-65	2007	-8.44E-02	5.68E-02	<b>7.57E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
R-95	2007	4.08E-02	4.42E-02	<b>7.95E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
U-103	2007	-5.21E-03	2.76E-02	<b>4.40E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
U-106	2007	1.17E-01	2.01E-01	<b>3.54E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
131	2007	-1.89E-02	9.45E-02	<b>1.54E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
S-134	2007	7.13E-03	2.53E-02	<b>3.78E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
S-137	2007	-1.92E-02	2.29E-02	<b>3.56E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
A-140	2007	2.23E-02	1.93E-01	<b>3.15E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
E-141	2007	1.38E-03	4.38E-02	<b>7.12E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
E-144	2007	-7.48E-02	1.33E-01	<b>2.09E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
L-208	2007	<b>2.10E-01</b>	9.91E-02	1.12E-01	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	+
B-212	2007	8.59E-02	5.78E-02	<b>5.41E-02</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
I-214	2007	<b>2.41E-01</b>	9.14E-02	7.47E-02	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	+
I-212	2007	-1.08E-01	2.96E-01	<b>4.84E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
B-214	2007	<b>2.45E-01</b>	6.97E-02	7.38E-02	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	+
H-234	2007	7.66E-01	6.24E-01	<b>2.00E+00</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U
-235	2007	1.91E-02	4.31E-02	<b>2.34E-01</b>	pCi/g Dry		357.58	g dry	11/01/13 12:44	11/18/13	7200	Sec	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**







11/07/13 07:13

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37203

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUSINC-13

LIMS #L56754

Initiated By: KTHURMAN

Init Date: 11/06/13 Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment:

Criteria	Yes No NA	Comment
1 Shipping container custody seals present and intact.	NA	
2 Sample container custody seals present and intact.	NA	
3 Sample containers received in good condition	Y	
4 Chain of custody received with samples	Y	
5 All samples listed on chain of custody received	Y	
6 Sample container labels present and legible.	Y	
7 Information on container labels correspond with chain of custody	Y	
8 Sample(s) properly preserved and in appropriate container(s)	NA	
9 Other (Describe)	NA	
<b>For Hazardous Materials Only:</b>		
10 Paperwork shows TBE and shippers name, address and phone number	NA	
11 Paperwork shows sample quantity information	NA	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

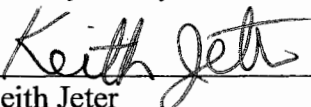
12/26/2013

LIMS #: L56756  
Project ID#: CH085-3EUNIVMO-09  
Received: 11/06/2013  
Delivery Date: 12/06/2013  
P.O.#: SIGNED QUOTE  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
\_\_\_\_\_  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L001-001-SL	L56756-1	
C1309025-L001-001-SO	L56756-2	
C1309025-L001-002-SL	L56756-3	
C1309025-L001-002-SO	L56756-4	
C1309025-L001-003-SL	L56756-5	
C1309025-L001-003-SO	L56756-6	
C1309025-L001-004-SL	L56756-7	
C1309025-L001-004-SO	L56756-8	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L001-005-SL	L56756-9	
C1309025-L001-005-SO	L56756-10	
C1309025-L001-006-SL	L56756-11	
C1309025-L001-006-SO	L56756-12	
C1309025-L001-007-SL	L56756-13	
C1309025-L001-007-SO	L56756-14	
C1309025-L001-008-SL	L56756-15	
C1309025-L001-008-SO	L56756-16	
C1309025-L001-009-SL	L56756-17	
C1309025-L001-009-SO	L56756-18	
C1309025-L001-010-SL	L56756-19	
C1309025-L001-010-SO	L56756-20	
C1309025-L001-011-SL	L56756-21	
C1309025-L001-011-SO	L56756-22	
C1309025-L001-012-SL	L56756-23	
C1309025-L001-012-SO	L56756-24	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

12/26/13 15:17



**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Sample ID: **C1309025-L001-001-SL**

Collect Start: 11/02/2013 13:24

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56756-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.01E-01	4.01E-01	<b>6.81E-01</b>	pCi/g		3.2432	g wet		11/23/13	30	M	U
-3	2003	-2.10E-02	3.74E-01	<b>6.20E-01</b>	pCi/g		3.2432	g wet		11/26/13	15	M	U

Sample ID: **C1309025-L001-001-SO**

Collect Start: 11/02/2013 13:24

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56756-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.53E-01	3.83E-01	<b>6.48E-01</b>	pCi/g		3.4081	g wet		11/23/13	30	M	U
-3	2003	-1.99E-02	3.56E-01	<b>5.90E-01</b>	pCi/g		3.4081	g wet		11/26/13	15	M	U

Sample ID: **C1309025-L001-002-SL**

Collect Start: 11/02/2013 13:29

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56756-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.31E-01	4.26E-01	<b>7.22E-01</b>	pCi/g		3.0572	g wet		11/23/13	30	M	U
-3	2003	-2.25E-01	3.74E-01	<b>6.57E-01</b>	pCi/g		3.0572	g wet		11/26/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17

**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L001-002-SO</b>	Collect Start: 11/02/2013 13:29	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-4		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-7.16E-02	4.11E-01	<b>6.80E-01</b>	pCi/g		3.2447	g wet		11/23/13	30	M	U
-3	2003	-2.39E-02	3.73E-01	<b>6.19E-01</b>	pCi/g		3.2447	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L001-003-SL</b>	Collect Start: 11/02/2013 13:33	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-5		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.56E-01	4.08E-01	<b>6.80E-01</b>	pCi/g		3.2465	g wet		11/23/13	30	M	U
-3	2003	<b>2.19E+00</b>	5.62E-01	6.19E-01	pCi/g		3.2465	g wet		11/26/13	15	M	+

Sample ID: <b>C1309025-L001-003-S0</b>	Collect Start: 11/02/2013 13:33	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-6		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.80E-01	4.09E-01	<b>7.02E-01</b>	pCi/g		3.1464	g wet		11/23/13	30	M	U
-3	2003	<b>2.14E+00</b>	5.71E-01	6.39E-01	pCi/g		3.1464	g wet		11/26/13	15	M	+

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56756 Page 4 of 13

**Bolded text indicates reportable value.**



# Report of Analysis

12/26/13 15:17



**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L001-004-SL</b>	Collect Start: 11/02/2013 13:38	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-7		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.58E-01	4.09E-01	<b>6.92E-01</b>	pCi/g		3.1924	g wet		11/23/13	30	M	U
-3	2003	<b>1.85E+00</b>	5.44E-01	6.29E-01	pCi/g		3.1924	g wet		11/26/13	15	M	+

Sample ID: <b>C1309025-L001-004-SO</b>	Collect Start: 11/02/2013 13:38	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-8		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.03E-01	4.20E-01	<b>7.16E-01</b>	pCi/g		3.0827	g wet		11/23/13	30	M	U
-3	2003	-1.61E-01	3.78E-01	<b>6.52E-01</b>	pCi/g		3.0827	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L001-005-SL</b>	Collect Start: 11/02/2013 14:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	9.13E-02	4.24E-01	<b>6.94E-01</b>	pCi/g		3.1813	g wet		11/23/13	30	M	U
-3	2003	-2.23E-01	3.59E-01	<b>6.32E-01</b>	pCi/g		3.1813	g wet		11/26/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- Low = Low recovery
- High = High recovery

**Bolded text indicates reportable value.**

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L001-005-SO</b>	Collect Start: 11/02/2013 14:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-10		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.15E-01	4.27E-01	<b>7.18E-01</b>	pCi/g		3.0745	g wet		11/23/13	30	M	U
-3	2003	-2.21E-01	3.73E-01	<b>6.54E-01</b>	pCi/g		3.0745	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L001-006-SL</b>	Collect Start: 11/02/2013 14:06	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-11		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.46E-01	4.18E-01	<b>7.16E-01</b>	pCi/g		3.0847	g wet		11/23/13	30	M	U
-3	2003	-2.52E-02	3.93E-01	<b>6.51E-01</b>	pCi/g		3.0847	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L001-006-SO</b>	Collect Start: 11/02/2013 14:06	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-12		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.15E-01	4.29E-01	<b>7.18E-01</b>	pCi/g		3.0765	g wet		11/23/13	30	M	U
-3	2003	1.89E-02	3.98E-01	<b>6.53E-01</b>	pCi/g		3.0765	g wet		11/26/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- high = Activity concentration exceeds customer reporting value
- spec = MDC exceeds customer technical specification
- low = Low recovery
- hi = High recovery

**Bolded text indicates reportable value.**

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L001-007-SL</b>	Collect Start: 11/02/2013 14:12	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-13			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.79E-01	4.73E-01	<b>7.94E-01</b>	pCi/g	R2	3.74	g wet		12/17/13	15	M	U
-3	2003	<b>3.60E+00</b>	7.94E-01	8.65E-01	pCi/g	R1	3.4545	g wet		11/26/13	15	M	+

Sample ID: <b>C1309025-L001-007-SO</b>	Collect Start: 11/02/2013 14:12	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-14			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.87E-01	4.57E-01	<b>7.79E-01</b>	pCi/g	R2	3.815	g wet		12/17/13	15	M	U
-3	2003	<b>1.16E+00</b>	6.42E-01	8.93E-01	pCi/g	R1	3.3451	g wet		11/26/13	15	M	+

Sample ID: <b>C1309025-L001-008-SL</b>	Collect Start: 11/02/2013 14:14	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-15			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.45E-01	5.65E-01	<b>9.01E-01</b>	pCi/g	R2	3.296	g wet		12/17/13	15	M	U
-3	2003	<b>3.10E+00</b>	8.28E-01	9.65E-01	pCi/g	R1	3.0961	g wet		11/26/13	15	M	+

## Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [\*] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [tgh] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17

**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



Project Manager

Sample ID: <b>C1309025-L001-008-SO</b>	Collect Start: 11/02/2013 14:14	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-16			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-8.41E-01	4.54E-01	<b>8.24E-01</b>	pCi/g	R2	3.607	g wet		12/17/13	15	M	U
-3	2003	2.87E-02	5.83E-01	<b>9.56E-01</b>	pCi/g	R1	3.1251	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L001-009-SL</b>	Collect Start: 11/02/2013 14:24	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-17			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.98E-01	5.00E-01	<b>8.68E-01</b>	pCi/g	R2	3.424	g wet		12/17/13	15	M	U
-3	2003	-3.65E-01	5.65E-01	<b>9.89E-01</b>	pCi/g	R1	3.0206	g wet		11/27/13	15	M	U

Sample ID: <b>C1309025-L001-009-SO</b>	Collect Start: 11/02/2013 14:24	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56756-18			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.85E-01	5.01E-01	<b>8.50E-01</b>	pCi/g	R2	3.495	g wet		12/17/13	15	M	U
-3	2003	<b>1.32E+00</b>	6.90E-01	9.51E-01	pCi/g	R1	3.1426	g wet		11/27/13	15	M	+

## Flag Values

- I = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- I\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- [ = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17

**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L001-010-SL</b>	Collect Start: 11/02/2013 14:28	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-19		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.77E-01	5.07E-01	<b>8.78E-01</b>	pCi/g	R2	3.382	g wet		12/17/13	15	M	U
-3	2003	3.11E-01	6.15E-01	<b>9.67E-01</b>	pCi/g	R1	3.0894	g wet		11/27/13	15	M	U

Sample ID: <b>C1309025-L001-010-SO</b>	Collect Start: 11/02/2013 14:28	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-20		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.35E-01	4.39E-01	<b>7.81E-01</b>	pCi/g	R2	3.805	g wet		12/17/13	15	M	U
-3	2003	-3.42E-01	5.17E-01	<b>9.07E-01</b>	pCi/g	R1	3.2934	g wet		11/27/13	15	M	U

Sample ID: <b>C1309025-L001-011-SL</b>	Collect Start: 11/02/2013 14:31	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-21		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.15E-01	4.62E-01	<b>7.89E-01</b>	pCi/g	R2	3.767	g wet		12/17/13	15	M	U
-3	2003	-2.97E-01	5.40E-01	<b>9.38E-01</b>	pCi/g	R1	3.1865	g wet		11/27/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

12/26/13 15:17



**L56756**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L001-011-SO</b>	Collect Start: 11/02/2013 14:31	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-22		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.88E-01	4.54E-01	<b>7.83E-01</b>	pCi/g	R2	3.795	g wet		12/17/13	15	M	U
-3	2003	-5.23E-01	5.46E-01	<b>9.84E-01</b>	pCi/g	R1	3.0353	g wet		11/27/13	15	M	U

Sample ID: <b>C1309025-L001-012-SL</b>	Collect Start: 11/02/2013 14:38	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-23		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.17E-01	4.65E-01	<b>8.21E-01</b>	pCi/g	R2	3.617	g wet		12/17/13	15	M	U
-3	2003	-6.92E-01	4.51E-01	<b>8.58E-01</b>	pCi/g	R1	3.4801	g wet		11/27/13	15	M	U

Sample ID: <b>C1309025-L001-012-SO</b>	Collect Start: 11/02/2013 14:38	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56756-24		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-7.84E-01	4.71E-01	<b>8.47E-01</b>	pCi/g	R2	3.509	g wet		12/17/13	15	M	U
-3	2003	-1.52E-01	5.11E-01	<b>8.65E-01</b>	pCi/g	R1	3.4532	g wet		11/27/13	15	M	U

Flag Values

J = Compound/Analyte not detected (< MDC) or less than 3 sigma

· = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)

J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma

ligh = Activity concentration exceeds customer reporting value

pec = MDC exceeds customer technical specification

· = Low recovery

l = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L56756 Page 10 of 13

**bolded text indicates reportable value.**



# Chain of Custody Record

No. C1309025-05

L56756  
WH33B

Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830

Project Name: MU Sinclair Farm Phase 4		Project Number: C1309025				<div style="text-align: right;">Page 1 of 2</div> <div style="text-align: right;">Purchase Order #: _____ N/A _____</div>																							
Send Report To: Dave Culp, dculp@chaseenv.com		Sampler (Print Name): Dave Culp																											
Address: 109 Flint Road		Sampler (Print Name): N/A																											
Oak Ridge, TN 37830		Shipment Method: Hand Deliver																											
Phone: 865-207-3664		Laboratory Receiving: Teledyne Brown																											
Fax: 865-481-8818																													
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested	C-14 / H-3												Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)										
C1309025-L001-001-SL	11-2-13	1324	Soil	1	X													Standard TAT, MDC < 1 pCi/g											
C1309025-L001-001-SO	11-2-13	1324	Soil	1	X													"											
C1309025-L001-002-SL	11-2-13	1324 <sup>329</sup>	Soil	1	X													"											
C1309025-L001-002-SO	11-2-13	1338 <sup>1324</sup>	Soil	1	X													"											
C1309025-L001-003-SL	11-2-13	1333	Soil	1	X													"											
C1309025-L001-003-SO	11-2-13	1333	Soil	1	X													"											
C1309025-L001-004-SL	11-2-13	1338	Soil	1	X													"											
C1309025-L001-004-SO	11-2-13	1338	Soil	1	X													"											
C1309025-L001-005-SL	11-2-13	1400	Soil	1	X													"											
C1309025-L001-005-SO	11-2-13	1400	Soil	1	X													"											
C1309025-L001-006-SL	11-2-13	1406	Soil	1	X													"											
C1309025-L001-006-SO	11-2-13	1406	Soil	1	X													"											
C1309025-L001-007-SL	11-2-13	1412	Soil	1	X													"											
C1309025-L001-007-SO	11-2-13	1412	Soil	1	X													"											
C1309025-L001-008-SL	11-2-13	1414	Soil	1	X													"											
C1309025-L001-008-SO	11-2-13	1414	Soil	1	X													"											
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:	<table border="1"> <tr> <th>QA/QC level</th> <th>Turnaround</th> </tr> <tr> <td>Level I</td> <td>1</td> </tr> <tr> <td>Level II</td> <td>1</td> </tr> <tr> <td>Level III</td> <td>1</td> </tr> <tr> <td>Other</td> <td>1</td> </tr> </table>													QA/QC level	Turnaround	Level I	1	Level II	1	Level III	1	Other	1
QA/QC level	Turnaround																												
Level I	1																												
Level II	1																												
Level III	1																												
Other	1																												
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:																							
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:																							



## Chain of Custody Record

**No. C1309025-05**

**Chase Environmental Group, Inc.**  
109 Flint Road  
Oak Ridge, TN 37830

[illegible]



11/06/13 15:04

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37205

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #156756

Initiated By: KTHURMAN

Init Date: 11/06/13

Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

04/18/2014

LIMS #: L58122  
Project ID#: CH085-3EMUSINC-13  
Received: 03/20/2014  
Delivery Date: 04/19/2014  
P.O.#: C1309025-08  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L001-003-SO-0206	L58122-1	
C1309025-L001-007-SO-0306	L58122-2	
C1309025-L001-J13-SL	L58122-3	
C1309025-L001-J13-SO-0003	L58122-4	
C1309025-L001-J14-SL	L58122-5	
C1309025-L001-J14-SO-0003	L58122-6	
C1309025-L001-J15-SO-0001	L58122-7	
C1309025-L001-J15-SO-0102	L58122-8	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**

A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L001-J16-SL	L58122-9	
C1309025-L001-SO-0001	L58122-10	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

04/18/14 12:41



**L58122**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Sample ID: <b>C1309025-L001-003-SO-0206</b>	Collect Start: 03/13/2014 12:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58122-1			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	1.48E+00	4.24E-01	5.26E-01	pCi/g		3.2	g wet		04/18/14	30	M	+

Sample ID: <b>C1309025-L001-007-SO-0306</b>	Collect Start: 03/13/2014 12:00	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58122-2			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	4.66E-01	3.42E-01	5.04E-01	pCi/g		3.34	g wet		04/18/14	30	M	U

Sample ID: <b>C1309025-L001-J13-SL</b>	Collect Start: 03/13/2014 09:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58122-3			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	2.70E-01	3.42E-01	5.28E-01	pCi/g		3.19	g wet		04/18/14	30	M	U

Sample ID: <b>C1309025-L001-J13-SO-0003</b>	Collect Start: 03/13/2014 09:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58122-4			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	3.22E-01	3.11E-01	4.70E-01	pCi/g		3.58	g wet		04/18/14	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

04/18/14 12:41



**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L58122**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L001-J14-SL</b>	Collect Start: 03/13/2014 09:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-5		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	3.79E-01	3.55E-01	<b>5.36E-01</b>	pCi/g		3.14	g wet		04/18/14	30	M	U

Sample ID: <b>C1309025-L001-J14-SO-0003</b>	Collect Start: 03/13/2014 09:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-6		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	<b>7.49E-01</b>	3.78E-01	5.29E-01	pCi/g		3.18	g wet		04/18/14	30	M	+

Sample ID: <b>C1309025-L001-J15-SO-0001</b>	Collect Start: 03/13/2014 13:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-7		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	<b>6.07E-01</b>	3.69E-01	5.31E-01	pCi/g		3.17	g wet		04/18/14	30	M	+

Sample ID: <b>C1309025-L001-J15-SO-0102</b>	Collect Start: 03/13/2014 13:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-8		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-3	2003	1.67E-01	3.06E-01	<b>4.82E-01</b>	pCi/g		3.49	g wet		04/18/14	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- F = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

04/18/14 12:41



**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L58122**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L001-J16-SL</b>	Collect Start: 03/13/2014 10:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
I-3	2003	<b>8.17E-01</b>	3.91E-01	5.43E-01	pCi/g		3.1	g wet		04/18/14	30	M	+

Sample ID: <b>C1309025-L001-SO-0001</b>	Collect Start: 03/13/2014 10:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58122-10		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
I-3	2003	<b>2.14E+00</b>	4.59E-01	5.19E-01	pCi/g		3.24	g wet		04/18/14	30	M	+

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- † = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- spec = MDC exceeds customer technical specification
- ✓ = Low recovery
- ! = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration







03/24/14 15:26

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR38498

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L58122

Initiated By: KTHURMAN

Init Date: 03/21/14

Receive Date: 03/20/14

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

11/26/2013

LIMS #: L56757  
Project ID#: CH085-3EUNIVMO-09  
Received: 11/06/2013  
Delivery Date: 12/06/2013  
P.O.#: SIGNED QUOTE  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-001-SL	L56757-1	
C1309025-L002-001-SO	L56757-2	
C1309025-L002-002-SL	L56757-3	
C1309025-L002-002-SO	L56757-4	
C1309025-L002-003-SL	L56757-5	
C1309025-L002-003-SO	L56757-6	
C1309025-L002-004-SL	L56757-7	
C1309025-L002-004-SO	L56757-8	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-005-SL	L56757-9	
C1309025-L002-005-SO	L56757-10	
C1309025-L002-006-SL	L56757-11	
C1309025-L002-006-SO	L56757-12	
C1309025-L002-007-SL	L56757-13	
C1309025-L002-007-SO	L56757-14	
C1309025-L002-008-SL	L56757-15	
C1309025-L002-008-SO	L56757-16	
C1309025-L002-009-SL	L56757-17	
C1309025-L002-009-SO	L56757-18	
C1309025-L002-010-SL	L56757-19	
C1309025-L002-010-SO	L56757-20	
C1309025-L002-011-SL	L56757-21	
C1309025-L002-011-SO	L56757-22	
C1309025-L002-012-SL	L56757-23	
C1309025-L002-012-SO	L56757-24	
C1309025-L002-J13-SL	L56757-25	
C1309025-L002-J13-SO	L56757-26	
C1309025-L002-J14-SL	L56757-27	
C1309025-L002-J14-SO	L56757-28	
C1309025-L002-J15-SL	L56757-29	
C1309025-L002-J15-SO	L56757-30	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

11/26/13 16:32



**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Sample ID: **C1309025-L002-001-SL**

Collect Start: 11/02/2013 09:44

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56757-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	4.94E-01	5.90E-01	<b>9.04E-01</b>	pCi/g		3.044	g wet		11/25/13	10	M	U
-3	2003	1.74E-01	5.20E-01	<b>8.43E-01</b>	pCi/g		3.044	g wet		11/26/13	30	M	U

Sample ID: **C1309025-L002-001-SO**

Collect Start: 11/02/2013 09:44

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56757-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>1.29E+00</b>	6.20E-01	8.55E-01	pCi/g		3.219	g wet		11/25/13	10	M	+
-3	2003	3.49E-01	5.00E-01	<b>7.97E-01</b>	pCi/g		3.219	g wet		11/26/13	30	M	U

Sample ID: **C1309025-L002-002-SL**

Collect Start: 11/02/2013 09:58

Matrix: Soil

(S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 11/06/2013

% Moisture:

LIMS Number: L56757-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	7.16E-01	5.97E-01	<b>8.88E-01</b>	pCi/g		3.1	g wet		11/25/13	10	M	U
-3	2003	-2.70E-01	4.90E-01	<b>8.28E-01</b>	pCi/g		3.1	g wet		11/26/13	30	M	U

## Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [\*] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [h] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-002-SO</b>	Collect Start: 11/02/2013 09:58	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-4			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>3.80E+00</b>	7.16E-01	7.60E-01	pCi/g		3.623	g wet		11/25/13	10	M	+
-3	2003	2.49E-01	4.41E-01	<b>7.08E-01</b>	pCi/g		3.623	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-003-SL</b>	Collect Start: 11/02/2013 10:15	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-5			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>4.43E+00</b>	7.87E-01	8.14E-01	pCi/g		3.382	g wet		11/25/13	10	M	+
-3	2003	-3.77E-01	4.42E-01	<b>7.59E-01</b>	pCi/g		3.382	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-003-SO</b>	Collect Start: 11/02/2013 10:15	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-6			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>1.76E+00</b>	6.21E-01	8.04E-01	pCi/g		3.423	g wet		11/25/13	10	M	+
-3	2003	-2.70E-01	4.42E-01	<b>7.50E-01</b>	pCi/g		3.423	g wet		11/26/13	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- . = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- . = Low recovery
- l = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 16:32



**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L002-004-SL</b>	Collect Start: 11/02/2013 10:25	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-7		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	2.74E+00	7.04E-01	8.36E-01	pCi/g		3.292	g wet		11/25/13	10	M	+
-3	2003	3.28E-01	4.88E-01	7.79E-01	pCi/g		3.292	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-004-SO</b>	Collect Start: 11/02/2013 10:25	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-8		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	4.60E-01	4.67E-01	7.07E-01	pCi/g		3.893	g wet		11/25/13	10	M	U
-3	2003	2.37E-01	4.11E-01	6.59E-01	pCi/g		3.893	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-005-SL</b>	Collect Start: 11/02/2013 10:36	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	6.11E-01	4.81E-01	7.11E-01	pCi/g		3.871	g wet		11/25/13	10	M	U
-3	2003	-1.42E-01	3.96E-01	6.63E-01	pCi/g		3.871	g wet		11/26/13	30	M	U

Flag Values

/ = Compound/Analyte not detected (< MDC) or less than 3 sigma  
 . = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)  
 /\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma  
 ligh = Activity concentration exceeds customer reporting value  
 pec = MDC exceeds customer technical specification  
 . = Low recovery  
 l = High recovery

No = Peak not identified in gamma spectrum  
 Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

bolded text indicates reportable value.



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L002-005-SO</b>	Collect Start: 11/02/2013 10:36	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-10			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	9.51E-02	4.52E-01	<b>7.31E-01</b>	pCi/g		3.765	g wet		11/25/13	10	M	U
-3	2003	4.38E-02	4.16E-01	<b>6.82E-01</b>	pCi/g		3.765	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-006-SL</b>	Collect Start: 11/02/2013 10:46	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-11			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.11E-01	4.80E-01	<b>7.47E-01</b>	pCi/g		3.682	g wet		11/25/13	10	M	U
-3	2003	-8.67E-02	3.66E-01	<b>6.19E-01</b>	pCi/g		3.682	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-006-SO</b>	Collect Start: 11/02/2013 10:46	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-12			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.37E-01	5.20E-01	<b>8.76E-01</b>	pCi/g		3.142	g wet		11/25/13	10	M	U
-3	2003	6.38E-01	5.70E-01	<b>8.95E-01</b>	pCi/g		3.142	g wet		11/26/13	30	M	U

Flag Values

J = Compound/Analyte not detected (< MDC) or less than 3 sigma

· = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)

J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma

High = Activity concentration exceeds customer reporting value

pec = MDC exceeds customer technical specification

· = Low recovery

I = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-007-SL</b>	Collect Start: 11/02/2013 10:53	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-13		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	6.45E-01	4.94E-01	<b>7.28E-01</b>	pCi/g		3.778	g wet		11/25/13	10	M	U
-3	2003	-6.15E-01	4.24E-01	<b>7.44E-01</b>	pCi/g		3.778	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-007-SO</b>	Collect Start: 11/02/2013 10:53	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-14		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	6.08E-01	5.75E-01	<b>8.65E-01</b>	pCi/g		3.1807	g wet		11/25/13	10	M	U
-3	2003	-4.84E-01	5.15E-01	<b>8.84E-01</b>	pCi/g		3.1807	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-008-SL</b>	Collect Start: 11/02/2013 10:57	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-15		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.21E-02	5.14E-01	<b>8.50E-01</b>	pCi/g		3.2385	g wet		11/25/13	10	M	U
-3	2003	-7.48E-02	5.24E-01	<b>8.68E-01</b>	pCi/g		3.2385	g wet		11/26/13	30	M	U

Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [\*] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [ ] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [ ] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

No = Peak not identified in gamma spectrum  
Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

bolded text indicates reportable value.



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-008-SO</b>	Collect Start: 11/02/2013 10:57	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-16		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	1.14E-01	5.40E-01	<b>8.74E-01</b>	pCi/g		3.1487	g wet		11/25/13	10	M	U
3	2003	-5.10E-01	5.19E-01	<b>8.93E-01</b>	pCi/g		3.1487	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-009-SL</b>	Collect Start: 11/02/2013 11:12	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-17		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	7.58E-01	6.14E-01	<b>9.11E-01</b>	pCi/g		3.0218	g wet		11/25/13	10	M	U
3	2003	9.11E-01	6.02E-01	<b>9.30E-01</b>	pCi/g		3.0218	g wet		11/26/13	30	M	U

Sample ID: <b>C1309025-L002-009-SO</b>	Collect Start: 11/02/2013 11:12	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-18		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	4.09E-01	5.37E-01	<b>8.28E-01</b>	pCi/g		3.3233	g wet		11/25/13	10	M	U
3	2003	1.16E-01	5.33E-01	<b>8.69E-01</b>	pCi/g		3.233	g wet		11/26/13	30	M	U

Flag Values

- [-] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [+] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [h] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [l] = Low recovery
- [h] = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-010-SL</b>	Collect Start: 11/02/2013 11:19	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-19		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	5.78E-01	5.87E-01	<b>8.89E-01</b>	pCi/g		3.0968	g wet		11/25/13	10	M	U
-3	2003	-2.04E-01	3.72E-01	<b>6.49E-01</b>	pCi/g		3.0968	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-010-SO</b>	Collect Start: 11/02/2013 11:19	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-20		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.28E-01	5.08E-01	<b>8.19E-01</b>	pCi/g		3.3596	g wet		11/25/13	10	M	U
-3	2003	-8.91E-02	3.30E-01	<b>5.59E-01</b>	pCi/g		3.596	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-011-SL</b>	Collect Start: 11/02/2013 11:24	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-21		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.88E-01	4.44E-01	<b>7.10E-01</b>	pCi/g		3.8002	g wet		11/25/13	10	M	U
-3	2003	-1.23E-01	3.08E-01	<b>5.29E-01</b>	pCi/g		3.8002	g wet		11/26/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- . = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- . = Low recovery
- [ = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 16:32



**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L002-011-SO</b>	Collect Start: 11/02/2013 11:24	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-22			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.59E-01	4.91E-01	<b>8.40E-01</b>	pCi/g		3.2112	g wet		11/26/13	10	M	U
-3	2003	-2.24E-01	3.55E-01	<b>6.26E-01</b>	pCi/g		3.2112	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-012-SL</b>	Collect Start: 11/02/2013 11:34	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-23			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-1.63E-01	4.86E-01	<b>8.21E-01</b>	pCi/g		3.2858	g wet		11/26/13	10	M	U
-3	2003	-2.54E-01	3.43E-01	<b>6.12E-01</b>	pCi/g		3.2858	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-012-SO</b>	Collect Start: 11/02/2013 11:34	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-24			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-7.67E-02	5.23E-01	<b>8.71E-01</b>	pCi/g		3.0978	g wet		11/26/13	10	M	U
-3	2003	-1.13E-01	3.82E-01	<b>6.49E-01</b>	pCi/g		3.0978	g wet		11/26/13	15	M	U

## Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [ ] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [high] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09

Project Manager

Sample ID: <b>C1309025-L002-J13-SL</b>	Collect Start: 11/02/2013 11:44	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-25			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.65E+00	6.52E-01	8.94E-01	pCi/g		3.0157	g wet		11/26/13	10	M	+
-3	2003	-1.67E-01	3.86E-01	6.66E-01	pCi/g		3.0157	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-J13-SO</b>	Collect Start: 11/02/2013 11:44	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-26			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	.00E+00	5.42E-01	8.94E-01	pCi/g		3.0179	g wet		11/26/13	10	M	U
-3	2003	-4.18E-02	4.00E-01	6.66E-01	pCi/g		3.0179	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-J14-SL</b>	Collect Start: 11/02/2013 11:51	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 11/06/2013	% Moisture:	
LIMS Number: L56757-27			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.80E-01	5.50E-01	8.62E-01	pCi/g		3.1277	g wet		11/26/13	10	M	U
-3	2003	-2.89E-01	3.58E-01	6.42E-01	pCi/g		3.1277	g wet		11/26/13	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- I = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**bolded text indicates reportable value.**



# Report of Analysis

11/26/13 16:32

**L56757**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-J14-SO</b>	Collect Start: 11/02/2013 11:51	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-28		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.87E-01	4.79E-01	<b>8.36E-01</b>	pCi/g		3.2256	g wet		11/26/13	10	M	U
-3	2003	-2.68E-01	3.49E-01	<b>6.23E-01</b>	pCi/g		3.2256	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-J15-SL</b>	Collect Start: 11/02/2013 11:58	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-29		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.41E-01	4.57E-01	<b>7.82E-01</b>	pCi/g		3.4513	g wet		11/26/13	10	M	U
-3	2003	3.21E-01	3.86E-01	<b>5.82E-01</b>	pCi/g		3.4513	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L002-J15-SO</b>	Collect Start: 11/02/2013 11:58	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56757-30		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.74E-02	5.23E-01	<b>8.69E-01</b>	pCi/g		3.1041	g wet		11/26/13	10	M	U
-3	2003	2.38E-01	4.17E-01	<b>6.47E-01</b>	pCi/g		3.1041	g wet		11/26/13	15	M	U

Flag Values

J = Compound/Analyte not detected (< MDC) or less than 3 sigma

· = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)

J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma

High = Activity concentration exceeds customer reporting value

pec = MDC exceeds customer technical specification

· = Low recovery

I = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



## Chain of Custody Record

**No. C1309025-06**

LS 6757  
WH 33B

**Chase Environmental Group, Inc.**  
109 Flint Road  
Oak Ridge, TN 37830

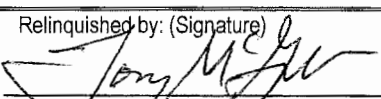
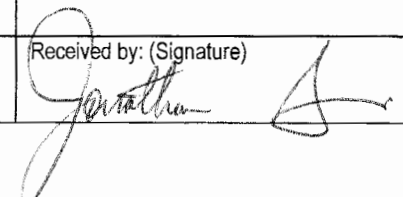
[illegible]



# Chain of Custody Record

No. C1309025-06

Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830

Project Name: MU Sinclair Farm Phase 4		Project Number: C1309025				Analysis Requested C-14 / H-3										Page 2 of 2  Purchase Order #: _____ N/A _____																						
Send Report To: Dave Culp, dculp@chaseenv.com		Sampler (Print Name): Dave Culp																																				
Address: 109 Flint Road		Sampler (Print Name): N/A																																				
Oak Ridge, TN 37830		Shipment Method: Hand Deliver																																				
Phone: 865-207-3664		Laboratory Receiving: Teledyne Brown																																				
Fax: 865-481-8818																																						
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers													Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)																				
C1309025-L002-009-SL	11-2-13	1112	Soil	1	X												Standard TAT, MDC < 1 pCi/g																					
C1309025-L002-009-SO	11-2-13	1112	Soil	1	X												"																					
C1309025-L002-010-SL	11-2-13	1119	Soil	1	X												"																					
C1309025-L002-010-SO	11-2-13	1119	Soil	1	X												"																					
C1309025-L002-011-SL	11-2-13	1124	Soil	1	X												"																					
C1309025-L002-011-SO	11-2-13	1124	Soil	1	X												"																					
C1309025-L002-012-SL	11-2-13	1134	Soil	1	X												"																					
C1309025-L002-012-SO	11-2-13	1134	Soil	1	X												"																					
C1309025-L002-013-SL	11-2-13	1144	Soil	1	X												"																					
C1309025-L002-013-SO	11-2-13	1144	Soil	1	X												"																					
C1309025-L002-014-SL	11-2-13	1151	Soil	1	X												"																					
C1309025-L002-014-SO	11-2-13	1151	Soil	1	X												"																					
C1309025-L002-015-SL	11-2-13	1158	Soil	1	X												"																					
C1309025-L002-015-SO	11-2-13	1158	Soil	1	X												"																					
Relinquished by: (Signature) 					Received by: (Signature)					Date:		Time:		11-2-13  <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">QA/QC level</th> <th colspan="2">Turnaround</th> </tr> <tr> <td>Level I</td> <td>1</td> <td>Routine</td> <td>1</td> </tr> <tr> <td>Level II</td> <td>1</td> <td>24 Hour</td> <td>1</td> </tr> <tr> <td>Level III</td> <td>1</td> <td>1 Week</td> <td>1</td> </tr> <tr> <td>Other</td> <td>1</td> <td>Other</td> <td>_____</td> </tr> </table>					QA/QC level		Turnaround		Level I	1	Routine	1	Level II	1	24 Hour	1	Level III	1	1 Week	1	Other	1	Other	_____
QA/QC level		Turnaround																																				
Level I	1	Routine	1																																			
Level II	1	24 Hour	1																																			
Level III	1	1 Week	1																																			
Other	1	Other	_____																																			
Relinquished by: (Signature)					Received by: (Signature)					Date:		Time:																										
Relinquished by: (Signature)					Received by: (Signature) 					Date: 11/6/13		Time: 11:20																										



11/06/13 15:22

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37206

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUSINC-13

LIMS #L56757

Initiated By: KTHURMAN

Init Date: 11/06/13 Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

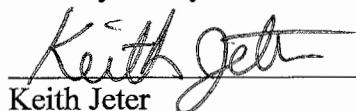
04/21/2014

LIMS #: L58124  
Project ID#: CH085-3EMUSINC-13  
Received: 03/20/2014  
Delivery Date: 04/19/2014  
P.O.#: C1309025-10  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.



Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-001-SO-0306	L58124-1	
C1309025-L002-002-SO-0306	L58124-2	
C1309025-L002-003-SO-0306	L58124-3	
C1309025-L002-J16-SL	L58124-4	
C1309025-L002-J16-SO-0003	L58124-5	
C1309025-L002-J16-SO-0306	L58124-6	
C1309025-L002-J17-SL	L58124-7	
C1309025-L002-J17-SO-0003	L58124-8	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane

Knoxville, TN 37931-3133

865-690-6819

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-J17-SO-0306	L58124-9	
C1309025-L002-J18-SL	L58124-10	
C1309025-L002-J18-SO-0002	L58124-11	
C1309025-L002-J18-SO-0204	L58124-12	
C1309025-L002-J19-SL	L58124-13	
C1309025-L002-J19-SO-0003	L58124-14	
C1309025-L002-J19-SO-0306	L58124-15	
C1309025-L002-J20-SL	L58124-16	
C1309025-L002-J20-SO-0003	L58124-17	
C1309025-L002-J20-SO-0306	L58124-18	
C1309025-L002-J21-SL	L58124-19	
C1309025-L002-J21-SO-0003	L58124-20	
C1309025-L002-J21-SO-0306	L58124-21	
C1309025-L002-J22-SL	L58124-22	
C1309025-L002-J22-SO-0003	L58124-23	
C1309025-L002-J22-SO-0306	L58124-24	
C1309025-L002-J23-SL	L58124-25	
C1309025-L002-J23-SO-0003	L58124-26	
C1309025-L002-J23-SO-0306	L58124-27	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

04/21/14 13:50



**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Sample ID: <b>C1309025-L002-001-SO-0306</b>	Collect Start: 03/14/2014 11:15	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-1			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.69E-02	4.80E-01	7.93E-01	pCi/g		3.41	g wet		04/18/14	20	M	U

Sample ID: <b>C1309025-L002-002-SO-0306</b>	Collect Start: 03/14/2014 10:45	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-2			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.58E+00	5.24E-01	7.91E-01	pCi/g		3.13	g wet		04/17/14	30	M	+

Sample ID: <b>C1309025-L002-003-SO-0306</b>	Collect Start: 03/14/2014 13:00	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-3			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.39E-01	5.90E-01	9.61E-01	pCi/g		3.16	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J16-SL</b>	Collect Start: 03/14/2014 11:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-4			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	4.98E-01	4.83E-01	7.71E-01	pCi/g		3.21	g wet		04/17/14	30	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

04/21/14 13:50



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L002-J16-SO-0003</b>	Collect Start: 03/14/2014 11:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-5			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	7.86E-01	6.37E-01	<b>9.90E-01</b>	pCi/g		3.07	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J16-SO-0306</b>	Collect Start: 03/14/2014 11:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-6			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	1.50E-02	5.99E-01	<b>9.86E-01</b>	pCi/g		3.08	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J17-SL</b>	Collect Start: 03/13/2014 15:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-7			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	7.93E-01	6.00E-01	<b>9.29E-01</b>	pCi/g		3.27	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J17-SO-0003</b>	Collect Start: 03/13/2014 15:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-8			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	2.93E-01	5.73E-01	<b>9.21E-01</b>	pCi/g		3.3	g wet		04/16/14	15	M	U

Flag Values

- = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- \* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- igh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- = High recovery

No = Peak not identified in gamma spectrum  
Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

bolded text indicates reportable value.



# Report of Analysis

04/21/14 13:50



**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L002-J17-SO-0306</b>	Collect Start: 03/13/2014 15:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-9		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	6.73E-01	6.20E-01	<b>9.71E-01</b>	pCi/g		3.13	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J18-SL</b>	Collect Start: 03/14/2014 11:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-10		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.35E-01	5.72E-01	<b>9.61E-01</b>	pCi/g		3.16	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J18-SO-0002</b>	Collect Start: 03/14/2014 11:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-11		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.20E-01	5.51E-01	<b>9.41E-01</b>	pCi/g		3.23	g wet		04/16/14	15	M	U

Sample ID: <b>C1309025-L002-J18-SO-0204</b>	Collect Start: 03/14/2014 11:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-12		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.29E-02	5.99E-01	<b>9.90E-01</b>	pCi/g		3.07	g wet		04/16/14	15	M	U

Flag Values

/ = Compound/Analyte not detected (< MDC) or less than 3 sigma  
 = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)  
 /\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma  
 /gh = Activity concentration exceeds customer reporting value  
 pec = MDC exceeds customer technical specification  
 = Low recovery  
 / = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum  
 Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

04/21/14 13:50



**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L002-J19-SL</b>	Collect Start: 03/13/2014 16:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-13		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.82E-01	5.37E-01	9.15E-01	pCi/g		3.32	g wet		04/16/14	15	M U	

Sample ID: <b>C1309025-L002-J19-SO-0003</b>	Collect Start: 03/13/2014 16:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-14		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.19E-02	5.85E-01	9.68E-01	pCi/g		3.14	g wet		04/16/14	15	M U	

Sample ID: <b>C1309025-L002-J19-SO-0306</b>	Collect Start: 03/13/2014 16:00	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-15		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.23E-01	5.43E-01	9.12E-01	pCi/g		3.33	g wet		04/17/14	15	M U	

Sample ID: <b>C1309025-L002-J20-SL</b>	Collect Start: 03/14/2014 11:50	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
LIMS Number: L58124-16		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.91E-01	4.77E-01	8.20E-01	pCi/g		3.02	g wet		04/17/14	30	M U	

## Flag Values

- Compound/Analyte not detected (< MDC) or less than 3 sigma
- Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- Activity concentration exceeds customer reporting value
- MDC exceeds customer technical specification
- Low recovery
- High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**bolded text indicates reportable value.**



# Report of Analysis

04/21/14 13:50



**TELEDYNE**  
BROWN ENGINEERING, INC.  
A Teledyne Technologies Company

**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13

Project Manager

Sample ID: <b>C1309025-L002-J20-SO-0003</b>	Collect Start: 03/14/2014 11:50	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-17			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-9.86E-01	5.11E-01	<b>9.23E-01</b>	pCi/g		3.29	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J20-SO-0306</b>	Collect Start: 03/14/2014 11:50	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-18			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	3.45E-01	5.72E-01	<b>9.15E-01</b>	pCi/g		3.32	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J21-SL</b>	Collect Start: 03/13/2014 16:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-19			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-9.10E-01	5.35E-01	<b>9.55E-01</b>	pCi/g		3.18	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J21-SO-0003</b>	Collect Start: 03/13/2014 16:30	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-20			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-8.82E-01	5.65E-01	<b>1.00E+00</b>	pCi/g		3.03	g wet		04/17/14	15	M	U

Flag Values

J = Compound/Analyte not detected (< MDC) or less than 3 sigma

· = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)

J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma

high = Activity concentration exceeds customer reporting value

spec = MDC exceeds customer technical specification

· = Low recovery

i = High recovery

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

**Bolded text indicates reportable value.**



# Report of Analysis

04/21/14 13:50

**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-J21-SO-0306</b>	Collect Start: 03/13/2014 16:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
IMS Number: L58124-21		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-1.07E+00	4.94E-01	9.01E-01	pCi/g		3.37	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J22-SL</b>	Collect Start: 03/14/2014 12:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
IMS Number: L58124-22		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-8.22E-01	5.00E-01	8.91E-01	pCi/g		3.41	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J22-SO-0003</b>	Collect Start: 03/14/2014 12:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
IMS Number: L58124-23		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-7.34E-01	5.26E-01	9.26E-01	pCi/g		3.28	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J22-SO-0306</b>	Collect Start: 03/14/2014 12:30	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 03/20/2014	% Moisture:
IMS Number: L58124-24		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
14	2003	-6.54E-01	5.07E-01	8.88E-01	pCi/g		3.42	g wet		04/17/14	15	M	U

## Flag Values

- = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- \* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- igh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- = High recovery

olded text indicates reportable value.

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

04/21/14 13:50

**L58124**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13



A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L002-J23-SL</b>	Collect Start: 03/14/2014 12:20	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-25			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-9.68E-01	5.61E-01	1.00E+00	pCi/g		3.03	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J23-SO-0003</b>	Collect Start: 03/14/2014 12:20	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-26			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-5.70E-01	5.18E-01	8.99E-01	pCi/g		3.38	g wet		04/17/14	15	M	U

Sample ID: <b>C1309025-L002-J23-SO-0306</b>	Collect Start: 03/14/2014 12:20	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 03/20/2014	% Moisture:	
LIMS Number: L58124-27			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.78E-01	5.38E-01	9.41E-01	pCi/g		3.23	g wet		04/17/14	15	M	U

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- high = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- l = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

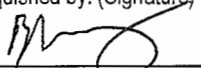
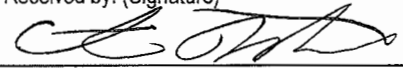
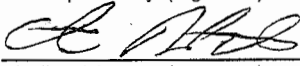
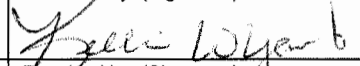
MDC - Minimum Detectable Concentration







L58124  
Chase Environmental Group, Inc.  
109 Flint Road  
Oak Ridge, TN 37830

Project Name: MU Sinclair Farm Phase 4		Project Number: C1309025				<div>Analysis Requested</div> <div>C-14</div> <div>Page 2 of 2</div> <div>Purchase Order #: _____ N/A _____</div>												
Send Report To: Dave Culp, dculp@chaseenv.com		Sampler (Print Name): <u>Brendan Miller</u>																
Address: 109 Flint Road		Sampler (Print Name): N/A																
Oak Ridge, TN 37830		Shipment Method: Hand Deliver																
Phone: 865-207-3664		Laboratory Receiving: Teledyne Brown																
Fax: 865-481-8818																		
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers													Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
C1309025-L002-J20-SL	3/14/14	1150	Soil	1	X												Standard TAT, MDC < 1 pCi/g	
C1309025-L002-J20-SO-0003	3/14/14	1150	Soil	1	X												"	
C1309025-L002-J20-SO-0306	3/14/14	1150	Soil	1	X												"	
C1309025-L002-J21-SL	3/13/14	1630	Soil	1	X												"	
C1309025-L002-J21-SO-0003	3/13/14	1630	Soil	1	X												"	
C1309025-L002-J21-SO-0306	3/13/14	1630	Soil	1	X												"	
C1309025-L002-J22-SL	3/14/14	1230	Soil	1	X												"	
C1309025-L002-J22-SO-0003	3/14/14	1230	Soil	1	X												"	
C1309025-L002-J22-SO-0306	3/14/14	1230	Soil	1	X												"	
C1309025-L002-J23-SL	3/14/14	1220	Soil	1	X												"	
C1309025-L002-J23-SO-0003	3/14/14	1220	Soil	1	X												"	
C1309025-L002-J23-SO-0306	3/14/14	1220	Soil	1	X												"	
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:	<div>QA/QC level</div> <div>Turnaround</div>											
					3/20/14	1530												
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:												
					3/20/14	1600	<div>Level I</div> <div>Level II</div> <div>Level III</div> <div>Other</div>											
Relinquished by: (Signature)		Received by: (Signature)			Date:	Time:												



03/24/14 16:06

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR38500

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L58124

Initiated By: KTHURMAN

Init Date: 03/21/14

Receive Date: 03/20/14

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

**Report of Analysis/Certificate of Conformance**

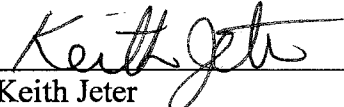
05/15/2014

LIMS #: L58691  
Project ID#: CH085-3EMUSINC-13  
Received: 05/07/2014  
Delivery Date: 05/14/2014  
P.O.#: C1309025-13  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
\_\_\_\_\_  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-002-SO-0912	L58691-1	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

05/15/14 16:16

**L58691**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Sample ID: C1309025-L002-002-SO-0912

Collect Start: 03/14/2014 10:45

Matrix: Soil (S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 05/07/2014

% Moisture: 25.63

LIMS Number: L58691-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-2.13E-01	5.35E-01	<b>8.89E-01</b>	pCi/g		1.8411	g dry		05/13/14	60	M	U

## Flag Values

- [ ] = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [\*] = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\*] = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [high] = Activity concentration exceeds customer reporting value
- [pec] = MDC exceeds customer technical specification
- [ ] = Low recovery
- [ ] = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



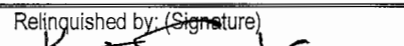
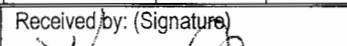
**No. C1309025-13**

25869

Page 1 of 1

Purchase Order #: N/A

[illegible]

Relinquished by: (Signature) 	Received by: (Signature) 	Date: 5/7/14	Time: 1700		
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:	QA/QC level	Turnaround
				Level I	Routine
				Level II	24 Hour
				Level III	1 Week
				Other	Other



05/07/14 16:32

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR39045

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L58691

Initiated By: KTHURMAN

Init Date: 05/07/14

Receive Date: 05/07/14

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

05/15/2014

LIMS #: L58693  
Project ID#: CH085-3EMUSINC-13  
Received: 05/07/2014  
Delivery Date: 05/14/2014  
P.O.#: C1309025-14  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
\_\_\_\_\_  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-002-SO-1215	L58693-1	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

05/15/14 16:16

**L58693**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Sample ID: **C1309025-L002-002-SO-1215**

Collect Start: 03/14/2014 10:45

Matrix: Soil (S)

Station:

Collect Stop:

Volume:

Description:

Receive Date: 05/07/2014

% Moisture: 18.01

LIMS Number: L58693-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>1.59E+00</b>	5.45E-01	8.41E-01	pCi/g		1.9494	g dry		05/13/14	60	M	+

## Flag Values

- J = Compound/Analyte not detected (< MDC) or less than 3 sigma
- = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- J\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- ligh = Activity concentration exceeds customer reporting value
- pec = MDC exceeds customer technical specification
- = Low recovery
- l = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



**No. C1309025-14**

LS8693

Page 1 of 1



05/07/14 16:32

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR39047

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L58693

Initiated By: KTHURMAN

Init Date: 05/07/14 Receive Date: 05/07/14

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes No NA	Comment
1 Shipping container custody seals present and intact.	NA	
2 Sample container custody seals present and intact.	NA	
3 Sample containers received in good condition	Y	
4 Chain of custody received with samples	Y	
5 All samples listed on chain of custody received	Y	
6 Sample container labels present and legible.	Y	
7 Information on container labels correspond with chain of custody	Y	
8 Sample(s) properly preserved and in appropriate container(s)	NA	
9 Other (Describe)	NA	
<b>For Hazardous Materials Only:</b>		
10 Paperwork shows TBE and shippers name, address and phone number	NA	
11 Paperwork shows sample quantity information	NA	





**TELEDYNE**  
**BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company  
2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

05/15/2014

LIMS #: L58695  
Project ID#: CH085-3EMUSINC-13  
Received: 05/07/2014  
Delivery Date: 05/14/2014  
P.O.#: C1309025-15  
Release #:  
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L002-002-SO-1517	L58695-1	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

05/15/14 16:16

**L58695**

Chase Environmental Group, Inc.

CH085-3EMUSINC-13



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Sample ID: <b>C1309025-L002-002-SO-1517</b>	Collect Start: 03/14/2014 10:45	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 05/07/2014	% Moisture: 19.85
LIMS Number: L58695-1		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	<b>1.18E+00</b>	5.36E-01	8.40E-01	pCi/g		1.9609	g dry		05/13/14	60	M	+

## Flag Values

- [ = Compound/Analyte not detected (< MDC) or less than 3 sigma
- [\* = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- [\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- [igh = Activity concentration exceeds customer reporting value
- [pec = MDC exceeds customer technical specification
- [ = Low recovery
- [ = High recovery

**bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

L58695 2 of 4







05/07/14 16:33

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR39049

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L58695

Initiated By: KTHURMAN

Init Date: 05/07/14

Receive Date: 05/07/14

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	





**TELEDYNE  
BROWN ENGINEERING, INC.**

A Teledyne Technologies Company

2508 Quality Lane  
Knoxville, TN 37931-3133  
865-690-6819

Project Manager  
Chase Environmental Group, Inc.  
109 Flint Rd.

Oak Ridge, TN 37830

### Report of Analysis/Certificate of Conformance

11/26/2013

LIMS #: L56760

Project ID#: CH085-3EUNIVMO-09

Received: 11/06/2013

Delivery Date: 12/06/2013

P.O.#: SIGNED QUOTE

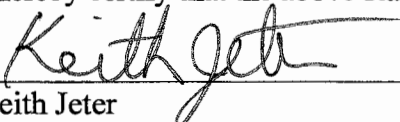
Release #:

SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

  
Keith Jeter  
Operations Manager

*Cross Reference Table*

Client ID	Laboratory ID	Station ID (if applicable)
C1309025-L003-001-SL	L56760-1	
C1309025-L003-001-SO	L56760-2	
C1309025-L003-002-SL	L56760-3	
C1309025-L003-002-SO	L56760-4	
C1309025-L003-003-SL	L56760-5	
C1309025-L003-003-SO	L56760-6	

This report shall not be reproduced or distributed except in its entirety.



# Report of Analysis

11/26/13 15:37

**L56760**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Sample ID: <b>C1309025-L003-001-SL</b>	Collect Start: 11/01/2013 15:03	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-1		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	5.36E-02	4.96E-01	<b>8.11E-01</b>	pCi/g	R1	3.3247	g wet		11/26/13	10	M	U
I-3	2003	-1.40E-01	3.52E-01	<b>6.04E-01</b>	pCi/g	R1	3.3247	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L003-001-SO</b>	Collect Start: 11/01/2013 15:03	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-2		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-6.19E-01	4.55E-01	<b>8.27E-01</b>	pCi/g	R1	3.2613	g wet		11/26/13	10	M	U
I-3	2003	-1.16E-01	3.61E-01	<b>6.16E-01</b>	pCi/g	R1	3.2613	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L003-002-SL</b>	Collect Start: 11/03/2013 15:20	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-3		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-3.53E-01	4.86E-01	<b>8.44E-01</b>	pCi/g	R1	3.1974	g wet		11/26/13	10	M	U
I-3	2003	-2.85E-01	3.50E-01	<b>6.28E-01</b>	pCi/g	R1	3.1974	g wet		11/26/13	15	M	U

## Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- + = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- U\* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

No = Peak not identified in gamma spectrum

Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



# Report of Analysis

11/26/13 15:37

**L56760**

Chase Environmental Group, Inc.

CH085-3EUNIVMO-09



**TELEDYNE  
BROWN ENGINEERING, INC.**  
A Teledyne Technologies Company

Project Manager

Sample ID: <b>C1309025-L003-002-SO</b>	Collect Start: 11/03/2013 15:20	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-4		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	7.79E-02	5.43E-01	<b>8.85E-01</b>	pCi/g	R1	3.0479	g wet		11/26/13	10	M	U
I-3	2003	-2.58E-01	3.72E-01	<b>6.59E-01</b>	pCi/g	R1	3.0479	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L003-003-SL</b>	Collect Start: 11/01/2013 15:40	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-5		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	6.96E-01	5.53E-01	<b>8.32E-01</b>	pCi/g	R1	3.2418	g wet		11/26/13	10	M	U
I-3	2003	.00E+00	3.76E-01	<b>6.20E-01</b>	pCi/g	R1	3.2418	g wet		11/26/13	15	M	U

Sample ID: <b>C1309025-L003-003-SO</b>	Collect Start: 11/01/2013 15:40	Matrix: Soil (S)
Station:	Collect Stop:	Volume:
Description:	Receive Date: 11/06/2013	% Moisture:
LIMS Number: L56760-6		

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
-14	2003	-4.84E-01	4.97E-01	<b>8.79E-01</b>	pCi/g	R1	3.0681	g wet		11/26/13	10	M	U
I-3	2003	-4.68E-01	3.44E-01	<b>6.55E-01</b>	pCi/g	R1	3.0681	g wet		11/26/13	15	M	U

## Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- +
- U\* = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- High = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- Spec = Activity concentration exceeds customer reporting value
- L = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

**Bolded text indicates reportable value.**

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

\*\*\*\* Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration



## Chain of Custody Record

**No. C1309025-07**

L 56760  
WH33B

**Chase Environmental Group, Inc.**  
109 Flint Road  
Oak Ridge, TN 37830

[illegible]



11/07/13 06:19

Teledyne Brown Engineering  
Sample Receipt Verification/Variance Report

SR #: SR37209

Client: CHASE ENVIRONMENTAL GROUP INC

Project #: CH085-3EMUSINC-13

LIMS #L56760

Initiated By: KTHURMAN

Init Date: 11/06/13

Receive Date: 11/06/13

**Notification of Variance**

Person Notified:

Contacted By:

Notify Date:

Notify Method:

Notify Comment:

**Client Response**

Person Responding:

Response Date:

Response Method:

Response Comment

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition		Y		
4 Chain of custody received with samples		Y		
5 All samples listed on chain of custody received		Y		
6 Sample container labels present and legible.		Y		
7 Information on container labels correspond with chain of custody		Y		
8 Sample(s) properly preserved and in appropriate container(s)			NA	
9 Other (Describe)			NA	
<b>For Hazardous Materials Only:</b>				
10 Paperwork shows TBE and shippers name, address and phone number			NA	
11 Paperwork shows sample quantity information			NA	



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Table of Contents

---

Part I: Mixture Sums and Single Radionuclide Guidelines

---

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETRG table in Ground Pathway of Detailed Report.

Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.140E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	8.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.948E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.207E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.207E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Contaminated Zone Dimensions

## Initial Soil Concentrations, pCi/g

Area: 4140.00 square meters  
 Thickness: 0.08 meters  
 Cover Depth: 0.00 meters

C-14 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	6.587E-03	4.696E-02	6.869E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	2.635E-04	1.878E-03	2.748E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 6.889E-02 mrem/yr at t = 2.488 ± 0.005 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 2.488E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 2.488E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.021E-02	0.4386	3.410E-02	0.4950	0.000E+00	0.0000	2.400E-03	0.0348	5.902E-04	0.0086	1.588E-03	0.0231	6.889E-02	1.0000
Total	3.021E-02	0.4386	3.410E-02	0.4950	0.000E+00	0.0000	2.400E-03	0.0348	5.902E-04	0.0086	1.588E-03	0.0231	6.889E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.091E-07	0.0000	2.731E-06	0.0004	0.000E+00	0.0000	4.878E-03	0.7405	1.466E-03	0.2225	2.395E-04	0.0364	8.326E-07	0.0001
Total	2.091E-07	0.0000	2.731E-06	0.0004	0.000E+00	0.0000	4.878E-03	0.7405	1.466E-03	0.2225	2.395E-04	0.0364	8.326E-07	0.0001

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.587E-03	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.587E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.800E-25	0.0000	2.324E-24	0.0000	0.000E+00	0.0000	1.376E-19	0.0000	6.638E-19	0.0000	3.060E-20	0.0000	7.084E-25	0.0000
Total	1.800E-25	0.0000	2.324E-24	0.0000	0.000E+00	0.0000	1.376E-19	0.0000	6.638E-19	0.0000	3.060E-20	0.0000	7.084E-25	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.099E-02	0.4470	2.297E-02	0.4892	0.000E+00	0.0000	1.556E-03	0.0331	3.490E-04	0.0074	1.088E-03	0.0232	4.696E-02	1.0000
Total	2.099E-02	0.4470	2.297E-02	0.4892	0.000E+00	0.0000	1.556E-03	0.0331	3.490E-04	0.0074	1.088E-03	0.0232	4.696E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.012E-02	0.4385	3.400E-02	0.4950	0.000E+00	0.0000	2.395E-03	0.0349	5.892E-04	0.0086	1.583E-03	0.0231	6.869E-02	1.0000
Total	3.012E-02	0.4385	3.400E-02	0.4950	0.000E+00	0.0000	2.395E-03	0.0349	5.892E-04	0.0086	1.583E-03	0.0231	6.869E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	6.587E-03	4.696E-02	6.869E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t = 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	3.795E+03	5.324E+02	3.639E+02	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at t<sub>min</sub> = time of minimum single radionuclide soil guideline  
and at t<sub>max</sub> = time of maximum total dose = 2.488 ± 0.005 years

Nuclide (i)	Initial (pCi/g)	t <sub>min</sub> (years)	DSR(i,t <sub>min</sub> )	G(i,t <sub>min</sub> ) (pCi/g)	DSR(i,t <sub>max</sub> )	G(i,t <sub>max</sub> ) (pCi/g)
C-14	1.000E+00	2.488 ± 0.005	6.889E-02	3.629E+02	6.889E-02	3.629E+02



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR1.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide Parent		THF(i)	DOSE(j,t), mrem/yr								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	6.587E-03	4.696E-02	6.869E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide Parent		THF(i)	S(j,t), pCi/g								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	8.617E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.50 seconds



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Table of Contents

---

Part I: Mixture Sums and Single Radionuclide Guidelines

---

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(XXX) only, factors are for infinite depth &amp; area. See ETFG table in Ground Pathway of Detailed Report.

Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.760E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	SI(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	WI( 1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.039E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA ( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA ( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA ( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA ( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA ( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA ( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA ( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA ( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA ( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA (10)
R017	Ring 11	not used	0.000E+00	---	FRACA (11)
R017	Ring 12	not used	0.000E+00	---	FRACA (12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET (1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET (2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET (3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET (4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET (5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET (6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.138E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.138E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV (1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV (2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV (3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE (1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE (2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE (3)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Contaminated Zone Dimensions

## Initial Soil Concentrations, pCi/g

Area: 2760.00 square meters  
 Thickness: 0.15 meters  
 Cover Depth: 0.00 meters

C-14 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.101E-02	4.962E-02	7.321E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	4.404E-04	1.985E-03	2.928E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 7.369E-02 mrem/yr at t = 2.894 ± 0.006 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 2.894E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 2.894E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.865E-02	0.5245	2.908E-02	0.3947	0.000E+00	0.0000	4.074E-03	0.0553	5.197E-04	0.0071	1.361E-03	0.0185	7.369E-02	1.0000
Total	3.865E-02	0.5245	2.908E-02	0.3947	0.000E+00	0.0000	4.074E-03	0.0553	5.197E-04	0.0071	1.361E-03	0.0185	7.369E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.495E-07	0.0000	5.007E-06	0.0005	0.000E+00	0.0000	8.971E-03	0.8147	1.709E-03	0.1552	3.237E-04	0.0294	1.869E-06	0.0002
Total	2.495E-07	0.0000	5.007E-06	0.0005	0.000E+00	0.0000	8.971E-03	0.8147	1.709E-03	0.1552	3.237E-04	0.0294	1.869E-06	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.101E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.101E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.904E-21	0.0000	3.794E-20	0.0000	0.000E+00	0.0000	5.012E-16	0.0000	1.411E-15	0.0000	1.065E-16	0.0000	1.416E-20	0.0000
Total	1.904E-21	0.0000	3.794E-20	0.0000	0.000E+00	0.0000	5.012E-16	0.0000	1.411E-15	0.0000	1.065E-16	0.0000	1.416E-20	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.645E-02	0.5331	1.934E-02	0.3897	0.000E+00	0.0000	2.611E-03	0.0526	3.024E-04	0.0061	9.181E-04	0.0185	4.962E-02	1.0000
Total	2.645E-02	0.5331	1.934E-02	0.3897	0.000E+00	0.0000	2.611E-03	0.0526	3.024E-04	0.0061	9.181E-04	0.0185	4.962E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.840E-02	0.5245	2.889E-02	0.3946	0.000E+00	0.0000	4.048E-03	0.0553	5.182E-04	0.0071	1.353E-03	0.0185	7.321E-02	1.0000
Total	3.840E-02	0.5245	2.889E-02	0.3946	0.000E+00	0.0000	4.048E-03	0.0553	5.182E-04	0.0071	1.353E-03	0.0185	7.321E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.101E-02	4.962E-02	7.321E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	2.270E+03	5.038E+02	3.415E+02	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 2.894 ± 0.006 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
				(pCi/g)		(pCi/g)
C-14	1.000E+00	2.894 ± 0.006	7.369E-02	3.393E+02	7.369E-02	3.393E+02



Summary : MU Sinclair Farm Cattle Lagoon Scenario 1, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR2.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	DOSE(j,t), mrem/yr								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.101E-02	4.962E-02	7.321E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	7.628E-15	4.442E-43	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.53 seconds



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Table of Contents

---

Part I: Mixture Sums and Single Radionuclide Guidelines

---

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETRG table in Ground Pathway of Detailed Report.

\* Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.140E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	8.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.948E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.207E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.207E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSNI
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSNI
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Contaminated Zone Dimensions

## Initial Soil Concentrations, pCi/g

Area: 4140.00 square meters  
 Thickness: 0.08 meters  
 Cover Depth: 1.00 meters

C-14 1.000E+00

## Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.841E-26	9.547E-02	1.465E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	7.363E-28	3.819E-03	5.860E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.477E-01 mrem/yr at t = 3.637 ± 0.007 years

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.637E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.637E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.477E-02	0.4385	7.311E-02	0.4950	0.000E+00	0.0000	5.148E-03	0.0349	1.266E-03	0.0086	3.405E-03	0.0231	1.477E-01	1.0000
Total	6.477E-02	0.4385	7.311E-02	0.4950	0.000E+00	0.0000	5.148E-03	0.0349	1.266E-03	0.0086	3.405E-03	0.0231	1.477E-01	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.841E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.841E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.841E-26	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.841E-26	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	4.258E-02	0.4460	4.679E-02	0.4901	0.000E+00	0.0000	3.181E-03	0.0333	7.119E-04	0.0075	2.208E-03	0.0231	9.547E-02	1.0000
Total	4.258E-02	0.4460	4.679E-02	0.4901	0.000E+00	0.0000	3.181E-03	0.0333	7.119E-04	0.0075	2.208E-03	0.0231	9.547E-02	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.423E-02	0.4385	7.252E-02	0.4950	0.000E+00	0.0000	5.107E-03	0.0349	1.257E-03	0.0086	3.377E-03	0.0231	1.465E-01	1.0000
Total	6.423E-02	0.4385	7.252E-02	0.4950	0.000E+00	0.0000	5.107E-03	0.0349	1.257E-03	0.0086	3.377E-03	0.0231	1.465E-01	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.841E-26	9.547E-02	1.465E-01	1.913E-42	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

## Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	2.619E+02	1.707E+02	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)

and Single Radionuclide Soil Guidelines G(i,t) in pCi/g

at tmin = time of minimum single radionuclide soil guideline

and at tmax = time of maximum total dose = 3.637 ± 0.007 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
				(pCi/g)		(pCi/g)
C-14	1.000E+00	3.637 ± 0.007	1.477E-01	1.693E+02	1.477E-01	1.693E+02



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, All Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR3.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide Parent		THF(i)	DOSE(j,t), mrem/yr							
(j)	(i)		t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03							
C-14	C-14	1.000E+00	1.841E-26	9.547E-02	1.465E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide Parent		THF(i)	S(j,t), pCi/g							
(j)	(i)		t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03							
C-14	C-14	1.000E+00	1.000E+00	3.483E-09	4.225E-26	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.46 seconds



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Table of Contents

### Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETPG table in Ground Pathway of Detailed Report.

\* Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.760E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRAC
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsat. zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.039E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.138E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.138E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	CL2WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	CL2CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
Storage times of contaminated foodstuffs (days):					
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Contaminated Zone Dimensions	Initial Soil Concentrations, pCi/g
Area: 2760.00 square meters	C-14 1.000E+00
Thickness: 0.15 meters	
Cover Depth: 1.00 meters	

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.525E-26	1.393E-01	2.301E-01	1.406E-23	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	1.410E-27	5.571E-03	9.202E-03	5.623E-25	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 2.308E-01 mrem/yr at t = 3.439 ± 0.007 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.439E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.439E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.210E-01	0.5243	9.112E-02	0.3948	0.000E+00	0.0000	1.277E-02	0.0553	1.632E-03	0.0071	4.263E-03	0.0185	2.308E-01	1.0000
Total	1.210E-01	0.5243	9.112E-02	0.3948	0.000E+00	0.0000	1.277E-02	0.0553	1.632E-03	0.0071	4.263E-03	0.0185	2.308E-01	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.525E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.525E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.525E-26	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.525E-26	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.136E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.136E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	7.419E-02	0.5327	5.432E-02	0.3901	0.000E+00	0.0000	7.341E-03	0.0527	8.420E-04	0.0060	2.573E-03	0.0185	1.393E-01	1.0000
Total	7.419E-02	0.5327	5.432E-02	0.3901	0.000E+00	0.0000	7.341E-03	0.0527	8.420E-04	0.0060	2.573E-03	0.0185	1.393E-01	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.207E-01	0.5245	9.081E-02	0.3947	0.000E+00	0.0000	1.272E-02	0.0553	1.624E-03	0.0071	4.250E-03	0.0185	2.301E-01	1.0000
Total	1.207E-01	0.5245	9.081E-02	0.3947	0.000E+00	0.0000	1.272E-02	0.0553	1.624E-03	0.0071	4.250E-03	0.0185	2.301E-01	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.542E-24	0.4653	5.925E-24	0.4215	0.000E+00	0.0000	1.028E-24	0.0731	2.914E-25	0.0207	2.720E-25	0.0193	1.406E-23	1.0000
Total	6.542E-24	0.4653	5.925E-24	0.4215	0.000E+00	0.0000	1.028E-24	0.0731	2.914E-25	0.0207	2.720E-25	0.0193	1.406E-23	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	3.525E-26	1.393E-01	2.301E-01	1.406E-23	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t = 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	1.795E+02	1.087E+02	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 3.439 ± 0.007 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
				(pCi/g)		(pCi/g)
C-14	1.000E+00	3.439 ± 0.007	2.308E-01	1.083E+02	2.308E-01	1.083E+02



Summary : MU Sinclair Farm Cattle Lagoon Scenario 2, Elevated Sample Results

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR4.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00		3.525E-26	1.393E-01	2.301E-01	1.406E-23	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00		1.000E+00	3.083E-05	2.931E-14	1.401E-45	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.51 seconds



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Table of Contents

### Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	H-3 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	H-3	6.400E-08	6.400E-08	DCF2( 1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	H-3	6.400E-08	6.400E-08	DCF3( 1)
D-34	Food transfer factors:			
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF( 1,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC( 1,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETEG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.116E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	4.600E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): H-3	1.000E+00	0.000E+00	---	SI(1)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	WI( 1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.039E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA ( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA ( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA ( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA ( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA ( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA ( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA ( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA ( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA ( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.106E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.106E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
Storage times of contaminated foodstuffs (days):					
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Contaminated Zone Dimensions

## Initial Soil Concentrations, pCi/g

Area: 2116.00 square meters  
 Thickness: 0.15 meters  
 Cover Depth: 0.00 meters

H-3 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.744E-04	1.541E-03	2.150E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	1.097E-05	6.163E-05	8.600E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 2.322E-03 mrem/yr at t = 1.481 ± 0.003 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.481E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	7.093E-16	0.0000	0.000E+00	0.0000	3.495E-14	0.0000	9.266E-15	0.0000	3.618E-15	0.0000	9.646E-18	0.0000
Total	0.000E+00	0.0000	7.093E-16	0.0000	0.000E+00	0.0000	3.495E-14	0.0000	9.266E-15	0.0000	3.618E-15	0.0000	9.646E-18	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.481E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	2.182E-03	0.9398	2.848E-08	0.0000	0.000E+00	0.0000	9.930E-05	0.0428	1.006E-05	0.0043	3.047E-05	0.0131	2.322E-03	1.0000
Total	2.182E-03	0.9398	2.848E-08	0.0000	0.000E+00	0.0000	9.930E-05	0.0428	1.006E-05	0.0043	3.047E-05	0.0131	2.322E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	8.268E-06	0.0301	0.000E+00	0.0000	2.401E-04	0.8753	1.640E-05	0.0598	9.443E-06	0.0344	1.124E-07	0.0004
Total	0.000E+00	0.0000	8.268E-06	0.0301	0.000E+00	0.0000	2.401E-04	0.8753	1.640E-05	0.0598	9.443E-06	0.0344	1.124E-07	0.0004

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.744E-04	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.744E-04	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	1.318E-12	0.0000	0.000E+00	0.0000	6.494E-11	0.0000	1.722E-11	0.0000	6.721E-12	0.0000	1.792E-14	0.0000
Total	0.000E+00	0.0000	1.318E-12	0.0000	0.000E+00	0.0000	6.494E-11	0.0000	1.722E-11	0.0000	6.721E-12	0.0000	1.792E-14	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	1.452E-03	0.9426	1.846E-08	0.0000	0.000E+00	0.0000	6.244E-05	0.0405	5.927E-06	0.0038	1.999E-05	0.0130	1.541E-03	1.0000
Total	1.452E-03	0.9426	1.846E-08	0.0000	0.000E+00	0.0000	6.244E-05	0.0405	5.927E-06	0.0038	1.999E-05	0.0130	1.541E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	3.347E-26	0.0000	0.000E+00	0.0000	1.649E-24	0.0000	4.372E-25	0.0000	1.707E-25	0.0000	4.552E-28	0.0000
Total	0.000E+00	0.0000	3.347E-26	0.0000	0.000E+00	0.0000	1.649E-24	0.0000	4.372E-25	0.0000	1.707E-25	0.0000	4.552E-28	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	2.020E-03	0.9396	2.640E-08	0.0000	0.000E+00	0.0000	9.218E-05	0.0429	9.441E-06	0.0044	2.825E-05	0.0131	2.150E-03	1.0000
Total	2.020E-03	0.9396	2.640E-08	0.0000	0.000E+00	0.0000	9.218E-05	0.0429	9.441E-06	0.0044	2.825E-05	0.0131	2.150E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	2.744E-04	1.541E-03	2.150E-03	1.266E-36	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	9.112E+04	1.623E+04	1.163E+04	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 1.481 ± 0.003 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
H-3	1.000E+00	1.481 ± 0.003	2.322E-03	1.077E+04	2.322E-03	1.077E+04



Summary : MU Sinclair Farm ETL Lagoon Scenario 1

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR5.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	DOSE(j,t), mrem/yr								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	2.744E-04	1.541E-03	2.150E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	S(j,t), pCi/g								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	1.000E+00	1.604E-07	4.131E-21	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.50 seconds



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	H-3 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	H-3	6.400E-08	6.400E-08	DCF2( 1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	H-3	6.400E-08	6.400E-08	DCF3( 1)
D-34	Food transfer factors:			
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF( 1,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC( 1,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETRG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.116E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	4.600E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): H-3	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.039E+01	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.106E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.106E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	CL2WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	CL2CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

## Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Contaminated Zone Dimensions

## Initial Soil Concentrations, pCi/g

Area: 2116.00 square meters  
 Thickness: 0.15 meters  
 Cover Depth: 1.00 meters

H-3 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	2.193E-03	3.233E-03	1.247E-25	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	0.000E+00	8.773E-05	1.293E-04	4.988E-27	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 3.461E-03 mrem/yr at t = 1.559 ± 0.003 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.559E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.559E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	3.252E-03	0.9398	4.245E-08	0.0000	0.000E+00	0.0000	1.480E-04	0.0428	1.505E-05	0.0043	4.542E-05	0.0131	3.461E-03	1.0000
Total	3.252E-03	0.9398	4.245E-08	0.0000	0.000E+00	0.0000	1.480E-04	0.0428	1.505E-05	0.0043	4.542E-05	0.0131	3.461E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	2.068E-03	0.9427	2.627E-08	0.0000	0.000E+00	0.0000	8.877E-05	0.0405	8.394E-06	0.0038	2.844E-05	0.0130	2.193E-03	1.0000
Total	2.068E-03	0.9427	2.627E-08	0.0000	0.000E+00	0.0000	8.877E-05	0.0405	8.394E-06	0.0038	2.844E-05	0.0130	2.193E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	3.037E-03	0.9396	3.969E-08	0.0000	0.000E+00	0.0000	1.385E-04	0.0429	1.418E-05	0.0044	4.246E-05	0.0131	3.233E-03	1.0000
Total	3.037E-03	0.9396	3.969E-08	0.0000	0.000E+00	0.0000	1.385E-04	0.0429	1.418E-05	0.0044	4.246E-05	0.0131	3.233E-03	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	1.138E-25	0.9128	1.790E-30	0.0000	0.000E+00	0.0000	7.572E-27	0.0607	1.412E-27	0.0113	1.891E-27	0.0152	1.247E-25	1.0000
Total	1.138E-25	0.9128	1.790E-30	0.0000	0.000E+00	0.0000	7.572E-27	0.0607	1.412E-27	0.0113	1.891E-27	0.0152	1.247E-25	1.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	0.000E+00	2.193E-03	3.233E-03	1.247E-25	0.000E+00	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t = 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	*9.597E+15	1.140E+04	7.734E+03	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 1.559 ± 0.003 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
				(pCi/g)		(pCi/g)
H-3	1.000E+00	1.559 ± 0.003	3.461E-03	7.224E+03	3.461E-03	7.224E+03



Summary : MU Sinclair Farm ETL Lagoon Scenario 2

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\SINCLAIR6.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	0.000E+00	2.193E-03	3.233E-03	1.247E-25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	1.000E+00	2.915E-05	2.478E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESRAD.EXE execution time = 0.47 seconds



Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Dose Conversion Factor (and Related) Parameter Summary  
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETEG table in Ground Pathway of Detailed Report.  
Case means Default.Lib w/o Associate Nuclide contributions.



Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.760E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E+00	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.138E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.138E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSNI
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSNI
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
S	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Contaminated Zone Dimensions

Initial Soil Concentrations, pCi/g

Area: 2760.00 square meters  
 Thickness: 0.15 meters  
 Cover Depth: 0.00 meters

C-14 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.435E-02	3.664E-12	0.000E+00	3.858E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	5.741E-04	1.465E-13	0.000E+00	1.543E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.435E-02 mrem/yr at t = 0.000E+00 years



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.258E-07	0.0000	6.537E-06	0.0005	0.000E+00	0.0000	1.184E-02	0.8250	2.041E-03	0.1422	4.624E-04	0.0322	2.440E-06	0.0002
Total	3.258E-07	0.0000	6.537E-06	0.0005	0.000E+00	0.0000	1.184E-02	0.8250	2.041E-03	0.1422	4.624E-04	0.0322	2.440E-06	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.435E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.435E-02	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.292E-17	0.0000	2.575E-16	0.0001	0.000E+00	0.0000	1.361E-12	0.3714	2.056E-12	0.5613	2.462E-13	0.0672	9.614E-17	0.0000
Total	1.292E-17	0.0000	2.575E-16	0.0001	0.000E+00	0.0000	1.361E-12	0.3714	2.056E-12	0.5613	2.462E-13	0.0672	9.614E-17	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.664E-12	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.664E-12	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.931E-03	0.5005	1.453E-03	0.3768	0.000E+00	0.0000	3.747E-04	0.0971	2.929E-05	0.0076	6.941E-05	0.0180	3.858E-03	1.0000
Total	1.931E-03	0.5005	1.453E-03	0.3768	0.000E+00	0.0000	3.747E-04	0.0971	2.929E-05	0.0076	6.941E-05	0.0180	3.858E-03	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Dose/Source Ratios Summed Over All Pathways  
 Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.435E-02	3.664E-12	5.685E-33	3.858E-03	2.678E-42	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
 Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	1.742E+03	*4.455E+12	*4.455E+12	6.480E+03	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
 and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
 at tmin = time of minimum single radionuclide soil guideline  
 and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	1.000E+00	0.000E+00	1.435E-02	1.742E+03	1.435E-02	1.742E+03



Individual Nuclide Dose Summed Over All Pathways  
Parent Nuclide and Branch Fraction Indicated

Nuclide Parent      THF(i)			DOSE(j,t), mrem/yr							
(j)	(i)		t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03							
C-14	C-14	1.000E+00	1.435E-02	3.664E-12	0.000E+00	3.858E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

Nuclide Parent      THF(i)			S(j,t), pCi/g							
(j)	(i)		t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03							
C-14	C-14	1.000E+00	1.000E+00	3.966E-11	6.238E-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 1.11 seconds



Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary .....	3
Summary of Pathway Selections .....	7
Contaminated Zone and Total Dose Summary .....	8
Total Dose Components	
Time = 0.000E+00 .....	9
Time = 1.000E+00 .....	10
Time = 3.000E+00 .....	11
Time = 1.000E+01 .....	12
Time = 3.000E+01 .....	13
Time = 1.000E+02 .....	14
Time = 3.000E+02 .....	15
Time = 1.000E+03 .....	16
Dose/Source Ratios Summed Over All Pathways .....	17
Single Radionuclide Soil Guidelines .....	17
Dose Per Nuclide Summed Over All Pathways .....	18
Soil Concentration Per Nuclide .....	18



Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1( 1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2( 1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3( 1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF( 1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF( 1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF( 1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC( 1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC( 1,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETRG table in Ground Pathway of Detailed Report.

\* Case means Default.Lib w/o Associate Nuclide contributions.



Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.760E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	9.200E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T( 2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T( 3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T( 4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T( 5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T( 6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T( 7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T( 8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T( 9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1( 1)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC( 1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU( 1,1)
R016	Saturated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCS( 1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E+00	ALEACH( 1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK( 1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE( 1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE( 2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE( 3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE( 4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE( 5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE( 6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE( 7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE( 8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE( 9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA( 1)
R017	Ring 2	not used	2.732E-01	---	FRACA( 2)
R017	Ring 3	not used	0.000E+00	---	FRACA( 3)
R017	Ring 4	not used	0.000E+00	---	FRACA( 4)
R017	Ring 5	not used	0.000E+00	---	FRACA( 5)
R017	Ring 6	not used	0.000E+00	---	FRACA( 6)
R017	Ring 7	not used	0.000E+00	---	FRACA( 7)
R017	Ring 8	not used	0.000E+00	---	FRACA( 8)
R017	Ring 9	not used	0.000E+00	---	FRACA( 9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.138E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.138E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS



Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed



Contaminated Zone Dimensions <hr/> Area: 2760.00 square meters Thickness: 0.15 meters Cover Depth: 1.00 meters	Initial Soil Concentrations, pCi/g <hr/> C-14 1.000E+00
---	--

Total Dose TDOSE(t), mrem/yr  
 Basic Radiation Dose Limit = 2.500E+01 mrem/yr  
 Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.698E-25	2.844E-26	7.983E-28	5.020E-02	2.902E-05	0.000E+00	0.000E+00	0.000E+00
M(t):	6.791E-27	1.138E-27	3.193E-29	2.008E-03	1.161E-06	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 5.125E-02 mrem/yr at t = 22.84 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 2.284E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 2.284E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.565E-02	0.5005	1.931E-02	0.3768	0.000E+00	0.0000	4.977E-03	0.0971	3.888E-04	0.0076	9.220E-04	0.0180	5.125E-02	1.0000
Total	2.565E-02	0.5005	1.931E-02	0.3768	0.000E+00	0.0000	4.977E-03	0.0971	3.888E-04	0.0076	9.220E-04	0.0180	5.125E-02	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.698E-25	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.698E-25	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.698E-25	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.698E-25	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.844E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.844E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.844E-26	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.844E-26	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	7.983E-28	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.983E-28	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.983E-28	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.983E-28	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	2.513E-02	0.5006	1.891E-02	0.3768	0.000E+00	0.0000	4.876E-03	0.0971	3.808E-04	0.0076	9.032E-04	0.0180	5.020E-02	1.0000
Total	2.513E-02	0.5006	1.891E-02	0.3768	0.000E+00	0.0000	4.876E-03	0.0971	3.808E-04	0.0076	9.032E-04	0.0180	5.020E-02	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.423E-05	0.4904	1.104E-05	0.3806	0.000E+00	0.0000	2.958E-06	0.1019	2.635E-07	0.0091	5.238E-07	0.0181	2.902E-05	1.0000
Total	1.423E-05	0.4904	1.104E-05	0.3806	0.000E+00	0.0000	2.958E-06	0.1019	2.635E-07	0.0091	5.238E-07	0.0181	2.902E-05	1.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

\*Sum of all water independent and dependent pathways.



Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.698E-25	2.844E-26	7.983E-28	5.020E-02	2.902E-05	0.000E+00	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t = 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	*4.455E+12	*4.455E+12	4.980E+02	8.615E+05	*4.455E+12	*4.455E+12	*4.455E+12

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 22.84 ± 0.05 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	1.000E+00	22.84 ± 0.05	5.125E-02	4.878E+02	5.125E-02	4.878E+02



Individual Nuclide Dose Summed Over All Pathways  
 Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.698E-25	2.844E-26	7.983E-28	5.020E-02	2.902E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
 Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g								
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	1.603E-01	4.119E-03	1.120E-08	1.407E-24	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.43 seconds