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SITE CLOSEOUT REPORT
FOR THE
PAINESVILLE SITE

PAINESVILLE, OHIO

AUTHORIZED PROJECT UNDER THE

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

(FUSRAP)

JANUARY 2014

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
BUFFALO DISTRICT
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

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DECLARATION OF RESPONSE ACTION COMPLETION AND ISSUANCE OF THE SITE CLOSEOUT REPORT FOR THE PAINESVILLE FUSRAP SITE

The response action at the Painesville Formerly Utilized Sites Remedial Action Program (FUSRAP) Site in Painesville, Ohio is complete in accordance with the Record of Decision (ROD) signed on April 7, 2006, and in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). As a result of the remedial action, no FUSRAP-related radioactive material addressed by the ROD remains on-site above the cleanup requirements and no further action to address FUSRAP-related contamination will be required on-site.

/S/ 13 JAN 2014

Margaret W. Burcham Date
Brigadier General, US Army
Commanding

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ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
AOCs	Areas of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
Argonne	Argonne National Laboratory
bgs	below ground surface
BNI	Bechtel National Incorporated
Bq/kg	Becquerel per kg
cc	cubic centimeter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeters
COCs	Constituents of Concern
DCGL	Derived Concentration Guideline Level
$DCGL_w$	Derived Concentration Guideline Level - wide area average
$DCGL_{emc}$	Derived Concentration Guideline Level - elevated measurement comparison
DCS	Diversion Control Setpoint
DOE	United States Department of Energy
DQOs	Data Quality Objectives
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FSS	Final Status Survey
FSSP	Final Status Survey Plan
ft	foot (feet)
ft^3	cubic feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	grams
GCL	Geosynthetic Clay Liner
GSA	General Services Administration
HCl	hydrochloric acid
in	inch (inches)
kg	kilograms
km	kilometers
lbs	pounds
LOSA	Lake Ontario Storage Area
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MED	Manhattan Engineer District
m	meters
m^2	square meters
m^3	cubic meters

ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE (continued)

mi	miles
mrem	milliroentgen equivalent man
mrem/yr	milliroentgen equivalent man per year
NCP	National Contingency Plan
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
ORNL	Oak Ridge National Laboratory
pCi/g	picoCuries per gram
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
Ra-226	Radium-226
Ra-228	Radium-228
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SAIC	Science Applications International Corporation
SEC	Safety and Ecology Corporation, Ltd.
SOR	Sum of Ratios
SU	Survey Unit
TCLP	Toxicity Characteristic Leaching Procedure
TDP	Technical Data Package
TEDE	Total Effective Dose Equivalent
Th-230	Thorium-230
Th-232	Thorium-232
Total U	Total Uranium
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238
µCi/ml	microCuries per milliliter
Uniroyal	Uniroyal Chemical Company
USACE	United States Army Corps of Engineers
VCM	Vinyl Chloride Monomer
yd^3	cubic yards

1.0 INTRODUCTION

The Painesville Site is located at 720 Fairport Nursery Road in Painesville, Ohio, approximately 22 miles northeast of Cleveland. The Painesville Site has been remediated under the Formerly Utilized Sites Remedial Action Program (FUSRAP) by the United States Army Corps of Engineers (USACE).

Generally under FUSRAP, USACE is authorized to investigate, and clean up or control sites contaminated as the result of actions by the Atomic Energy Commission (AEC) and its predecessor, the Manhattan Engineer District (MED), in support of the nation's early atomic energy and weapons program.

This report is intended to provide a final overall summary of response action taken at the site.

The scope of the response action at the Painesville Site only addressed the following FUSRAP-related constituents of concern (COCs) in site soils: radium-226 (Ra-226) and its decay products, thorium-230 (Th-230), thorium-232 (Th-232) and its decay products, and total uranium [uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238)].

Radiologically contaminated soils were excavated and mechanically segregated to reduce contaminated soil volume transported to an off-site facility for disposal. The implemented remedy achieved the degree of cleanup and protection specified in the Record of Decision (ROD) for the Painesville Site for all pathways of exposure. No further response is needed to protect human health and the environment from the FUSRAP-related COCs.

2.0 SITE LOCATION AND DESCRIPTION

The Painesville Site is located at 720 Fairport Nursery Road in the Township of Painesville in Lake County, Ohio, approximately 35.4 kilometers (km) [22 miles (mi)] northeast of Cleveland. The approximately 12 hectare (30-acre) former industrial facility is owned by the Chemtura Corporation (Chemtura), as of the release date of this document. Figure 1 shows the location of the site in relation to the surrounding area.

The site is bounded to the north by the Norfolk Southern Railway Company's Fairport Industrial Track (formerly known as the Fairport, Painesville, and Eastern Railway). Property to the west is owned by Chemtura. Fairport Nursery Road bounds the property to the south. Magnus International Group, which owns collocated Hardy Industrial Technologies and Recycling & Treatment Technologies of Ohio, bounds the property to the east.

The Painesville Township Park lies northeast of the site, while industrial properties are located on the other sides of the site. The Diamond Alkali Waste Lake, a confirmed hazardous waste site being addressed by the United States Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), is located approximately 1.6 km (1 mi) southeast of the site, and residential properties are to the northeast. An abandoned industrial site is located to the northwest. The Grand River is located approximately 0.2 km (0.1 mi) southwest of Fairport Nursery Road, and flows in a northwesterly direction towards Lake Erie.

The site contained as many as twenty-nine buildings and structures. The only structure currently remaining at the site is a vacant office building (formerly Building 400) used by the Uniroyal Chemical Company (Uniroyal).

3.0 SITE HISTORY

In the early 1940s, the Defense Plant Corporation constructed a magnesium production facility in Painesville, Ohio, on property acquired by the Federal Government. In support of the World War II effort and later government operations, the Diamond Magnesium Company operated this facility from 1942 to 1953 for the General Services Administration (GSA). In 1963, the GSA sold the plant to the U.S. Rubber Company, which later became Uniroyal, then the Crompton Manufacturing Company, Inc., and is now Chemtura. Uniroyal produced nitrile rubber, polyvinyl chloride (PVC) nitrile rubber, and various polymers at the site until it ceased operations in 1999. Uniroyal utilized several of the original Diamond Magnesium Company buildings for its operations, and also built new buildings on the site. Uniroyal constructed several landfills, impoundments and lagoons for waste disposal purposes on adjacent properties surrounding the site. After ceasing its operations in 1999, Uniroyal demolished all of the buildings on site with the exception of the office building, the former Building 400. Chemtura subsequently conducted investigation and/or cleanup activities for chemicals at the site, and is in the process of capping the lagoons and landfills on the adjacent properties. Figure 2 shows the former Diamond Magnesium Company site plan, which defines the boundary of the Painesville FUSRAP Site.

There is no known history of processing or production of radioactive materials at the Painesville Site. The radioactivity present at the site resulted from the use of scrap ferrous metal to scrub chlorine gas released during the magnesium production process. The GSA sought such scrap metal from the Atomic Energy Commission's (AEC) inventories at the Lake Ontario Storage Area (LOSA) in the Townships of Lewiston and Porter, New York. By the early 1950s, LOSA had accumulated significant quantities of scrap metal, in part because metal drums were used to ship and store residues from the processing of pitchblende ores. When the pitchblende residues were consolidated into a storage facility at LOSA, the emptied drums were cleaned for reuse or scrapped. These drums, which contained observable residues of pitchblende ores, were part of the scrap shipped to the Painesville Site (ORNL 1991). For this reason only those radionuclides associated with the pitchblende residues (primarily Ra-226, Th-230 and U-238 and their decay products) are considered MED/AEC-related, and therefore, are considered eligible to address under FUSRAP.

Approximately 1,500,000 kilograms (kg) (1,650 tons) of scrap metal were shipped to the Painesville Site. These shipments occurred in December 1951, July 1952, and April 1953, in the estimated quantities of 581,000 kg (640 tons), 508,000 kg (560 tons), and 408,000 kg (450 tons), respectively (USACE 1998a).The scrap metal was delivered by railroad to the western side of the property where it was stored on the ground with no cover. Former employees indicated an additional delivery route was also present on the eastern side of the buildings, where scrap was moved from the west railroad siding to the east siding by sliding uncovered railsided wooden skids or sleds pulled by a tractor (Eddington 1996). In an interview with a former plant manager, he indicated that scrap was off loaded from both east and west spurs and was moved via rail car from one siding to another (Trumbel 2001). From the eastern side, the scrap metal was either

immediately added to the hydrochloric acid (HCl) digester tanks or stored on the ground (ORNL 1990).

The scrap metal used to scrub chlorine gas was immersed into weak HCl for complete digestion. Liquid acid waste from the process was discharged directly into the Grand River until June 1952, at which time the discharge was redirected across the Grand River into a waste pond owned by the Diamond Alkali Company.

Because the COCs in the scrap metal were related to MED/AEC activities, Oak Ridge National Laboratory (ORNL) conducted a preliminary and limited radiological survey in 1988 to determine whether the site met the current radiological guidelines. The findings from this survey indicated that residual radioactivity was present at the site above existing guidelines for unrestricted use (ORNL 1990, 1991). The principal COCs were determined to be U-238, Ra-226, Th-230 and their naturally-occurring decay products.

Based on these initial surveys, in 1992, the United States Department of Energy (DOE) designated the Painesville Site as a FUSRAP site for further evaluation and remedial action, as appropriate (DOE 1992). DOE established FUSRAP in 1974 to identify, investigate, and if necessary, clean up or control sites that were contaminated as a result of activities conducted in support of the Nation's early atomic energy and weapons program. There activities were performed by the Manhattan Engineer District (MED) (1942–1946) and/or under the Atomic Energy Commission (AEC) (1947–1975). Therefore, only MED/AEC-related constituents, hereafter referred to as FUSRAP-related COCs, are authorized to be addressed under FUSRAP.

Engineer Regulation (ER) 200-1-4 for the Formerly Utilized Sites Remedial Action Program defines the criteria for inclusion of properties into FUSRAP. Under ER 200-1-4, there must be some sort of evidence of Federal Government liability, as defined by CERCLA, for contamination on the property for it to be considered eligible for FUSRAP. Liability under CERCLA is defined in Title 42, Chapter 103, Subchapter 1, Section 9607 of the United States Code. In summary, a party is liable under CERCLA if they have ever owned or operated a facility, or disposed of or arranged for disposal of material at a facility. USACE found no evidence that the Federal Government meets any of the criteria for CERCLA liability for areas outside of the designated FUSRAP boundary illustrated in Figure 2.

4.0 PREVIOUS INVESTIGATIONS

The Painesville Site has undergone a number of investigations relating to the occurrence of FUSRAP-related COCs. The following is a brief timeline of the events which are discussed in more detail in the following sections:

- 1988 ORNL Site Evaluation
- 1990 ORNL Additional Site Evaluation
- 1996 DOE Site Characterization Fieldwork
- 1997 USACE is assigned responsibility for FUSRAP
- 1998 Characterization Report and Engineering Evaluation/Cost Analysis (EE/CA)
- 1998 Non-Time Critical Removal Action

- 2000 Remedial Investigation (RI) Fieldwork
- 2003 RI/Feasibility Study (FS) Report
- 2005 FS Addendum
- 2005 Proposed Plan
- 2005 Pre-Remediation Sampling
- 2006 Record of Decision

4.1 DOE INVESTIGATIONS

On October 10 and 11, 1988, ORNL performed a preliminary site evaluation of the former Uniroyal (now Chemtura) property for the DOE. ORNL performed a gamma walkover survey over the study area and collected soil samples for radiological analysis. During the survey, information was obtained concerning other portions of the property which would need to be addressed as part of future efforts (ORNL 1990).

ORNL returned to the site in September 1990 to examine the former Lonza Chemical Company property (previously identified as Twin Rivers Technologies and now Hardy Industrial Technologies and Recycling & Treatment Technologies of Ohio) to the east adjacent to the railroad tracks, and to investigate areas that showed elevated gamma readings during the 1988 survey. The survey results (ORNL 1991) indicated that elevated concentrations of radionuclides were found in both surface and subsurface soil in excess of guidelines in DOE Order 5400.5 for release of a property without radiological restrictions (i.e. residual concentrations of Ra-226, radium-228 (Ra-228), Th-230, and Th-232 of 185 Becquerel per kg (Bq/kg) [5 picocuries per gram (pCi/g)] above background averaged over 15 centimeters (cm) [6 inches (in)] of soil and 555 Bq/kg (15 pCi/g) above background averaged over 15 cm (6 in) thick layers below this depth). The primary COCs were U-238, Th-230, and Ra-226 with activity levels as high as 2,800 Bq/kg (76 pCi/g), 11,000 Bq/kg (310 pCi/g), and 56,000 Bq/kg (1,500 pCi/g), respectively.

In 1996, Bechtel National Incorporated (BNI), Science Applications International Corporation (SAIC), and Argonne National Laboratory (Argonne), under contract to DOE, performed a detailed investigation of the Painesville Site. This investigation included ambient air sampling, external gamma rate exposure measurements, building radiological surveys, gamma walkover surveys, groundwater sampling, surface geophysical surveys, surface water sampling, sediment sampling, ecological sampling, and soil sampling. The results of this study are documented in the Characterization Report for the Painesville Site (USACE 1998a). No evidence of FUSRAP-related COCs in the sediment, surface water, or air was found at the Painesville Site.

4.2 USACE INVESTIGATIONS

In 1997, Congress transferred the responsibility of identifying and implementing the remedial actions for FUSRAP sites from the DOE to USACE. In 1998, USACE completed an EE/CA (USACE 1998b) to support a non-time critical removal action at the site. A Ra-226 soil cleanup goal of 999 Bq/kg (27 pCi/g) was developed and several alternatives for addressing the radiological contamination at the site were evaluated in the EE/CA. The selected alternative (referred to as Alternative 4, partial removal and commercial disposal) was documented in an Action Memorandum (USACE 1998c), and the removal action was then conducted in the fall of

1998. Approximately 1,014 in situ cubic meters (m^3) [1,326 in situ cubic yards (yd^3)] were removed before the project was suspended due to the onset of winter conditions, and the discovery that the extent of contamination was greater than anticipated in the Action Memorandum. During the removal action, samples were collected from soil that remained in place in the excavated area after removal was completed. These samples indicated that radiological contamination above the cleanup goals still existed below the limit of excavation (USACE 1999).

In May 2003, USACE completed a Remedial Investigation/Feasibility Study (RI/FS) Report for the Painesville Site (USACE 2003a). The RI/FS collected additional data from eleven investigative areas (i.e. Areas A, B, C, D, E, F, G, H, I, Post 1950 Structures, and the Rubble Pile), conducted a Baseline Risk Assessment, and developed and evaluated alternatives for addressing the site contamination. These alternatives included capping the contamination in place, and excavation and off-site disposal. Groundwater was evaluated in the 2003 RI/FS Report and found to be not impacted and protected from migration of radionuclides by the nature and thickness of the soils at the Painesville Site. In June 2005, USACE completed a Feasibility Study Addendum (USACE 2005a), which amended the cleanup goals and remedial alternatives first presented in the RI/FS.

USACE issued a Proposed Plan (USACE 2005b) in July 2005 for public comment, describing the preferred remedial action alternative for cleanup of the Painesville Site. In the fall of 2005, USACE conducted pre-remediation sampling (USACE 2006a) to further refine portions of the site conceptual model (i.e. the size, nature, and extent of the source terms at the site), defined in the RI/FS Report.

USACE signed the Record of Decision (ROD) (USACE 2006b) for the Painesville Site in April 2006. The selected remedy for cleanup of the Painesville Site, documented in the ROD, was excavation and off-site disposal. The ROD identified Ra-226 and its decay products, Th-230, Th-232 and its decay products, and total uranium (Total U) as radiological COCs in soil. All four COCs posed risks to human health above limits established in the NCP under an industrial-use scenario, which has been identified as the reasonable future-use scenario for the Painesville Site. Due to the fact that all but one of the buildings on the site have been demolished, and any industrial future use would likely require construction of new facilities, therefore, a construction worker receptor was selected as the critical group upon which the soil cleanup goals were developed. The remedial action proposed in the Proposed Plan and selected in the ROD does not address other hazardous contaminants that may be present at the site, which are not eligible for response under FUSRAP.

5.0 SELECTED REMEDY

The remedy selected for the Painesville Site is referred to as Alternative 3, Excavation of Soils and Offsite Disposal, in the Proposed Plan issued on July 18, 2005. Implementation of the Selected Remedy involved excavation of contaminated soils, offsite transportation, and disposal at an appropriate permitted/licensed disposal facility.

The USACE determined that the Nuclear Regulatory Commission standards for decommissioning of licensed facilities found in Title 10, Part 20, Section 1402, of the Code of

Federal Regulations (10 CFR 20.1402) and Chapter 3701:1-38, Rule Number 22, Section B, of the Ohio Administrative Code (OAC 3701:1-38-22(B) were relevant and appropriate for cleanup of FUSRAP-contamination in soils at the Painesville Site.

Under 10 CFR 20.1402, a facility is considered to be acceptable for unrestricted use if residual radioactivity above background does not exceed a total effective dose equivalent (TEDE) of 25 milliroentgen equivalent man per year (mrem/yr) to the average member of the critical group, including groundwater sources of drinking water. The facility must further reduce residual radioactivity to as low as reasonably achievable (ALARA) levels. The critical group, defined as "the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances" is the construction worker for the Painesville Site. OAC 3701:1-38-22(B) adopts the same required standard for license termination with unrestricted use as 10 CFR 20.1402.

In compliance with these standards, USACE:

1. Excavated FUSRAP contaminated soils that exceed, excluding background, a Sum of Ratios (SOR) of 1, based on the wide area average Derived Concentration Guideline Levels ($DCGL_w$) presented in Table 1. In addition, the elevated measurement comparison ($DCGL_{emc}$) was used to ensure no localized areas of elevated radioactivity will remain that could potentially produce an unacceptable risk. Verification of compliance with soil cleanup goals was demonstrated using surveys developed in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). This confirmation methodology was developed and documented in the Final Status Survey Plans (FSSPs) during the remedial design;

2. Removed and disposed off site all impacted soils to achieve cleanup goals, as discussed in item 1 above, for FUSRAP COCs.

Table 1 – Painesville Site Constituents of Concern and Soil Cleanup Goals

COC	Average Site Background Concentrations (pCi/g)[h]	Construction Worker Scenario $DCGL_w$ (pCi/g)[a,b,c]	Construction Worker Scenario $DCGL_{emc}$ (pCi/g)[b,c]
Ra-226[d]	0.95	9	12
Th-230	1.45	25	34
Th-232[e]	1.07	6	8
Total U[f]	2.72[g]	482	810

a. These cleanup goals represent activity levels above average site background activity corresponding to 25 mrem/yr. These cleanup goals are equivalent to an incremental lifetime cancer risk of approximately 2E-05 for a construction worker (for each COC). Reference: USACE 2006b.

b. If a mixture of radionuclides was present, then the SOR applied per MARSSIM. For example, using the $DCGL_w$ values for soil, the following sum of ratios equation is obtained:

$$SOR = \frac{Ra\text{-}226}{9} + \frac{Th\text{-}230}{25} + \frac{Th\text{-}232}{6} + \frac{U\text{-}234+U\text{-}235+U\text{-}238}{482}$$

where SOR = sum of ratios (SOR) result:

Ra-226 = net Ra-226 soil concentrations
Th-230 = net Th-230 soil concentrations
Th-232 = net Th-232 soil concentrations
U-234 = net Uranium-234 (U-234) soil concentrations
U-235 = net Uranium-235 (U-235) soil concentrations
U-238 = net Uranium-238 (U-238) soil concentrations

Note: Net soil concentrations exclude average background

c. $DCGL_w$ values are concentrations above average background and represent average concentration guidelines over a 10,000 m^2 area. $DCGL_{emc}$ values are concentrations above average background and represent average concentration guidelines over a 100 m^2 area.
d. Ra-226 criterion includes lead-210 (Pb-210) contribution to dose.
e. Th-232 criteria includes thorium-228 and Ra-228 contribution to dose.
f. Concentration represents the total uranium guideline.
g. Total uranium background is the sum of the average background values for U-234, U-235, and U-238.
h. Average site background concentrations (USACE 2003a)

The remedial action objectives (RAOs) for the Painesville Site were as follows:

- To comply with the identified applicable or relevant and appropriate requirements (ARARs); 10 CFR 20.1402 and OAC 3701:1-38-22(B).
- To ensure protection of human health and the environment by reducing exposure by external gamma, inhalation and ingestion to the FUSRAP COCs (Ra-226, Th-230, Th-232, and Total U) in site soils.
- To remediate the site soils so that the following site-wide area average Derived Concentration Guideline Levels ($DCGL_w$), exclusive of background, were not exceeded: Ra-226 = 333 Bq/kg (9 pCi/g), Th-230 = 925 Bq/kg (25 pCi/g), Th- 232 = 222 Bq/kg (6 pCi/g), and Total U = 18,000 Bq/kg (482 pCi/g).

The Selected Remedy addressed the principal threat from FUSRAP COCs at the site by removing radioactively contaminated soil from the site that may pose a future threat to the health of persons at the site. Implementation of this remedy was intended to meet the unrestricted release criteria as defined in the ARARs. The Selected Remedy only addressed FUSRAP-related COCs, and did not address any other hazardous substances that may have been present at the site. The determination of the need for and performance of response actions related to other releases of hazardous substances at this site was not within the authority of USACE under FUSRAP. It was the responsibility of other agencies and parties to undertake any other necessary response actions at the site.

6.0 REMEDIAL ACTION SUMMARY

USACE conducted fieldwork for a non-time critical removal action and two phases of remedial action at the Painesville Site as follows:

- **Non-Time Critical Removal Action** (September – November 1998)
- **Remedial Action** (April 2007 – April 2008)
- **Remedial Action** (April 2010- August 2011)

6.1 NON-TIME CRITICAL REMOVAL ACTION (1998)

USACE issued an EE/CA for the Painesville Site in June 1998 based upon a radiological risk evaluation that assumed reasonable worst-case exposure scenarios for the industrial facility. The risk evaluation assumed that the facility would expand into areas containing elevated levels of radionuclides and evaluated the resulting dose to a hypothetical future site worker from direct gamma radiation, soil ingestion, and dust inhalation (including radon decay product) pathways. The estimated dose to the maximally exposed future site worker under worst-case conditions, which would allow much higher exposures than were possible under current site conditions, was 99 mrem/yr. Since 10 CFR 20.1301 limits doses to the public from all sources to no more than 100 mrem/yr and requires application of the ALARA philosophy to reduce doses in most cases to a fraction of the 100 mrem/yr limit, the estimated dose of 99 mrem/yr was high enough to warrant non-time-critical removal actions under ALARA. The recommended removal action indicated that the contamination extended below the surface approximately eighteen inches and consisted of approximately 604 m^3 (790 yd^3) of soil containing Ra-226 contamination greater than 999 Bq/kg (27 pCi/g). The contractor, CKY, Inc. (CKY), excavated approximately 1,014 m^3 (1,326 yd^3) of low-level radioactively contaminated soil as deep as 1.2 to 1.5 meters (m) [4 to 5 feet (ft)] from Painesville and transported it by rail to Energy Solutions' Clive, Utah disposal facility (formerly Envirocare of Utah) as part of this non-time critical removal action before suspending work due to the onset of winter conditions and discovery that the extent of contamination was greater than anticipated.

Uniroyal closed its Painesville facility located on the site subsequent to the 1998 non-time critical removal action, which made available for investigation areas that were previously inaccessible. Results of the 1998 removal action and the cessation of Uniroyal site operations resulted in a re-evaluation of site conditions and a decision to conduct a RI/FS, which was conducted by USACE in September 2000 and primarily addressed residual radionuclides in soil (USACE 2003a).

6.2 REMEDIAL ACTION (2007/2008)

The RI/FS identified the need to remediate radiological soil contamination at eight areas of concern (AOCs) based on historical site usage and characterization data – Areas A, B, C, D, F, G, H and the Rubble Pile; the post-remediation configuration of which are illustrated in Figure 3. These AOCs were identified prior to the 2007/2008 remedial action and are described below.

<u>Area A</u>

Area A was located on the western edge of the Painesville Site. Investigations identified the presence of contaminated soil exceeding project cleanup goals (DCGLs) identified in the ROD

(USACE 2006b) at depths of up to approximately 3 m (10 ft) below ground surface (bgs) in Area A. Investigations also indicated the presence of approximately 0.9 to 1.2 m (3 to 4 ft) of uncontaminated fill material from past remediation and backfilling activities in upper portions of parts of Area A. Debris was also identified as being present in some portions of Area A both at the ground surface and at depth. Surficial soil contamination exceeding project DCGLs was also identified as being present at multiple discrete locations southwest of Area A, which USACE later designated as Area A Prime (A'). At the completion of the 2007/2008 remedial action additional FUSRAP-related contamination was observed to remain in both Areas A and A'.

Area B

Area B was located along the eastern rail spur in the east central portion of the site. Investigations identified contaminated soil exceeding project DCGLs in Area B surface and near surface soil, up to approximately 0.6 m (2 ft) bgs. Surface soil contamination was also identified as being present at a discrete location north of Area B which was later designated as Area B'. Upon completion of the 2007/2008 remedial action, remedial activities were completed for both Areas B and B'.

Area C

Area C abutted portions of the Hardy property along the eastern limit of the Painesville Site. Investigations identified the presence of contaminated surface and subsurface soil exceeding project DCGLs in Area C, extending up to 1.5 m (5 ft) bgs. Remediation in Area C was completed as part of the 2007/2008 remedial action. During remediation of Area C, which extended slightly onto the adjacent Hardy property, contamination was discovered in a portion of a former acid waste pipe leading west from Area C, which became a new excavation area designated as Area C-Pipe.

Area D

Area D was located in the southeast portion of the Chemtura property. Investigations identified contaminated soil exceeding project DCGLs in surface soil in Area D, extending up to 0.6 m (2 ft) bgs. Upon completion of the 2007/2008 remedial action, remediation activities were completed for this area.

Area F

Area F was located in the central portion of the site due east of the north-south oriented site haul road. Investigations indicated contaminated surface and subsurface soil exceeding project DCGLs at depths up to 1.2 m (4 ft) bgs in Area F. Upon completion of the 2007/2008 remedial action, remediation activities were completed for this area.

Area G

Area G was located between two old rail spurs approximately eighty yards south of the north site road and twenty yards west of the western site road. The investigations identified contaminated surface soil exceeding project DCGLs in the upper several feet in Area G. During remediation of Area G, contamination was identified in three small nearby areas designated as Area G', G", and GG. At the completion of the 2007/2008 remedial action, additional contamination was observed to remain in the area designated as Area GG.

Area H

Area H was located outside of the western boundary of the Painesville Site; contiguous to Area A. Investigations identified contaminated soil exceeding the project DCGLs at depths of up to approximately 1.5 m (5 ft) bgs in Area H. Debris was also identified as being present in some portions of Area H, both at the ground surface and at depth. At the completion of the 2007/2008 remedial action additional contamination was observed to remain in Area H.

Landfill III Portion of Area H

FUSRAP-related COCs in northern portions of Area H were noted as extending into uncapped portions of an adjacent inactive industrial waste landfill owned by the Painesville Site property owner and known as "Landfill III." Accordingly to an "Interim Action Work Plan for Landfill Areas I/II, III, and V" developed for the property owner by Enviro-Sciences, Inc. (USACE 2012), Landfill III was used for disposal of:

- "Scrap (Polyvinyl chloride) PVC resin, pigments, and scrap plastic compound (KMP), mixed trash, refuse, paper, and cardboard ash from operations;
- Spent (Vinyl chloride monomer) VCM reactor catalyst and mercury dichloride on spent catalyst from VCM operations;
- Highboilers (ethylene dichloride and aldehydes);
- Fly ash from the production of steam;
- Nitrile rubber scrap; and
- Impact modified plastic scraps."

The above-referenced Enviro-Sciences Work Plan stated that "(Toxicity characteristic leaching procedure) TCLP tests indicate that the landfill material is (Resource Conservation and Recovery Act, or RCRA) non-hazardous." The Enviro-Sciences Work Plan also indicated the presence of metals and volatile and semi-volatile organic compounds in soil and waste associated with Landfill III, with primary COCs including polycyclic aromatic hydrocarbons, antimony, cadmium, mercury and bis(2-ethylehexyl)phthalate. The property owner (Chemtura) constructed a clay cap over portions of Landfill III in 2006 outside and north of Area H.

Rubble Pile Area

The Rubble Pile Area was located south and east of the eastern rail spur and consists of soil and construction debris from past excavation of foundations in the vicinity of former acid digesters. Contamination exceeding project DCGLs was present in the upper 0.9 m (3 ft) of stockpiled material in the Rubble Pile Area all above the surrounding ground surface. Upon completion of the 2007/2008 remedial action, remediation activities were completed for this area.

Ra-226, Th-230, and U-238 were identified as the primary radiological soil COCs for the site and the radionuclides impacting cleanup decision making. The investigations also identified the presence of Th-232 above site background at relatively low concentrations at a limited number of locations. Thorium-232 was typically co-located with Ra-226 and U-238 on the property. The concentrations of Th-232 were not high enough to cause a remedial action or to change cleanup decisions on the property. More detailed information is available in the Remedial Investigation/Feasibility Study (USACE 2003a) and Feasibility Study Addendum (USACE 2005a).

A total of 13,760,000 kg (15,168 tons) [approximately 7,197 m^3 (9,413 in situ yd^3)] of low-level radioactively contaminated soil and debris were excavated by Cabrera Services, Inc. (Cabrera) and transported to US Ecology Idaho's Grand View facility for disposal between April 2007 and April 2008. Five of the eight AOCs (Areas B, C, D, F, and the Rubble Pile) were completely remediated during the 2007/2008 remedial action with the contaminated soil volume removed well in excess of the ROD estimated amount of 5,486 m^3 (7,175 yd^3).

Results of the remedial action resulted in a re-evaluation of site conditions and a decision to conduct further sampling at the site to reduce uncertainty in the estimated volume of contaminated soil remaining, which occurred in 2009. The results of this sampling were published in the Final Report for the Pre- Remediation Volume Uncertainty Reduction Subsurface Soil Sampling Project (USACE 2009) and are the basis for the work performed in the 2010/2011 remedial action.

6.3 REMEDIAL ACTION (2010/2011)

Areas A, C-Pipe, GG, and H were identified during the 2007/2008 remedial action as requiring additional remediation. This section describes four areas of excavation performed between April 2010 and August 2011.

Area A

Area A (which includes Area A and A') was an open excavation (from the 2007/2008 remedial action) up to 2.4 m (8 ft) deep in some areas and was filled with water. Additional excavation was required to depth over almost the entire floor of the area, as well as laterally across most of the perimeter of the excavation. Piping had previously been discovered in the deeper portion of the area and required removal and disposal. Concrete pillars and catch basins with associated piping were unearthed during remediation and resulted in removal and disposal, when indications of surface contamination were present. A section of the west wall was unable to be completely remediated in an effort to avoid breaching the known landfill boundary. More information regarding findings at the west wall of Area A are discussed in Section 7.0.

Area C-Pipe

Area C-Pipe contained a buried radiologically contaminated pipe, with an average of 2.4 m (8 ft) of overburden covering. The length of the pipe removed was approximately 107 m (350 ft). Concrete, clay and steel pipes (running all directions) were encountered during remediation. During site activities, an area north of the Area C-Pipe was identified, evaluated, and remediated using an excavator and the guided excavation procedure.

Area GG

Area GG was a localized hotspot that had been previously partially excavated and backfilled with stone. Geotextile material was in place from previous activities. Gravel, fabric, and rail ties were removed along with portions of the rail during the course of remediation. During a baseline survey, three localized spots were identified north of Area GG where Stockpile No. 3 was staged prior to placement. These locations were remediated with a bucket and shovel.

Area H

Area H was an open excavation (from the 2007/2008 remedial action) up to 1.5 m (5 ft) deep and was filled with water. Additional excavation was required outside the current excavation laterally and over portions of the floor of the area. On the northern bounds of Area H, materials from the uncapped portion of the industrial landfill, which were comingled with FUSRAP-related COCs, were encountered during remediation. Concrete pillars and catch basins with associated piping were unearthed during remediation and resulted in removal and disposal, when indications of surface contamination were present.

Excavated materials (with the exception of large concrete, metal pipes, and other debris that did not meet sizing requirements) were fed into a mechanical segregation system to radiologically survey and segregate excavated materials into above and below ROD acceptance criteria (i.e. DCGLs) stockpiles. Soil materials less than the DCGLs were returned as place back fill in the originating excavation after the final status survey (FSS) was complete. As with in situ soils, the soils that were processed by the soil segregation system for place back fill were evaluated using the FSS protocol described in Section 7.0, Monitoring Results.

During the 2010/2011 Remedial Action, a total of 43,500,000 kg (47,950 tons) of suspect contaminated soils and debris was excavated as part of the Painesville Site remediation effort. Of that total, the soil segregation system processed 42,600,000 kg (46,932 tons) of material while 924,000 kg (1,018 tons) were not processed due to oversize debris and materials that could not pass through the system, along with a small amount of material that was excavated after the system was demobilized. The segregation system segregated 41,800,000 kg (46,095 tons) of material to the "below criteria" stockpile for reuse at the site to fill the excavations, and 760,000 kg (837 tons) of material to the above-criteria stockpile for eventual shipment for offsite disposal. Therefore, of the total quantity of soil excavated, only 4% required offsite disposal, a significant reduction in the amount of soil transported and disposed of from the site. More detailed information on the segregation system can be found in Attachment B.

By August 2011, the Safety and Ecology Corporation, Ltd., (SEC) shipped a total of 1,680,000 kg (1,854 tons) of contaminated material, consisting of 1,570,000 kg (1,728 tons) of contaminated soil and 114,000 kg (126 tons) of contaminated debris that did not meet free release criteria to US Ecology Idaho's Grand View facility for disposal.
Table 2 presents the shipped disposal weights and volumes for the field efforts.

Table 2 – Disposed Material Summary

Removal Actions at the Painesville Site	Shipped Weight (tons)	Shipped (Ex Situ) Volume (yd^3)	Surface Area Excavated (acres)
1998 Non-Time Critical Removal Action	1,781	1,657	0.51
2007/2008 Remedial Action	15,156	11,694	1.87
2010/2011 Remedial Action	1,854	1,450	1.55
Total	**18,791**	**14,801**	**~4**

Contaminated materials from the 1998 Removal Action were loaded into roll-off containers on-site and transported via truck to an off-site transloading facility where they were transferred into rail cars and shipped via rail to Energy Solutions' Clive, Utah disposal facility (formerly Envirocare of Utah). For the 2007/2008 Remedial Action, contaminated materials were loaded into IP-1 and IP-2 lift bags and loaded via crane into gondola railcars on an adjacent rail spur and transported to US Ecology Idaho's Grand View facility for disposal. Contaminated materials from the 2010/2011 Remedial Action were directly loaded into gondola railcars on an adjacent rail spur and transported to US Ecology Idaho's Grand View facility for disposal.

After the Final Status Surveys (FSSs) were complete, the excavated areas illustrated in Figure 4 were backfilled. Soil materials not exceeding ROD criteria were used to backfill the originating remedial excavations. As part of site restoration, geosynthetic clay liner (GCL) was installed in excavated portions of Areas A and H in areas adjacent to Landfill III prior to backfilling to ensure that the remediation did not negatively impact the integrity of Chemtura's landfill cap.

6.4 COMMUNITY INVOLVEMENT

On July 18, 2005, USACE sent 126 individuals on the site mailing list, including elected officials, a letter announcing the release of the Proposed Plan for the remediation of the Painesville Site. Legal advertisements announcing the availability of the Proposed Plan for public review and comment, and the July 26, 2005 public meeting were placed in the following local newspapers; *The Plain Dealer* (Cleveland) - July 17 and 24, 2005; and *The News Herald* (Willoughby) - July 17 and 24, 2005.

The public meeting was held July 26, 2005, from 7 to 9 p.m. in the VFW Post 7754, 540 New Street, Fairport Harbor, Ohio. At the meeting USACE explained the history of the site, studies and investigations completed, areas of contamination, CERCLA evaluation criteria, the remedial alternatives, the preferred alternative, and the schedule. A stenographer was present at the meeting to record the proceedings and comments. Eleven members of the public requested the opportunity to speak at the meeting. Comments received at the public meeting and written comments received during the public comment period can be found in Appendix A of the ROD (USACE 2006b).

USACE held public availability sessions on May 24, 2007, and April 20, 2010, in advance of the 2007/2008 and 2010/2011 Remedial Actions, to inform the public of how the remedial action work was to be performed and to explain the measures to be established to ensure protection of human health and the environment.

Public input was encouraged to ensure that the remedy selected for the Painesville Site met the needs of the local community in addition to being an effective solution. The administrative record file, which contains all of the documentation used to support the selected remedy, is available at the following locations:

USACE FUSRAP Public Information Center
1776 Niagara Street
Buffalo, NY 14207

Fairport Public Library
335 Vine Street
Fairport Harbor, OH 44077

Morley Library
184 Phelps Street
Painesville, OH 44077

6.5 PERIMETER AIR MONITORING

USACE performed perimeter air monitoring during all excavation and soil handling activities conducted at the Painesville Site. Air monitoring results were compared to limits established in 10 CFR 20 Subpart E. Specifically, these limits are presented in Column 1, *Air Effluent Concentrations* in microCuries per milliliter (μCi/ml), of Table 2 in Appendix B of 10 CFR 20 and are applicable to the assessment and control of dose to the general public. The regulatory air effluent release limit of 2E-14 μCi/ml is equivalent to the Th-230 concentration which, if inhaled continuously over the course of a year, would produce a TEDE of 50 mrem. Based upon the perimeter monitoring data, no member of the public received a radiation exposure above regulatory limits. USACE also monitored dust levels to ensure nuisance dust was successfully controlled by the dust control measures employed during remediation.

6.6 RESIDUAL DOSE ASSESSMENT SUMMARY

A post-remediation radiological dose assessment was conducted by Argonne using residual concentrations of FUSRAP-related COCs (i.e. Ra-226, Th-230, and Total U) in soil to determine the potential radiation dose to the critical group (i.e. a construction worker) at the Painesville Site.

The USACE identified 10 CFR 20.1402 and OAC 3701:1-38-22(B) in the ROD (USACE 2006b) as ARARs for the Painesville Site. In compliance with these standards, the Painesville Site would be considered acceptable for unrestricted release for the critical group if residual radioactivity above background did not exceed a dose of 25 mrem/yr to a construction worker. The DCGLs for residual radioactivity of FUSRAP-related COCs in soil listed in Table 1 were developed for the Painesville Site to represent activity levels above average site background corresponding to the 25 mrem/yr criterion for a construction-worker scenario.

Input parameters and detailed evaluations performed to verify compliance with the ARARs are in Attachment C of this report. The drinking water pathway was not incorporated into this dose assessment. Groundwater was evaluated in the RI/FS report (USACE 2003a) and found to be not impacted and protected from migration of radionuclides by the nature and thickness of the soils at the site. Furthermore, uranium (the most mobile of the FUSRAP-related COCs) has been reduced to below average background soil concentrations across the site, thereby eliminating a source term for potential future groundwater impacts.

The average residual site-wide soil concentrations and their resultant dose are presented in Table 3 and discussed further in Attachment C.

Table 3 – Residual Soil Concentrations and Resultant Dose

Painesville FUSRAP Site	Soil Concentrations (pCi/g)				Annual Residual Dose to Construction Worker (mrem)[c]
	Ra-226	Th-230	Th-232	Total U [a]	
Residual Site-Wide Average Soil Concentrations	**1.40**	**1.17**	**0.82**	**2.33**	**1.2**
Average Site Background Concentrations[b]	**0.95**	**1.45**	**1.07**	**2.72**	**-**

a. Total uranium background is the sum of the average background values for U-234, U-235, and U-238.
b. Average site background concentrations (USACE 2003a)
c. The resulting doses are incremental to (above) background, as indicated by 10 CFR 20.

Since the residual dose for a construction worker is below the dose rate limit of 25 mrem/yr, the dose assessment indicates that no FUSRAP-related COCs remain at the Painesville Site that preclude construction worker exposure to the site media addressed by the ROD.

A second dose assessment was performed to determine the potential radiation dose to an urban resident who is assumed to live and garden on the site. The projected future use of this site is industrial, so this is a conservative evaluation of residual dose. Input parameters and detailed evaluations performed are in Attachment C of this report. The drinking water pathway was not incorporated into this dose assessment for the reasons described above. The resultant annual residual dose to an urban resident from residual average site-wide soil concentrations was 2.2 mrem. Therefore, the dose assessment indicates that no FUSRAP-related COCs remain at the Painesville Site that preclude unlimited use and unrestricted exposure to the site media addressed by the ROD, and therefore no five-year reviews are required.

To further evaluate the long-term protectiveness of the remedial action, the potential dose to a future hypothetical subsistence farmer were assessed. The main difference between exposure to an urban resident versus a more conservative subsistence farmer would be an increase in the amount of home-grown produce consumed (i.e. 50% for a subsistence farmer versus 5% for the urban resident). Milk, meat, and fish uptake and contribution to dose are much less significant for COCs (Ra-226 and Total U). If the plant ingestion pathway was increased by a factor of 10 (from 5% to 50% of home grown produce consumed), the resulting dose from this pathway would be 7.4 mrem/yr for residual site-wide average soil concentrations. The total dose to a subsistence farmer would still be below the dose rate limit of 25 mrem/yr.

6.7 FUTURE LAND USE

The Painesville Site is currently a vacant former industrial facility, owned by the Chemtura Corporation. The site formerly contained process buildings, warehouses, office buildings, a chemical transfer facility, several above-ground storage tanks, and a railroad spur. All buildings except a vacant office building[1] (formerly Building 400) used by Uniroyal have since been

[1] Radiological surveys of Building 400 were comparable to or less than background (USACE 1998a)

demolished by the property owner. The USACE is unaware of any plans for redevelopment of the site.

The Painesville Site has been an industrial site since the early 1940s, and is currently zoned as industrial. The site is surrounded by active and inactive industrial properties, including former industrial landfills to the west and north of the site. Soils at the site are poorly suited for agricultural purposes, as native soils are high in clay content, and a layer of miscellaneous fill exists over much of the site.

Groundwater supplies at the site are low in quantity and of low quality for drinking purposes. Groundwater at the Painesville Site is not used as a drinking water source, as Lake Erie is the water source for the majority of the local population and the Chagrin Formation underlying the Painesville area yields little or no water. Sulfur water or brine is often encountered during deep drilling operations. Information supplied by the Ohio EPA indicates that there are no domestic users of groundwater in the vicinity of the site.

Finally, the site property owner is conducting chemical investigations and/or cleanup activities at the site and adjacent properties, which include capping of landfills and lagoons surrounding the site, restricting potential future residential development or construction on these areas. Therefore, USACE has determined that the reasonable expected future site use of the Painesville Site will remain industrial.

7.0 MONITORING RESULTS

The FSS is a process designed to determine whether concentrations of residual radioactivity comply with the cleanup criteria as defined in the ROD (USACE 2006b). The FSS process for the post-remediation radiological dose assessment of residual radioactivity at the Painesville Site was conducted in accordance with MARSSIM (EPA 2000) and the Data Quality Objectives (DQOs) process (EPA 2006).

MARSSIM identified three classifications of areas, according to contamination potential:

- Class 1 areas are areas that had, prior to remediation, a potential for radioactive contamination or known contamination in excess of the DCGL. Class 1 soil areas are < 2,000 m^2.
- Class 2 areas are areas that have not been remediated, that have a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. Class 2 soil areas were < 10,000 m^2.
- Class 3 areas are areas that were not expected to contain residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL. Class 3 areas are unlimited in size. It should be noted that there are no Class 3 survey units for the Painesville Site.

FSS field and data collection activities were conducted during the years 2005, 2007, 2008, 2010, and 2011. Implementation of the FSS process included execution of some, or all, of the following activities for each FSS Unit within the Painesville Site:

- DQOs were established to determine the number and locations of measurement and sample points required to demonstrate compliance with ROD criterion.
- Areas of the site were classified as Class 1 or Class 2 units as shown in Table 4.
- Gamma walkover scans were performed over 100 percent of accessible soil surfaces within Class 1 and 2 survey units to measure surface gamma radiation, with results plotted against geographic locations.
- Quality Assurance (QA) checks of the walkover scans were conducted by both USACE and the Ohio EPA.
- Systematic (and some bias) surface soil samples were collected from within individual survey units in accordance with the USACE-approved Final Status Survey Plans (FSSPs).
- Samples were analyzed at an offsite USACE-approved laboratory.
- Split samples were collected for USACE QA analysis.
- Laboratory data was validated.
- Technical Data Packages (TDPs), prepared for each FSS Unit, documented the review of the FSS data to ensure that each unit met the ROD cleanup criteria (i.e. DCGLs).
- TDPs were written, submitted to, and approved by USACE.
- Oversight and random checks were conducted by the Ohio EPA, including biased samples and splits.

FSS data were collected by both Cabrera and SEC. Table 4 provides a summary of the survey unit number, MARSSIM classification, the contractor(s) responsible for collecting FSS data, and the contractor that completed each TDP.

7.1 FINAL STATUS SURVEY SUMMARY (2005, 2007/2008)

FSS activities were performed by Cabrera on the Painesville Site during the years 2005 (i.e. pre-remediation sampling), 2007, and 2008, with excavation of soils exceeding ROD criteria conducted in 2007 and 2008. FSS activities were not completed for all survey units (SUs) on the site due to encountering more extensive residual contamination than planned for and the cessation of remedial and FSS activities until additional characterization data could be evaluated and a revised remediation approach determined.

The pre-FSS configuration of the Painesville Site consisted of seventeen Class 1 SUs and twelve Class 2 SUs. FSS and additional characterization through 2008 resulted in the adjustment of the boundaries of several SUs and one Class 2 SU was reclassified as a Class 1 SU. The final-FSS configuration of the Painesville Site consisted of thirty FSS units: eighteen MARSSIM Class 1 SUs and twelve MARSSIM Class 2 SUs.

More than 432,000 gamma walkover survey data points were collected by Cabrera for the nineteen SUs (i.e. six Class 1 SUs (i.e. SUs 05, 06, 08, 09, 28, 29, and 30) and twelve Class 2 SUs (i.e. SUs 13 through 24) listed in Table 4 and illustrated in Figure 5) where the FSS was satisfactorily completed (i.e. SUs were determined to meet ROD criteria). A total of 285 FSS systematic and 85 FSS biased samples were utilized from 2005, 2007, and 2008 to represent the final residual surface soils within these nineteen SUs.

Table 4 – Final Status Survey Unit Collection Summary

Survey Unit Number	MARSSIM Classification	Data Collection	Data Presentation
01	1	SEC	SEC
02	1	SEC	SEC
03	1	SEC	SEC
04	1	SEC	SEC
05	1	Cabrera	Cabrera
06	1	Cabrera	Cabrera
07	1	SEC	SEC
08	1	Cabrera	Cabrera
09	1	Cabrera	Cabrera
10	1	SEC	SEC
11	1	SEC	SEC
12	1	SEC	SEC
13	2	Cabrera	Cabrera
14	2	Cabrera	Cabrera
15	2	Cabrera	Cabrera
16	2	Cabrera	Cabrera
17	2	Cabrera	Cabrera
18	2	Cabrera	Cabrera
19	2	Cabrera	Cabrera
20	2	Cabrera	Cabrera
21	2	Cabrera	Cabrera
22	2	Cabrera	Cabrera
23	2	Cabrera	Cabrera
24	2	Cabrera	Cabrera
25	1	SEC	SEC
26	1	SEC	SEC
27	1	Cabrera/SEC	SEC
28	1	Cabrera	Cabrera
29	1	Cabrera	Cabrera
30	1	Cabrera	SEC

A summary of FSS (systematic and biased) sample results for the nineteen SUs where FSS was satisfactorily completed through 2008 is found below.

- The average systematic surface soil activity concentrations for Ra-226, Th-230, Th-232, and Total U were 43, 41, 29, and 80 Bq/kg (1.17, 1.11, 0.77, and 2.17 pCi/g), respectively.
- The average systematic surface $DCGL_W$ Sum of Ratios (SOR) value was 0.02.
- No systematic sample exhibited $DCGL_W$ SOR scores greater than 1.0.

- The maximum FSS (systematic or biased) surface soil activity concentrations for Ra-226, Th-230, Th-232, and Total U were 212, 233, 64, and 647 Bq/kg (5.74, 6.29, 1.73, and 17.48 pCi/g), respectively.
- The maximum FSS (systematic or biased) surface $DCGL_W$ SOR value was 0.52.

More than 1,650 FSS, investigative, bounding, and remedial surface and subsurface soil samples was field screened by the on-site gamma spectroscopy laboratory in the years 2007 and 2008. The on-site screening was interpreted as qualitative in nature and was used to assist remedial and investigation activities and not intended to demonstrate compliance with the requirements of the cleanup criteria in the ROD.

Based on the results of in-process excavation survey and data collection efforts, eleven Class 1 SUs (i.e. 01 through 04, 07, 10 through 12, and 25 through 27) within the Painesville Site (shown in Figure 5) did not demonstrate compliance with the requirements of the cleanup criteria in the ROD and were required to be addressed by the 2010/2011 Remedial Action.

7.2 FINAL STATUS SURVEY SUMMARY (2010/2011)

FSS activities were performed by SEC on the Painesville Site during the years 2010 and 2011, coincident with excavation of soils exceeding ROD criteria. SEC performed gamma walkover surveys, and collected biased and systematic surface soil samples in the twelve remaining MARSSIM Class 1 Survey Units. The twelve remaining MARSSIM Class 1 Survey Units are shown in Figure 5.

Table 5 summarizes the number of FSS units, data points, and samples collected during the 2007/2008 and 2010/2011 Remedial Actions. FSS samples were first analyzed by gamma spectroscopy in an on-site laboratory, after which alpha and gamma spectroscopy was performed by off-site laboratories on all systematic and biased and excavation control samples. Excavation control samples were guided by direct gamma scans to determine if excavation thresholds had been met and the excavation was ready for FSS. Table 3 summarizes the residual average site-wide concentrations from all Class 1 and Class 2 SUs after the 2010/2011 remedial action.

Table 6 summarizes the number of samples collected from each FSS unit and the minimum (MIN), average (AVG), and maximum (MAX) FSS result (in pCi/g and inclusive of background contribution) for each Survey Unit and COC. Between twelve and twenty-three final status survey samples were collected in each final status survey unit at a depth of 0 – 15 cm (0 - 6 in) from the bottom of the remedial excavation to demonstrate compliance with the ROD cleanup criteria prior to backfill.

A summary of the pre-remediation COC concentrations in each AOC was presented in Table 1 of the ROD (USACE 2006b). More detailed information is available in the RI/FS (USACE 2003a) and FS Addendum (USACE 2005a).

Table 5 – Sampling Summary for each Final Status Survey Unit

FSS Unit	MARSSIM Classification	Area	Surface Area (m^2)	Gamma Walkover Survey Data Points	Number of Systematic Samples	Number of Quality Control Samples	Number of Biased Samples	Number of Excavation Control Samples
01	1	A	1,426	69,691	17	0	5	19
02	1	A	1,803	75,447	17	0	0	4
03	1	A	2,145	70,326	19	2	1	17
04	1	A	1,970	63,356	17	2	0	11
05	1	D	1,279	1,329	17	2	9	N/A
06	1	RP	1,942	29,303	19	2	6	N/A
07	1	GG	134	6,530	17	2	6	5
08	1	C	1,339	8,805	18	0	3	N/A
09	1	B	1,952	20,272	18	2	9	N/A
10	1	H	1,950	48,314	17	2	0	3
11	1	H	2,077	60,339	19	2	0	0
12	1	C-Pipe	1,137	41,474	23	2	3	12
13	2	N/A	7,716	10,447	14	0	4	N/A
14	2	N/A	8,669	5,762	14	0	6	N/A
15	2	N/A	8,183	47,159	14	0	5	N/A
16	2	N/A	7,986	4,198	12	0	6	N/A
17	2	N/A	10,380	38,690	17	0	0	N/A
18	2	N/A	9,906	7,962	15	0	7	N/A
19	2	N/A	9,164	72,132	15	0	8	N/A
20	2	N/A	10,754	70,290	14	0	6	N/A
21	2	N/A	5,728	1,233	17	0	0	N/A
22	2	N/A	8,426	55,944	16	0	7	N/A
23	2	N/A	7,825	22,834	16	0	1	N/A
24	2	N/A	3,166	0[a]	17	2	2	N/A
25	1	A	2,522	71,418	22	2	0	3
26	1	H	2,616	61,179	23	2	0	8
27	1	GG	1,158	32,228	17	0	3	3
28	1	F	1,757	21,445	17	0	6	N/A
29	1	B’	442	4,737	15	0	4	N/A
30	1	C	1,910	21,629	17	0	4	0
			Total	**1,044,473**	**510**		**111**	**85**

a. Due to accessibility issues (i.e. vegetation, gravel, and railroad tracks) at Survey Unit 24, a gamma walkover survey could not be performed. Soils samples were used to evaluate $DCGL_w$ compliance.

Table 6 – Results Summary for Class 1 and Class 2 Final Status Survey Units

FSS Unit	Number of FSS Samples	Ra-226[a]			Th-230[b]			Th-232[c]			Total U[d]			Average SOR $DGGL_w$[e]
		Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	
01	17	0.84	**1.37**	**2.14**	1.11	1.34	**1.71**	1.03	**1.33**	**1.55**	1.89	**2.64**	**4.14**	0.01
02	17	**1.23**	**1.53**	**2.22**	0.76	1.04	**1.49**	0.79	1.01	**1.20**	1.56	2.34	**6.50**	0.02
03	19	0.81	**1.40**	**1.87**	0.80	1.33	**1.65**	0.49	**1.27**	**1.58**	1.67	**2.54**	**5.50**	0.01
04	17	**1.04**	**1.40**	**1.65**	0.81	1.02	1.21	0.66	0.99	**1.27**	1.81	2.39	**3.81**	0.01
05	17	0.53	**1.78**	**4.75**	0.86	**1.74**	**6.29**	0.35	0.85	**1.15**	1.60	**2.43**	**3.84**	0.08
06	19	0.74	**1.65**	**4.22**	0.35	1.22	**2.00**	0.27	0.84	**1.14**	0.57	**3.06**	**17.48**	0.05
07	17	**1.24**	**1.82**	**2.90**	0.81	1.20	**1.87**	0.67	0.95	**1.17**	1.42	2.22	**3.31**	0.05
08	18	0.76	**1.67**	**5.10**	0.73	1.16	**1.65**	0.11	0.81	**1.27**	1.34	2.42	**3.57**	0.04
09	18	0.40	**1.76**	**4.59**	0.51	1.21	**2.77**	0.19	0.80	**1.37**	1.16	2.40	**5.86**	0.06
10	17	**1.18**	**1.62**	**2.56**	0.99	1.21	**1.46**	0.90	**1.19**	**1.39**	1.79	2.38	**3.59**	0.03
11	19	**1.08**	**1.63**	**2.32**	0.99	1.24	**1.70**	0.83	**1.11**	**1.27**	1.55	2.35	**3.75**	0.03
12	23	0.60	**1.49**	**3.17**	0.43	1.04	**1.63**	0.22	0.79	**1.10**	0.86	1.89	**3.18**	0.02
13	14	0.68	**1.16**	**2.38**	0.65	1.07	**1.43**	0.43	0.77	1.02	1.63	2.04	2.32	0.01
14	14	0.07	0.90	**3.58**	0.68	1.18	**2.36**	0.23	0.71	**1.33**	1.23	2.23	**5.90**	0.02
15	14	0.05	0.60	**1.22**	0.38	0.89	**1.54**	0.17	0.62	1.65	0.71	1.82	**2.62**	0.00
16	12	-0.04	0.83	**1.85**	0.57	0.98	1.35	0.11	0.68	1.04	1.12	1.90	**2.44**	0.01
17	17	0.35	0.89	**1.57**	0.64	1.11	**1.53**	0.36	0.89	**1.24**	1.42	1.91	2.32	0.00
18	15	0.72	**1.30**	**3.20**	0.71	1.11	**2.57**	0.09	0.81	**1.32**	1.13	2.22	**6.31**	0.02
19	15	-0.11	0.80	**2.60**	0.41	0.80	1.22	0.05	0.54	**1.17**	1.10	1.69	**3.28**	0.01
20	14	0.65	**1.09**	**2.59**	0.42	1.01	**1.78**	0.38	0.70	**1.16**	1.42	2.09	**4.15**	0.01
21	17	0.22	0.65	**1.10**	0.26	0.75	1.17	0.10	0.50	**1.09**	0.27	1.52	2.49	0.00
22	16	0.42	**1.32**	**4.08**	0.57	1.24	**2.84**	0.24	0.80	**1.42**	1.13	2.50	**4.17**	0.04
23	16	0.00	**0.99**	**2.10**	0.61	1.08	1.40	0.59	0.94	**1.49**	1.35	2.16	2.58	0.01
24	17	0.02	0.87	**1.36**	0.50	1.04	**1.32**	0.29	0.89	**1.24**	0.90	2.09	2.47	0.00
25	22	0.80	**1.89**	**3.77**	0.80	1.33	**1.86**	0.13	1.00	**1.29**	1.30	2.23	**3.02**	0.06
26	23	**1.08**	**1.54**	**2.36**	0.83	1.15	**1.58**	0.58	0.96	**1.19**	1.60	2.04	2.63	0.02
27	17	0.56	**2.64**	**8.13**	0.29	**1.89**	**5.77**	0.19	0.68	**1.23**	0.78	**3.42**	**7.64**	0.16
28	17	0.59	**1.09**	**1.55**	0.63	1.06	**1.57**	0.40	0.87	**1.47**	1.29	2.09	**2.93**	0.00
29	15	0.35	**1.23**	**2.21**	0.56	1.11	**1.53**	0.18	0.77	**1.33**	1.27	2.17	**3.05**	0.01
30	17	0.59	**1.09**	**1.55**	0.63	1.06	**1.57**	0.40	0.87	**1.47**	1.29	2.09	**2.93**	0.03

a. The average site background concentration and ROD cleanup criteria for Ra-226 were 0.95 and 9 pCi/g, respectively.
b. The average site background concentration and ROD cleanup criteria for Th-230 were 1.45 and 25 pCi/g, respectively.
c. The average site background concentration and ROD cleanup criteria for Th-232 were 1.07 and 6 pCi/g, respectively.
d. The average site background concentration and ROD cleanup criteria for Total U were 2.72 and 482 pCi/g, respectively.
e. A Sum of Ratio, excluding contribution from background, of less than 1 indicates ROD cleanup criteria were met.

Note: Above background FSS results are **bold**

As demonstrated in Table 6, no FSS samples exceeded the ROD cleanup criteria. The following MARSSIM criteria were satisfied to meet the ROD criteria:

1. Compliance with the $DCGL_w$ values were determined by using the average background concentrations in Table 1 and post-remediation soil sample (0-15 cm (0-6 in) bgs) results and calculated SOR values. SOR calculations for $DCGL_w$ comparisons were developed by using the DCGLs for the four radiological COCs listed in Table 1.

2. If the SU average SOR is less than 1, but any individual SOR value was greater than 1, the Sign Test and $DCGL_{emc}$ were performed. The Sign Test, a nonparametric statistical test, is designed to detect uniform failure of compliance with release criteria for systematic surface samples throughout a SU. Passing the Sign Test indicated that the number of samples in the unit with a $DCGL_w$ SOR score of 1.0 or less was greater than the Sign Test critical value for the unit.

3. Compliance with the 100 m^2 $DCGL_{emc}$ was determined by calculating SOR values by using the results of samples collected from the top 15 cm of soil. Biased soil samples were collected if it was determined by scans or visual observations that soils could potentially exceed the $DCGL_{emc}$. SOR calculations for $DCGL_{emc}$ comparisons were developed by using $DCGL_{emc}$ values for the four COCs listed in Table 1, after adjusting for background activity concentration of each COC to obtain the net concentration of each COC. The SOR $DCGL_{emc}$ value must be less than or equal to 1.0 for every individual soil sample.

For the Painesville Site, the FSS results indicated that all MARSSIM Class 1 and 2 survey units met the requirements of the ROD.

7.3 PLACE BACK SOILS

As with in situ soils, the soils that had been processed by the soil segregation system for place back during the 2010/2011 Remedial Action were also evaluated with a FSS protocol. This operational process provided 100% assay of materials, which were managed in batch (survey element) units. These batches were combined into 15 place back soil stockpiles, roughly equivalent to SUs, from which a total of 266 systematic samples were sent to an off-site laboratory to evaluate the residual radioactivity. The results of the samples from the 15 place back soil stockpiles are summarized in Table 7.

For the Painesville Site, the FSS-like results indicated that the place back soils used to backfill remediated excavations from the 2010/2011 Remedial Action met the requirements of the ROD.

Table 7 – Summary of Final Status Survey-Like Samples for Place Back Soils

Stockpile Number	Place Back Location	Number of Systematic Samples	Average Ra-226 Result (pCi/g)	Average Th-230 Result (pCi/g)	Average Th-232 Result (pCi/g)	Average Total U Result (pCi/g)	Average SOR $DCGL_w$[a]
01	Area A	17	1.98	1.51	1.12	3.20	0.06
02	Area A	17	1.86	1.22	0.99	2.74	0.05
03	Area A	17	1.80	0.93	0.82	2.16	0.04
04	Area A	17	1.75	1.13	1.01	2.74	0.04
05	Area A	17	2.31	1.44	1.05	3.52	0.10
06	Area A	19[b]	2.93	1.47	1.06	3.74	0.17[b]
07	Area A	17	2.59	1.33	1.00	3.28	0.13
08	Area A/H	17	2.60	1.46	1.04	4.09	0.13
09	Area GG	17	2.85	1.60	0.93	3.31	0.16
10	Area A West Wall (Below GCL)	20	1.96	1.30	1.01	3.24	0.06
11	Area H Landfill (Below GCL)	20	2.07	1.28	0.97	3.23	0.07
12	Area C-Pipe	20	1.60	1.13	0.81	2.64	0.02
13	Area C-Pipe	17	1.83	1.27	0.88	2.78	0.05
14	Area A/H	17	1.75	1.24	0.85	2.92[b]	0.04[b]
15	Area A/H	17	1.95	1.27	0.94	3.41	0.06

a. A Sum of Ratio, excluding contribution from background, of less than 1 indicates ROD cleanup criteria were met.
b. Values were revised after further review and therefore are inconsistent with those presented in Table 4-13 of the Final Completion Report (USACE 2012).

7.4 WEST WALL OF AREA A

Excavation in Area A extended beyond the initial footprint in all directions. Area A was remediated to the ROD criteria with the exception of a small area along the western boundary.

The northern section of this area as shown in Figure 6 was surveyed and documented to be above the gamma walkover survey scan threshold criteria. Twelve soil samples were collected and analyzed as illustrated in Figure 6. The sample results are provided in Table 8 below and Appendix I.1 of the Final Completion Report for the Painesville Site Remediation (USACE 2012).

Excavation activities during the 2010/2011 Remedial Action were stopped due to approaching the toe of Chemtura's Landfill III cap that was constructed by the property owner in 2006. Landfill III, located immediately west of the Painesville FUSRAP Site, is owned and operated by Chemtura. Landfill III is an industrial solid waste landfill subject to the requirements of OAC Chapter 3745-29 and regulated by the Ohio EPA. As such, a GCL was installed over the above ROD criteria material described in Table 8 to ensure that the integrity of the closed Landfill III cap was not compromised.

Table 8 – Sample Results from the Western Boundary of Area A

Sample Location	Ra-226[a]	Th-230[a]	Th-232[a]	Total U[a]	Average SOR $DCGL_w$[b]
OT59	**22.70**	**10.20**	**0.89**	**15.43**	**2.69**
OT60	6.94	4.44	0.87	7.99	0.69
OT61	**17.10**	**8.67**	**0.82**	**16.51**	**2.01**
OT62	**18.40**	**10.40**	**0.78**	**19.57**	**2.23**
A109	1.85	1.74	1.03	3.41	0.05
A110	4.35	3.41	1.05	5.59	0.36
A111	4.42	5.26	1.02	6.15	0.44
A112	1.01	1.81	0.50	2.77	0.00
A113	**13.85**	**8.71**	**0.96**	**7.68**	**1.63**
A114	**11.37**	**8.41**	**0.99**	**5.58**	**1.34**
A116	**16.11**	**10.87**	**1.14**	**3.97**	**1.97**
A116	**14.41**	**11.08**	**1.17**	**8.33**	**1.79**

a. Results include contribution from background (i.e. background is not subtracted).
b. Samples exceeding a SOR of 1 are **bold**.

Since the southern section of the landfill, which was below the scan threshold, was observed to contain volatile organic compound impacted materials, a GCL was installed, as was done for the northern portion of Area H which overlapped the footprint of Landfill III.

8.0 DEMONSTRATION OF CLEANUP QUALITY

USACE and the remediation contractors routinely performed many different Quality Assurance/Quality Control (QA/QC) activities. Contractor project QC was maintained through the implementation of project specific Quality Control Plans and Quality Assurance Project Plans. Controlled copies of pertinent plans were available onsite for the duration of the projects. The USACE QA process included having a USACE construction inspector and/or health physicist on-site during the remediation to ensure that plans and proper procedures were implemented.

Upon completion of the gamma walkover scans, a QC review of the data was performed. The review included an examination of GPS printout data, instrument calibration check, review of procedures and discussion of findings. Upon completion of the QC process, USACE performed a QA review of the data and conducted a verification gamma scan. Argonne National Laboratory performed an independent review of gamma walkover data, as well as all final status survey data.

Field duplicates and QA splits were compared to the original samples as a measure of precision. All samples used to close out the sites were found to meet the required quality standards. QC measures associated with the soil segregation system are discussed in Attachment B.

The Ohio EPA and the Ohio Department of Health also performed QA review of the data, conducted verification gamma scans, and collected field split and biased samples.

9.0 SUMMARY OF OPERATION AND MAINTENANCE

The applied alternative of complete soil excavation above ROD criteria and off-site disposal does not require operation and maintenance actions at the Painesville Site.

10.0 SUMMARY OF REMEDIAL COSTS

Table 9 presents a summary of remediation costs for the Painesville Site. There are no operation and maintenance costs. The Contractors for the 1998 Non-Time Critical Removal Action, 2007/2008 Remedial Action, and 2010/2011 Remedial Action were CKY, Inc., Cabrera Services, Inc., and Safety and Ecology Corporation, Ltd., respectively.

Table 9 – Summary of Remedial Costs

Painesville Removal/Remedial Actions	Estimate in EE/CA or ROD	Total Remediation Costs[a]
	(millions of dollars)	
Non-Time Critical Removal Action (1998)	$1.5 (EE/CA)	**$1.8**
Remedial Action (2007/2008)	$9.0 (ROD)[c]	**$19.8**
Remedial Action (2010/2011)		**$19.9[b]**
Total	-	**$41.5**

a. Total Remediation Costs include both contractor and government costs.
b. The USACE received $15.2 million in funding through the American Recovery and Reinvestment Act of 2009.
c. The ROD did not anticipate the need to excavate Area C-Pipe. Also, contaminated soil requiring disposal (primarily from Areas A and H and to a lesser degree Areas B, C, D, F, G, H, and the Rubble Pile) was well in excess of the ROD estimate of 5,486 m^3 (7,175 yd^3).

11.0 FIVE-YEAR REVIEW

Since the implemented remedy has resulted in FUSRAP-related COCs remaining at the site below levels that allow for unlimited use and unrestricted exposure, five-year reviews are not required pursuant to Section 121(c) of CERCLA and Part 300.430(f)(4)(ii) of the NCP.

12.0 SITE SUMMARY

The implemented remedy achieved the degree of cleanup and protection specified in the ROD (USACE 2006b) for the Painesville Site for all pathways of exposure. No further response is needed to protect human health and the environment from the FUSRAP-related COCs. All ROD remedial action goals have been achieved, and all ARARs have been met for the site. Residual concentrations have been found to be suitable for projected use of the site without restrictions.

Table 10 summarizes lessons learned from the planning and execution of the remedial action at the Painesville Site.

Table 10 – Painesville Site Remedial Action Lessons Learned

Topic	Description of Lessons Learned	Recommended Future Action
Remedial Action Planning		
Communications	Project meetings were helpful throughout the course of the project to share information and discuss all aspects of remediation.	Conduct face to face meetings between USACE and the contractor at key junctures to discuss options and potential changes in approach that would facilitate smooth project execution.
Information Management	Electronic communication from between the project site and other locations was challenging.	Promote the use of project websites and implement a work-around in advance when limitations on data transfer exist.
Data Collection and Management	Issues with data management included delays in Contractors providing on-site and off-site data to USACE, missing spatial coordinates, incorrect minimum detection activities, and data provided without interpretation, evaluations, and conclusions.	Better establish upfront expectations with Contractors for when and how data will be provided to USACE.
Remedial Action Execution		
Data Analysis	On-site laboratory data was used as preliminary data to make low-risk decisions for merging stockpiles for reuse and assisting in the progress of the final status survey due to its shorter turnaround time when compared with off-site laboratories. However, the risk-driving radionuclide at the Painesville Site, Ra-226, had a 21-day turnaround time using gamma spectroscopy (versus a 30-day turnaround for an off-site lab) to obtain a definitive result. In hindsight, an on-site alpha spectroscopy lab would have been more conducive to the targeted COCs.	Develop a correlation study early in the project between on-site and off-site laboratory data. Also, ensure that the most definitive on-site lab methodology for the targeted COCs to allow for the use of on-site data for decision-making purposes to reduce the time required having open excavations and managing below criteria stockpiles.

Topic	Description of Lessons Learned	Recommended Future Action
Dust Suppression	Liquid copolymer soil stabilizer was used for dust suppression or dust control for stockpiles of soils that were temporarily staged. The product was readily available, dried flexible, biodegradable, easy to apply, dried transparent and odorless, non flammable/volatile/hazardous/corrosive, safe for all equipment, non-slippery, non-regulated for transportation, non-leaching, water-resistant, environmentally safe, and PM_{10} and $PM_{2.5}$ compliant (stops hazardous dust particles of 2.5^{+} microns in size).	Recommend using liquid copolymer soil stabilizer for dust control of stockpiles staged for more than a week. Use of dye communicates a visual designation for inspection. Not recommended for saturated soils or use during the winter.
Water Management	USACE managed 3.4 million gallons of water due to record precipitation during the 2010/2011 remedial action and extended open excavation periods (some areas since the 2007/2008 remedial action).	Water management plans should be documented and discussed in advance of remedial action fieldwork and early characterization should be performed to evaluate and compare best project solutions for water management during remediation.
Temporary On-Site Storage	IP1 and IP2 bags were used for temporary on-site storage of excavated soil and debris pending off-site waste transport and disposal to facilitate on-site storage in an environmentally-controlled manner while allowing progress to be made on site remediation goals.	Consider the use of IP1 and IP2 bags when consistent with project goals. Limit their use when handling sharp debris which can damage the bags.

Topic	Description of Lessons Learned	Recommended Future Action
Transportation and Disposal	In the Request for Proposal issued by USACE for the 2010/2011 Remedial Action of the Painesville Site, one of the technical efficiency criterion specified for evaluation by USACE was the minimization of material below ROD criteria shipped off-site. In their proposal, SEC as the prime contractor proposed use of automatic soil segregation technology provided by subcontractor MACTEC's (now AMEC Environment & Infrastructure's) Orion *ScanSort*SM System to minimize waste requiring transportation and disposal at the Painesville Site. During the 2010/2011 Remedial Action, a total of 42,600,000 kg (46,932 tons) of material was processed by the soil segregation system. The cost to design, mobilize, calibrate, operate, and demobilize the soil segregation system was approximately $2.15 million. In addition, confirmatory soil samples from the below DCGL stockpiles were collected for off-site laboratory radiological/chemical analysis; soil handling/moving in combination with these costs increased the soil segregation costs to a total of $2.7 million. Dividing the total cost by the amount of material processed yields a soil segregation system cost per ton of approximately $58 for the Painesville Site. To transport and dispose of material from the site, the cost per ton was $170, yielding a cost savings per ton of $112 for use of the soil segregator. This equates to a total transportation and disposal cost savings of $5.26 million.	Consider incorporating technical efficiency criterion such as "the minimization of material below ROD criteria shipped off-site" into requests for proposals for remedial action to encourage the use of innovative technologies and processes to minimize waste.

Topic	Description of Lessons Learned	Recommended Future Action
Post-Remediation		
Site Closeout Report	The Site Closeout Report for the Painesville Site, developed in accordance with USACE 2003b and DOE 2013, was initiated concurrently with the Final Completion Report for the Painesville Site Remediation (USACE 2012) to ensure all required information was readily available prior to contract closeout.	Allow sufficient time to gather information for and prepare the Site Closeout Report. This is especially true for long-term projects with multiple phases of remedial action. Ensure construction completion reports contain necessary information prior to finalizing contracts.

13.0 REFERENCES

DOE 1992. *Letter from J. Wagoner to L. Price (Authorized for Remedial Action of Diamond Magnesium Site in Painesville, Ohio)*, September 25, 1992.

DOE 2013. *Program Plan for the Formerly Utilized Sites Remedial Action Program, LMS/S09273*, January 2013.

Eddington 1996. *Personal Telephone Interview, 683 Argonne Drive, Painesville, Ohio*, September 12, 1996.

EPA 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), EPA 402-R-97-016*, Rev. August 1, 2000.

EPA 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, EPA/240/B-06/001, Office of Environmental Information, Washington, D.C.*, February 2006.

ORNL 1990. *Preliminary Site Survey Report for the Uniroyal Chemical Company, Formerly the Painesville Company, 720 Fairport-Nursery Road, Painesville, Ohio (DMP002). ORNL/TM-11119*, March 1990.

ORNL 1991. *Radiological Characterization Survey of the Former Painesville Company Site, 720 Fairport-Nursery Road, Painesville, Ohio (DMP001, DMP002). ORNL/TM-11817*, December 1991.

Trumbel 2001. *Interview with Glade Trumbel*, June 2001.

USACE 1998a. *Characterization Report for the Painesville Site, Painesville, Ohio*, May 1998.

USACE 1998b. *Engineering Evaluation/Cost Analysis for the Painesville Site, Painesville, Ohio*, June 1998.

USACE 1998c. *Action Memorandum for the Removal of Radioactively Contaminated Soil at the Painesville, Ohio Site*, September 1998.

USACE 2003a. *Final Remedial Investigation/Feasibility Study Report for the Painesville Site, Painesville, Ohio*, May 2003.

USACE 2003b. *Environmental Quality - Formerly Utilized Sites Remedial Action Program (FUSRAP), Engineer Regulation (ER) 200-1-4*, August 2003.

USACE 2005a. *Final Feasibility Study Addendum for the Painesville Site, Painesville, Ohio*, June 2005.

USACE 2005b. *Final Proposed Plan for Remediation of the Painesville Site, Painesville, Ohio*, July 2005.

USACE 2006a. *Final Pre-Remediation Sampling Data Report for the Painesville Site, Painesville, Ohio*, March 2006.

USACE 2006b. *Final Record of Decision for the Painesville Site, Painesville, Ohio*, April 2006.

USACE 2010. *Final Status Survey Report for the Painesville FUSRAP Site, Painesville, Ohio*, June 2010.

USACE 2012. *Final Completion Report for the Painesville Site Remediation, Painesville, Ohio*, FY2010-2011, April 2012.

ATTACHMENT A: FIGURES

Figure 1: Painesville Site in Relation to the Surrounding Area
Figure 2: Former Diamond Magnesium Company Site Plan
Figure 3: Former Areas of Concern on the Painesville FUSRAP Site
Figure 4: Aerial Extent of Remedial Actions (1998-2011)
Figure 5: MARSSIM Final Status Survey Units
Figure 6: Extent of Area A West Wall Excavation

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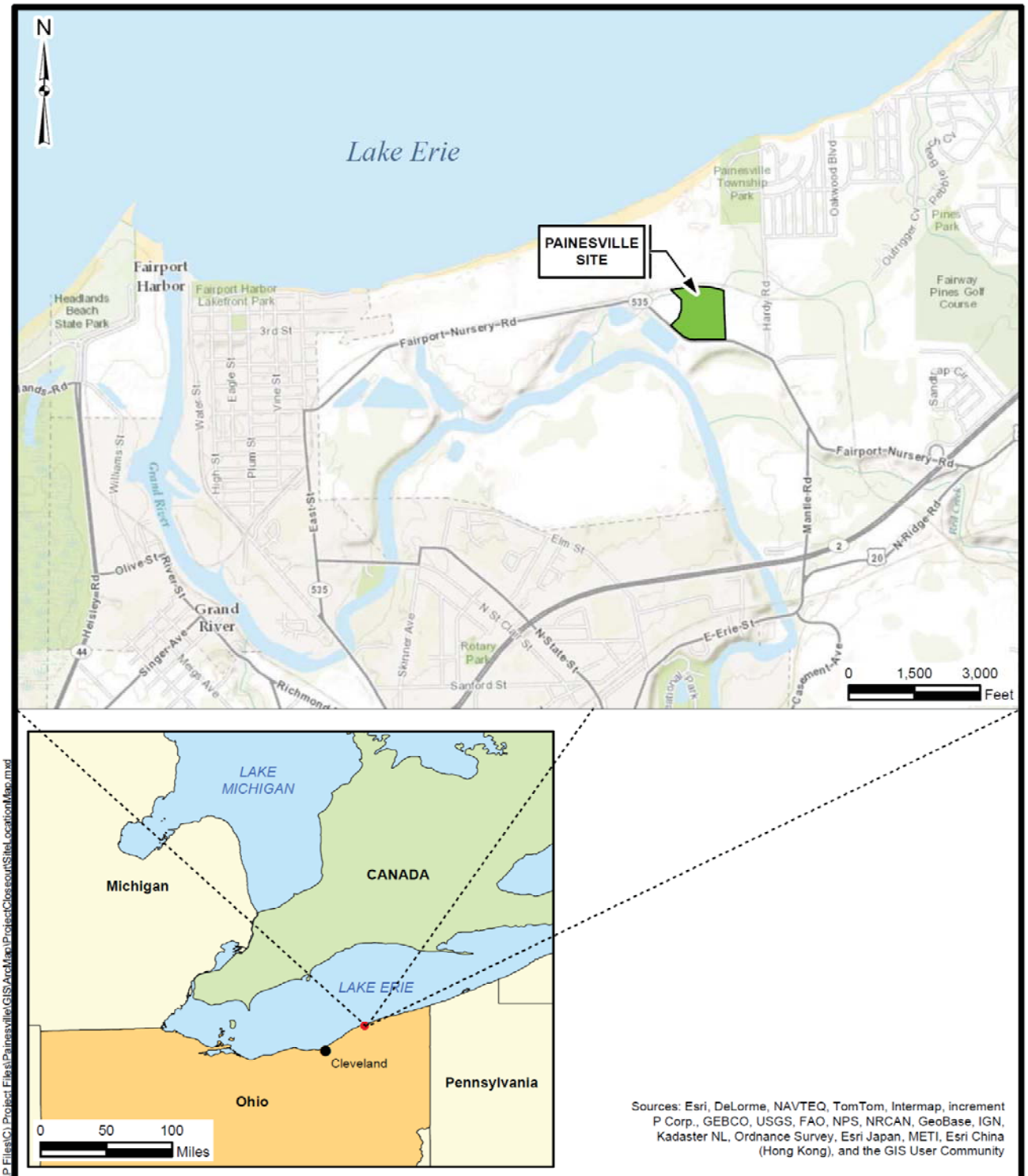

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BUFFALO, NY

PAINESVILLE SITE IN RELATION TO THE SURROUNDING AREA

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PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO

FIGURE 1

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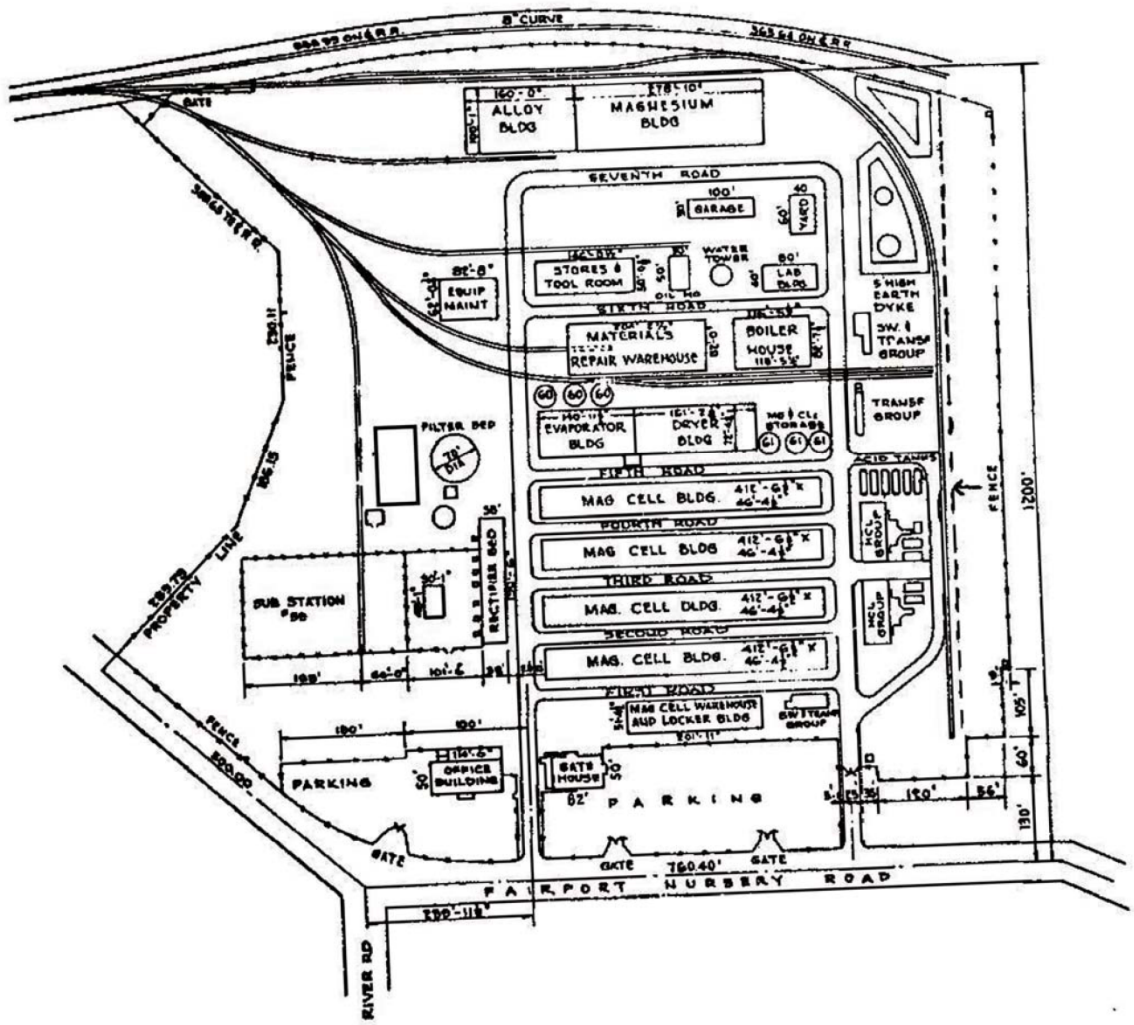

0 125 250 500 Feet

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BUFFALO, NY

FORMER DIAMOND MAGNESIUM COMPANY
SITE PLAN

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PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO

FIGURE 2

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Legend

FUSRAP Site Boundary

Former Areas of Concern

Source: Bing Maps aerial imagery web mapping service (2012).

Notes:
1) RP - Rubble Pile.

0 100 200 400 Feet

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FORMER AREAS OF CONCERN ON
THE PAINESVILLE FUSRAP SITE (1998 - 2011)

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PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO

FIGURE 3

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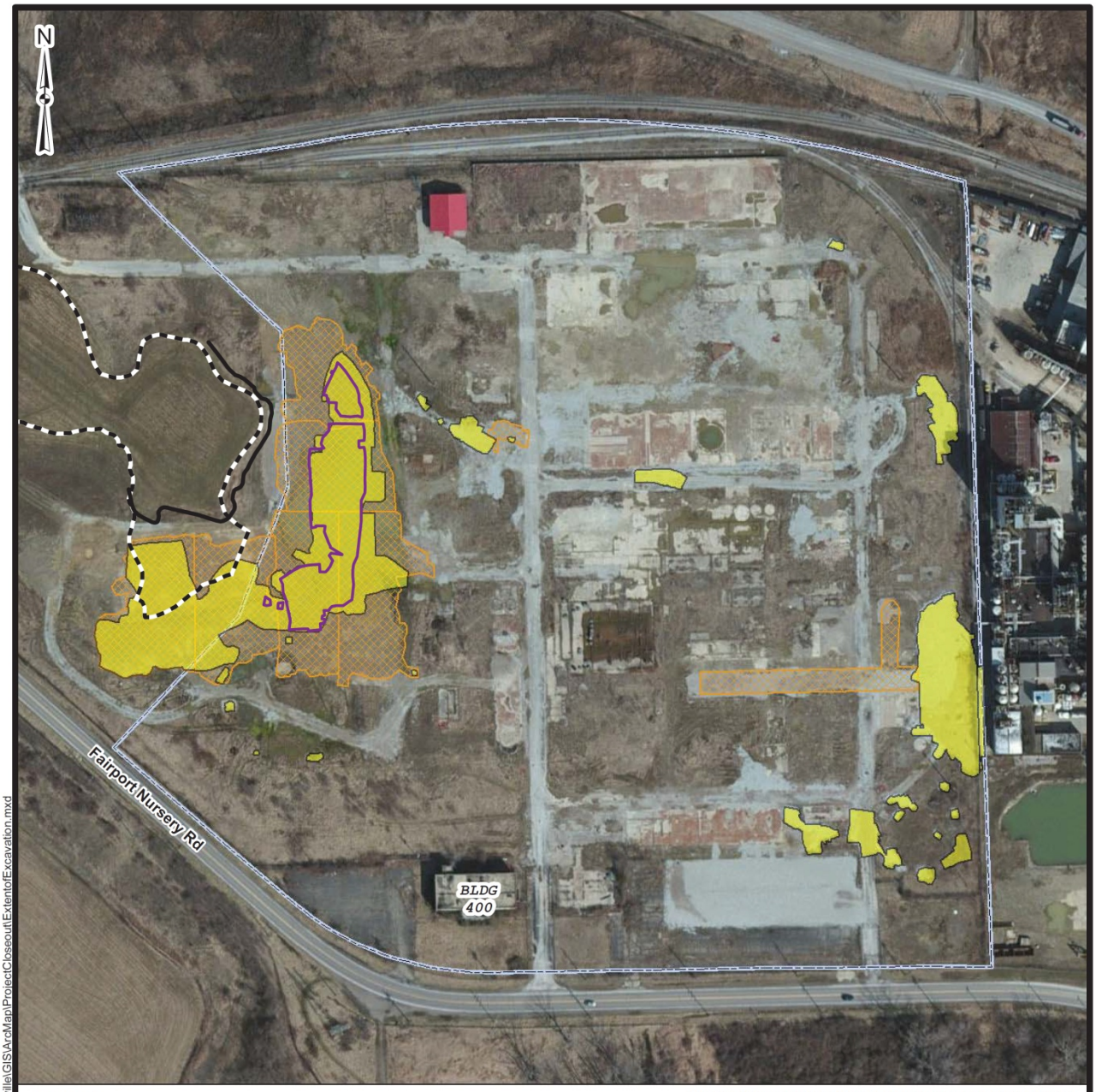


Legend

Source: Bing Maps aerial imagery web mapping service (2012).

- FUSRAP Site Boundary
- 1998 Removal Action
- 2007/2008 Remedial Action
- 2010/2011 Remedial Action
- Limits of Chemtura Landfill (2000 Ground Conductivity Survey)
- Toe of Chemtura Landfill Cap (2010 GPS Mapped)

0 100 200 400 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

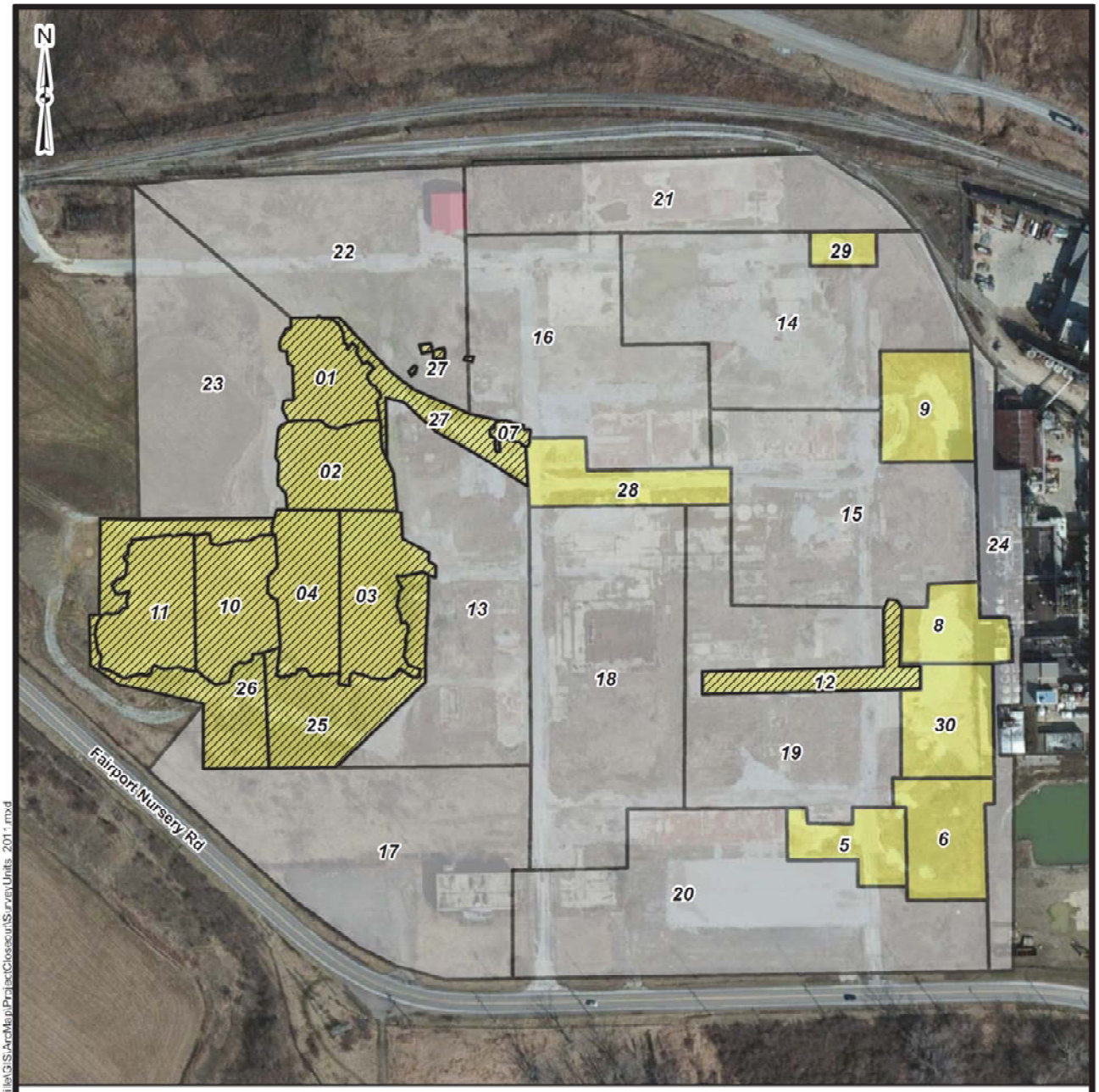
AERIAL EXTENT OF REMEDIAL ACTIONS
(1998 - 2011)

Name: ExtentofExcavation.mxd
Drawn By: H5TDESPM
Date Saved: 15 Mar 2013
Time Saved: 4:04:36 PM

PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO

FIGURE 4

Document Path: K:\Specgrp\1) FUSRAP Files\C) Project Files\Painesville\GIS\ArcMap\ProjectCloseout\ExtentofExcavation.mxd



Source: Bing Maps aerial imagery web mapping service (2012).

Legend

- Class 1 Survey Unit
- Class 2 Survey Unit
- Class 1 Survey Unit Addressed by 2010-2011 Remedial Action

0 100 200 400 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

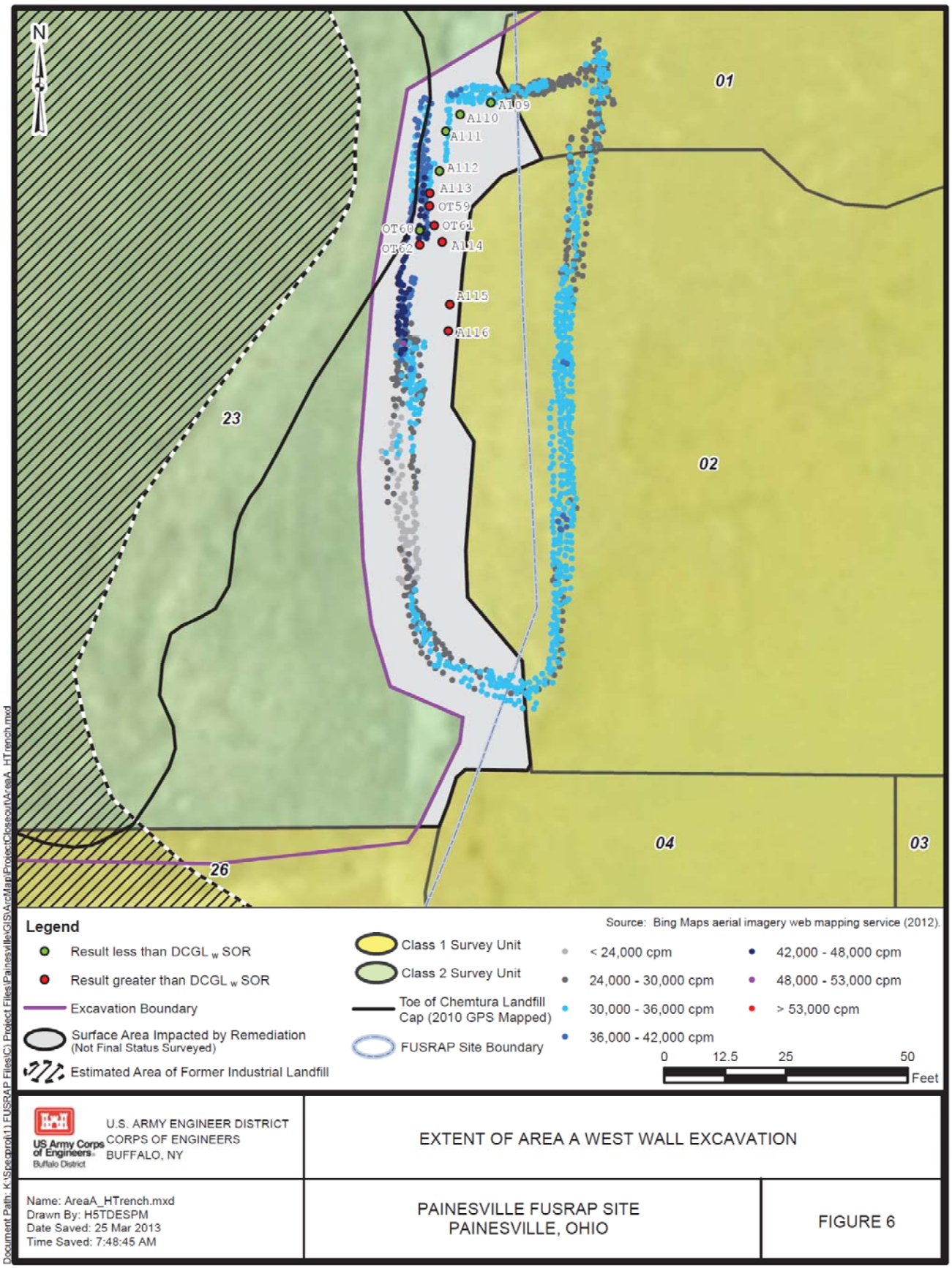
MARSSIM FINAL STATUS SURVEY UNITS

Name: SurveyUnits_2011.mxd
Drawn By: H5TDESPM
Date Saved: 19 Mar 2013
Time Saved: 9:39:41 AM

PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO

FIGURE 5

Document Path: K:\Specgroup1\FUSRAP Files\C\Project Files\Painesville\GIS\ArcMap\ProjectClosseout\SurveyUnits_2011.mxd


N
01
02
03
04
23
26
A109
A110
A111
A112
A113
OT59
OT61
OT60
OT62
A114
A115
A116
Legend
Result less than DCGL w SOR
Result greater than DCGL w SOR
Excavation Boundary
Surface Area Impacted by Remediation (Not Final Status Surveyed)
Estimated Area of Former Industrial Landfill
Class 1 Survey Unit
Class 2 Survey Unit
Toe of Chemtura Landfill Cap (2010 GPS Mapped)
FUSRAP Site Boundary
< 24,000 cpm
24,000 - 30,000 cpm
30,000 - 36,000 cpm
36,000 - 42,000 cpm
42,000 - 48,000 cpm
48,000 - 53,000 cpm
> 53,000 cpm
Source: Bing Maps aerial imagery web mapping service (2012).
0 12.5 25 50
Feet
US Army Corps of Engineers
Buffalo District
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY
EXTENT OF AREA A WEST WALL EXCAVATION
Name: AreaA_HTrench.mxd
Drawn By: H5TDESPM
Date Saved: 25 Mar 2013
Time Saved: 7:48:45 AM
PAINESVILLE FUSRAP SITE
PAINESVILLE, OHIO
FIGURE 6
Document Path: K:\Specproj\11-FUSRAP Files\C) Project Files\Painesville\GIS\ArcMap\Project\Closeout\AreaA_HTrench.mxd

ATTACHMENT B: IMPLEMENTATION OF SOIL SEGREGATION TECHNOLOGY AT THE PAINESVILLE FUSRAP SITE

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Implementation of Soil Segregation Technology at the Painesville FUSRAP Site

EXECUTIVE SUMMARY

Typically the highest cost component of the remediation of radiological soils at FUSRAP sites is the cost to transport and dispose of the excavated soils, typically contaminated with naturally occurring isotopes of uranium, thorium and radium, at an appropriately permitted off-site disposal facility. The heterogeneous nature of the contamination encountered at these sites makes it difficult to accurately delineate the extent of contaminated soil using the limited, discrete sampling data collected during the investigation phases; and difficult to precisely excavate only the contaminated soil that is above the established cleanup limits using standard in-field scanning and guiding methodologies. This usually results in a conservative guided excavation to ensure cleanup criteria are met, with the attendant transportation and disposal costs for the larger volumes of soil excavated. To address this issue during the remediation of the Painesville FUSRAP Site, located in Painesville, Ohio, the Buffalo District of the U.S. Army Corps of Engineers, and its contractor, Safety and Ecology Corporation (SEC), employed the Orion *ScanSort*SM automatic soil segregation technology provided by MACTEC (now AMEC Environment & Infrastructure) to reduce the potential for transportation and disposal of soils that met the cleanup limits. This waste minimization technology utilized gamma spectroscopy of conveyor-fed soils to automatically segregate the material into above and below criteria discharge piles. Use of the soil segregation system resulted in cost savings through the significant reduction of the volume of excavated soil that required off-site transportation and disposal, and the reduction of the amount of imported clean backfill required via reuse of “below criteria” segregated soil as place back material in restoring the excavations. Measurements taken by the soil segregation system, as well as results of quality control sampling of segregated soils, confirmed that soils segregated as below criteria for reuse as site fill did meet the ROD cleanup criteria for the site.

ISSUE

The cost to transport and dispose of radiologically contaminated materials at the disposal facilities permitted to accept them is typically the highest cost component of FUSRAP site cleanups. Thus a primary goal is to accurately delineate and excavate only those contaminated materials that exceed the cleanup limits established for the site, minimizing the amount of waste that requires disposal. However, as demonstrated by the series of investigations and remediation efforts required at the Painesville FUSRAP Site, it is difficult to accurately delineate the extent of subsurface soil contamination prior to remediation. The contamination at FUSRAP sites is typically very heterogeneous in nature. FUSRAP contamination is not typically found in small, discrete plumes where it may have originally been deposited in the 1940s and 1950s, due to natural migration processes and movement of soils during changes in site use and configuration by subsequent site owners. Subsurface soil investigations are typically conducted through installation of multiple small-diameter soil borings throughout the site, which present a limited view of subsurface soil conditions and can potentially miss areas of contamination. Contaminated soil volume estimates and footprints must be developed through interpolation of the discrete sampling point data.

Once remediation starts, waste minimization typically focuses on minimizing the quantity of soil excavated. Since prior practice has required that all excavated soils be shipped offsite for disposal, methods are employed to precisely excavate only those soils exceeding cleanup criteria, as the more soil is excavated, the higher the transportation and disposal costs.

Common USACE practice has been to guide the excavation via field gamma scanning measurements and collection and analysis of in-process samples from the excavation. However, guiding excavations is more labor-intensive and time-consuming, with lower production rates, than mass excavation. Also, precision excavation efforts to minimize waste volumes must be balanced against leaving the site in an acceptable condition that meets cleanup criteria. Establishing a precise correlation between field gamma scanning measurements and cleanup levels is difficult, so that scan thresholds used to guide excavation are set conservatively. While this conservativeness bounds the uncertainty in meeting the required remediated site conditions, it also results in an increase in volumes excavated and associated transportation and disposal costs.

In the Request for Proposal issued by USACE for the 2010/2011 Remedial Action of the Painesville Site, one of the technical efficiency criterion specified for evaluation by USACE was the minimization of material below ROD criteria shipped off-site. In their proposal, Safety and Ecology Corporation (SEC) as the prime contractor proposed use of automatic soil segregation technology provided by subcontractor MACTEC's (now AMEC Environment & Infrastructure's) Orion *ScanSort*SM System to minimize waste requiring transportation and disposal at the Painesville Site.

METHOD

Design and Implementation at the Painesville Site

SEC proposed to excavate all impacted or potentially impacted soils and buried materials and place the excavated materials into stockpiles. Once large debris was removed from the materials all "flowable" soil would be assayed by gamma spectroscopy to determine if the material met the ROD acceptance criteria. The 100% assay of all excavated material was accomplished by using the MACTEC (now AMEC Environment & Infrastructure) Orion *ScanSort*SM system as follows.

To begin excavation of an impacted area a gross gamma survey using a 7.6 cm by 7.6 cm (3 in by 3 in) sodium iodide detector coupled to a Trimble Global Positioning System was conducted. The results were plotted on a figure to clearly mark areas above the threshold value in gross counts per minute (cpm). The threshold value was the gross count rate above which the soil was likely to be greater than the ROD acceptance criteria. The value was initially determined from a correlation of analytical sample laboratory results and corresponding field scan data and updated during the project as more correlation data became available. After the initial excavation of impacted areas the remediation was guided by field gross gamma surveys and biased sampling based on the results of the field scan data. All of the excavated soil was then stockpiled for processing by the soil segregation system. Once no areas above the threshold value remained the area was isolated for final status survey including an additional 100% coverage gross gamma survey.

Description of Soil Segregation Technology

MACTEC's (now AMEC Environment & Infrastructure's) Orion *ScanSort*SM system is a radiological monitoring and processing system designed to perform real-time segregation of soil into two distinct groups based upon its radiological properties. The system is capable of processing and segregating large volumes of soil with relatively high throughput rates. Commercially available material conveyors are utilized to physically manage the soil. These

conveyors prepare and condition material, they transport the material past various radiation sensors, and they provide the physical means to sort material based on detector readings. The material is sorted into two distinct groups (piles), commonly referred to as the “Below Criteria” and “Above Criteria” (or “Diverted”) groups. The basis upon which the soil material is sorted and segregated into distinct volumes is controlled by the establishment of diversion control setpoint(s) (DCSs) that automatically trigger the diverting mechanism, sorting the material into the appropriate group. The selection of the system’s DCSs depends on a number of factors including the:

- Critical Concentration(s),
- Critical Volume(s) (against which the Critical Concentration(s) are evaluated),
- Unit Volume,
- Statistical distribution of radioactivity concentrations within the material, and
- Required confidence (or certainty) in the measured mean concentration(s) in the resulting “Below Criteria” and “Above Criteria” volumes.

In order to establish DCSs, the Critical Concentration was defined. The Critical Concentration is simply the concentration-oriented compliance metric for a radiological contaminant distributed in soil, usually expressed in units of activity per unit mass (Bq/kg or pCi/g). At the Painesville Site, the Critical Concentration was developed with respect to an appropriate dose consequence for the COCs, and is equal to the DCGLs with SOR applied.

Four radionuclide COCs (Ra-226, Th-232, Th-230, and Total U) comprised the radiological clean-up goal for the Painesville Site. Ra-226 and Th-232 are easily and directly measurable by strong, characteristic gamma emissions. Th-230 and the uranium isotopes U-238, U-235 and U-234 (Total U) are not easily or directly measurable by gamma emission. Ra-226 served as an appropriate surrogate for COCs in the U-238 decay series including Th-230 and Total U. Based on previous site characterization, remediation and final survey activities, conservative relative activity factors were determined and applied to the Ra-226 value to attribute appropriate concentrations to Th-230 and Total U. The relative activity factors are shown in the following Table I. Use of these factors overestimated the activity concentration of Th-230 and Total U based on the measured concentration of Ra-226 for the purposes of segregating soil into above and below criteria stockpiles, thereby ensuring a conservative quantification of residual radioactivity (SOR) in the “below criteria” group.

Table I. Surrogate Ratio Correction Factors

Isotope	Concentration (pCi/g)	Relative Activity Correction	
		Ratio	Factor
Ra-226	1	Ra-226:Ra-226	1
Th-230	2	Th-230:Ra-226	2
Total U	4.09	Total U:Ra-226	4.09

The Orion *ScanSort*SM system measured and quantified the Ra-226 and Th-232 gamma emissions and utilized the equilibrium correction factors to determine the Th-230 and Total U activity of the material in order to perform real-time soil segregation.

Table II presents the SOR ratio calculation based on the ratio correction factors presented in Table I and assuming a constant activity concentration of 65 Bq/kg (1.75 pCi/g) for Th-232.

Since remedial investigations identified the presence of Th-232 above site background at relatively low concentrations at a limited number of locations, a constant Th-232 activity concentration of 65 Bq/kg (1.75 pCi/g), which was the maximum Th-232 detection in background, was assumed in sum of ratios calculations. Each ratio was derived as follows:

- Ra-226 – (6.1 – 1.42) pCi/g / 9 pCi/g = 0.52, 6.1 pCi/g or Ra-226 corrected for maximum Ra-226 in background, divided by the Ra-226 DCGL
- Th-230 – ((2 x 6.1) – 2.56) pCi/g / 25 pCi/g = 0.39, Ra-226 activity x 2 corrected for maximum in Th-230 background, divided by the Th-230 DCGL
- Th-232 – (1.75 – 1.53) pCi/g / 6 pCi/g = 0.037, 1.75 pCi/g corrected for maximum Th-232 in background, divided by the Th-232 DCGL
- Total U (sum of U-238, U-235, and U-234) – (((4 x 6.1) + (0.091 x 6.1)) – 5.97) pCi/g / 482 pCi/g = 0.039, Ra-226 activity x 4 to account for U-238 and U-234, plus Ra-226 activity x 0.091 to account for U-235, corrected for maximum Total U in background, divided by Total U DCGL

The SOR approaches 1 (0.98) when the gross value of Ra-226 is equal to 6.1 pCi/g. [2]

Next, the Critical Volume was defined. The Critical Volume for material sorting is the volume upon which a compliance decision is made. The Critical Volume was developed with respect to the Critical Concentration ($DCGL_W$, $DCGL_{emc}$) and an appropriate dose consequence for the COCs. The $DCGL_W$ values developed at the Painesville Site are based on an area of 10,000 m^2 (107,639 ft^2), and the $DCGL_{emc}$ values are based on an area of 100 m^2 (1,076 ft^2), both with a contamination layer thickness of 2 m (7 ft). Table III presents areal and volumetric quantities used during the development of the $DCGL_W$ and the $DCGL_{emc}$ values.

Table II. Sum of Ratios Calculation Based on Assumed Relative Activity Values

Radionuclide	Relative (to Ra-226) Activity	Gross Activity Concentration (pCi/g)	Ratio: Net Activity/ DCGLw
Ra-226	1:1	6.1	0.52
Th-230	2:1	12.2	0.3856
Th-232	0.036:1	1.75	0.036667
Total U	4.09:1	25.0	0.039387
		SOR:	0.98

Table III. $DCGL_W$ and $DCGL_{emc}$ Volumetric Quantities

	$DCGL_W$		$DCGL_{emc}$	
Area	10,000 m^2	107,639.1 ft^2	100 m^2	1076.4 ft^2
Depth	2.0 m	6.5 ft	2.0 m	6.5 ft
Density	1.1 g/cc	68.7 lbs/ft^3	1.1 g/cc	68.7 lbs/ft^3
Volume	20,000 m^3	706,293 ft^3	200.0 m^3	7,062.9 ft^3
Mass	22,000,000 kg	24,251 tons	220,000 kg	242.5 tons

lbs/ft3 = pounds per cubic feet
g/cc = grams per cubic centimeter
Using the site-specific DCGL assumptions listed in Table III, the Critical Volumes represent 20,000 m^3 (706,293 ft^3) or 22,000,000 kg (24,251 tons) of material, and 200 m^3 (7,063 ft^3) or

220,000 kg (242.5 tons) of material. The Critical Volumes are monitored to ensure, with acceptable confidence (e.g., with an acceptably low false negative error rate), that the measured mean concentration is less than the $DCGL_W$s.

Following the establishment of the Critical Concentrations and Critical Volumes, the DCSs were developed. USACE, SEC and MACTEC elected to implement (3) DCSs to sort potentially impacted soil to ensure that the mean concentrations in the “below criteria” piles did not exceed the concentration limits. If, during soil sorting operations, any of the three radiological DCSs were exceeded, the control software indicated an “Alarm” signal, and the violating soil material was sorted into the “above criteria” pile. Note that the DCS volumes listed in Table IV are significantly smaller (and therefore more conservative) than the Critical Volumes listed in Table III. The DCSs are presented in Table IV.

The volumes associated with the diversion control setpoints were selected to be conservative with respect to the critical volumes (defined by the ROD compliance criteria). Smaller DCS related volumes are more conservative in that decisions are made on incrementally smaller volumes. The result is that smaller volumes of soil exhibiting elevated concentrations of radioactivity were identified as “above criteria” and segregated for off-site disposal.

Table IV. Diversion Control Setpoints

DCS	Mass (kg)	Mass (tons)	$DCGL_W$ (SOR)	Ra-226 (Gross)
1	63,503	70	1	6.1 pCi/g
2	6,350	7	2	12.2 pCi/g
3	635	0.7	3	18.3 pCi/g

Exposure risk (dose) in a given scenario is dependent upon both the concentration and volume (mass). DCS #1 was designed explicitly to demonstrate compliance with the ROD criteria. While it has the lowest concentration component, it also has the largest volume (mass) component. DCS #2 and #3 were used as “best management practice” criteria designed to sort out even smaller volumes of materials that might occur at higher concentrations. These locally elevated volumes of soil which might arguably and justifiably be left on-site (because they would not raise the average in the larger compliance volume to greater than the $DCGL_W$) were sorted and disposed as radioactive waste. This reduced the likelihood that locally elevated anomalies remained in the soil returned to the site as place-back fill. Only one DCS is required to demonstrate compliance with the ROD; however, use of the three DCSs served to remove locally elevated radioactivity from the site even if it could be averaged away. It is analogous to a $DCGL_W$ and $DCGL_{emc}$.

The results of the DCS settings, specifically the average activity concentration of the diverted stock piles, were continually evaluated through a rigorous QC program. The soil processed through the soil segregation system as < DCS (< ROD criteria) was stockpiled and after QC sampling confirmed the characterization of the soil as meeting the ROD acceptance criteria, was placed back on-site. Specifically, the average activity concentration of every Class 1 SU mass of soil (based on DCGL model contaminated zone), segregated by the system met the DCGL/SOR < 1 criteria in accordance with the survey and sample requirements of the FSSP.

This was verified by both a review of the 100% coverage scanning gamma spectroscopy of the entire volume of soil processed by the soil segregation system and the sample and analysis of 17 random-start, equally representative samples from every 4,399,846 kg (4,850 tons)

(representing 1 Class 1 survey unit volume per the ROD). A grab sample was taken from the output conveyor belt at a sample frequency equal to 1 per every 254,012 (280 tons) passing through. For example if the system was processing soil at 90,718 kg (100 tons) per hour, a sample was taken every 2.8 hours the system was in operation until a stockpile of 4,399,846 kg (4,850 tons) has passed through the system as < DCS, resulting in the minimum 17 samples per SU. The random start requirement was met by the inherent randomness of stockpiling soil prior to processing through the system.

Each of the 17 samples was analyzed by on-site laboratory-based gamma spectroscopy analysis. The sum of ratios (SOR) calculation was performed to predict and confirm, based on the surrogate value of 6.1 pCi/g for Ra-226, if the stockpile of soil meet the ROD criteria as defined in the expanded SOR below:

$$SOR_{DCGLw} = \frac{Ra-226}{6.1} \qquad \text{(Eq. 1)}$$

The samples were all forwarded to an appropriately certified off-site lab for analysis by alpha spectroscopy for isotopic uranium, Th-232 and Th-230, and for Ra-226 analysis by gamma spectroscopy after progeny ingrowth (Pb-214 or Bi-214) within a sealed counting container. The results were used to complete the following SOR calculation:

$$SOR_{DCGLw} = \frac{Ra-226}{9} + \frac{Th-230}{25} + \frac{Th-232}{6} + \frac{U-total}{482} \qquad \text{(Eq. 2)}$$

All of the activity concentrations were net values using the background values established for the project to calculate the net activity. A Sign test was performed using the error control DQO confidence intervals selected for the Painesville Site: α = 0.025 (2.5%) for Type I errors and β = 0.05 (5%) for Type II errors.

An Orion *ScanSort*SM system output report for the 4,399,846 kg (4,850 tons) was compared to the results of the 17 sample analytical results. The QC check confirmed the results of the Orion *ScanSort*SM system report and the sample and analysis results both concluded the volume of soil meets the ROD acceptance criteria, i.e., the average SOR is < 1.

RESULTS

Soil Segregation Output

In 2010 and 2011, a total of 43,499,508 kg (47,950 tons) of suspect contaminated soils and debris was excavated as part of the Painesville Site remediation effort. Of that total, 42,575,994 kg (46,932 tons) of soil and soil-like material were able to be processed through the Orion *ScanSort*SM automatic soil segregation system, while 923,514 kg (1,018 tons) were not processed, consisting primarily of oversize debris and materials that could not pass through the system, along with a small amount of material that was excavated after the system was demobilized. The *ScanSort*SM system segregated 41,816,680 kg (46,095 tons) of material to the “below criteria” stockpile for reuse at the site to fill the excavations, and 759,314 kg (837 tons) of material to the above-criteria stockpile for eventual shipment for offsite disposal. Of the quantity of soil processed through the automatic soil segregation system, only 2% required offsite

disposal; and of the total quantity of soil excavated, only 4% required offsite disposal, a significant reduction in the amount of soil transported and disposed of from the site.

During operations, the Orion *ScanSort*SM system took more than 659,000 measurements of the processed soils, assaying 91 individual batches. The average gross Ra-226 concentration measured by the system for the "below criteria" place back soils over those 91 batches was 3 pCi/g, well below both the $DCGL_w$ for Ra-226 of 9 pCi/g net above background and the first DCS for Ra-226 of 6.1 pCi/g gross.

As described above, in addition to reviewing the data from the Orion *ScanSort*SM measurements, a minimum of 17 QC samples were collected randomly from every 4,399,846 kg (4,850 tons) of "below criteria" soil segregated by the system, and analyzed at an off-site laboratory for the FUSRAP COCs. The average result of the collected QC samples for each of the COCs is shown below in Table V, compared to the site background and $DCGL_w$ concentrations.

Table V. Average Sample Results for "Below Criteria" Segregated Soils

COC	Maximum Background Level (pCi/g)	DCGLw - Net Above Background (pCi/g)	Average QC Sample Result - Gross (pCi/g)
Ra-226	1.42	9	2.12
Th-230	2.56	25	1.30
Th-232	1.53	6	0.97
Total U	5.97	482	3.13

The average QC sample results were well below the $DCGL_w$ for each of the respective COCs and on the order of background levels at the site. These results when combined with the 100% assay by the automatic soil segregation system demonstrate that the soils segregated to the "below criteria" stockpiles did indeed meet the cleanup criteria specified in the ROD and were appropriate to reuse as fill in the completed excavations.

Cost Savings

Cost savings were realized through use of the automatic soil segregation technology in two primary areas; transportation and disposal costs and clean backfill procurement costs.

The total cost to design, mobilize, calibrate, operate and demobilize the Orion *ScanSort*SM system for the Painesville Site was approximately $2.15 million. The total cost including soil handling and confirmatory laboratory analysis was $2.7million. Dividing that cost by the total amount of soil and soil-like material processed at the site yields a cost per ton processed for the Painesville Site of approximately $58. The cost per ton to transport and dispose of material from the site was $170, yielding a cost per ton savings of $112 for use of the soil segregator versus transportation and disposal for the Painesville Site remediation.

Challenges and Future Considerations

As described above, a key factor in segregator efficiency is maintaining a uniform thickness of material on the survey conveyor, which requires the material being processed to be sufficiently

flowable and less than 10 cm (4 inches) in size. During the 2010/2011 Remedial Action at the Painesville Site, the site experienced heavy snowfall in the winter months, and record rainfall in the spring of 2011, which saturated the clay soils at the site, causing them to stick and clump together to an unanticipated level so that they were clogging the soil segregation equipment. This was addressed by the application of various drying techniques to the pre-segregation soil stockpiles, and bringing on site a more powerful soil screening machine or scalper to break up the soil clumps; which while both successful were also time-consuming and slowed production. In addition, a larger volume of concrete debris was excavated than originally anticipated, which could not be processed in its excavated state. This was successfully addressed by bringing a concrete crusher on site partway through the project, which was able to reduce the concrete to a size that could be processed through the automatic soil segregator while removing the rebar that couldn't be processed from the concrete. Thus the majority of the processed concrete could be reused as fill rather than having to be disposed of. Conducting geotechnical analyses of site soils and developing a better estimate of excavated concrete and other debris in the planning stages prior to implementation of the soil segregator on site would help alleviate these issues in the future.

Another key to utilizing the automatic soil segregation technology in the most efficient manner during site remediation is in the optimization of the excavation, segregation and backfilling procedures. On the excavation side, the typical methodology for USACE FUSRAP remediations was to attempt to precisely excavate only those soils exceeding the cleanup criteria. However, the time and effort required to develop gamma scan thresholds and then guide the excavation with field scan measurements and in-process sampling results in a slower excavation process. At the Painesville Site, USACE continued to employ precise excavation methodology during the 2010 - 2011 remediation effort to minimize the soil excavated, due to USACE unfamiliarity with the ability of the Orion *ScanSort*^{SM} system to accurately measure and segregate all of the excavated site soils. The slower guided excavation rate resulted in excavations remaining open longer before final status surveys could be conducted, which subsequently led to other issues such as having to manage large quantities of water that collected in the excavations while they were open longer. For future cleanups, by relying on the ability of the automatic soil segregation technology to assay 100% of the excavated soil and determine which material exceeds the cleanup criteria, excavation of a pre-determined, more conservative soil footprint could be conducted in an uninterrupted manner, allowing quicker completion of excavation and initiation of final status surveys to close out the excavations. This would also allow quicker generation of a larger pre-segregation stockpile, another factor in ensuring efficient use of the soil segregator, as the segregator can process soil at a higher rate than it can be excavated.

On the backfilling end, it is generally desirable to backfill excavations in as timely a manner as possible after final status surveys have demonstrated that the cleanup criteria have been met in the excavations, again to avoid having to manage potentially large quantities of water collecting in open excavations. At the Painesville Site, for the majority of the project USACE did not give acceptance to reuse of "below criteria" stockpiles for place back in the excavations until the results of the QC samples analyzed in the off-site laboratory had been received, again due primarily to USACE unfamiliarity with this new technology and a desire to see definitive analysis results confirm the measurements from the *ScanSort*^{SM} system showing the cleanup criteria had been met. This would typically take 28 days or longer, due to the laboratory analysis method utilized for Ra-226. In the future, the time to approve segregated soil for reuse could be shortened through relying solely on the segregator system measurements to show criteria had been met, or through use of an on-site alpha spectroscopy laboratory for quick turnaround of confirmatory sample data.

CONCLUSION

Automatic soil segregation technology was successfully implemented as part of the 2010/2011 Remedial Action at the Painesville FUSRAP Site. The Orion *ScanSort*SM system employed at the site demonstrated the ability to accurately determine the radioactivity concentrations in the processed soil and soil-like material and quickly segregate that material for appropriate final disposition. Data from the soil segregation system and confirmatory QC samples indicated that the segregated "below criteria" soils met the cleanup criteria in the ROD, and was appropriate for reuse as fill in the excavations. The reduction of the total excavated soil volume requiring off-site disposal by 94% yielded significant project cost savings through reduction of transportation and disposal and backfill procurement costs. Use of automatic soil segregation technology was an efficient and cost-effective method for addressing the radiological contamination at the Painesville Site.

REFERENCES

1. U.S. Army Corps of Engineers, *Record of Decision, Painesville Site, Painesville, Ohio,* April 7, 2006.
2. U.S. Army Corps of Engineers, *Soil Segregator Operation Plan, Painesville FUSRAP Site Remediation, Painesville, Ohio,* March 2010.

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ATTACHMENT C: POST-REMEDIATION RADIOLOGICAL DOSE ASSESSMENT FOR THE PAINESVILLE FUSRAP SITE

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ANL/EVS/R-13/7

POST-REMEDIATION RADIOLOGICAL DOSE ASSESSMENT

PAINESVILLE SITE
PAINESVILLE, OHIO

NOVEMBER 2013

U.S. Army Corps of Engineers
Formerly Utilized Sites Remedial Action Program

Prepared for:
U.S. Army Corps of Engineers, Formerly Utilized Sites Remedial Action Program

With technical assistance from:
Environmental Science Division, Argonne National Laboratory

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GENERAL ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
CFR	*Code of Federal Regulations*
COC	constituent of concern
DCGL	derived concentration guideline level
EPA	U.S. Environmental Protection Agency
FGR	Federal Guidance Report
FUSRAP	Formerly Utilized Sites Remedial Action Program
MED	Manhattan Engineer District
NRC	U.S. Nuclear Regulatory Commission
OAC	*Ohio Administrative Code*
Pb-210	Lead-210
Ra-226	Radium-226
ROD	Record of Decision
TEDE	total effective dose equivalent
Th-230	Thorium-230
Th-232	Thorium-232
Total U	Total Uranium
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238
USACE	United States Army Corps of Engineers

UNITS OF MEASURE

cm^3	cubic centimeter(s)
d	day(s)
g	gram(s)
kg	kilogram(s)
L	liter(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mol	mole(s)
mrem	millirem(s)
pCi	picocurie(s)
s	second(s)
yr	year(s)

METRIC CONVERSION CHART

To Convert to Metric			To Convert from Metric		
If You Know	Multiply By	To Get	If You Know	Multiply By	To Get
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
gallons	0.00378	cubic meters	cubic meters	264.55	gallons
cubic inches	16.3870	cubic centimeters	cubic centimeters	0.061023	cubic inches
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28,349,523	micrograms	micrograms	3.527396E-08	ounces
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
Radiation					
picocurie	0.037	Becquerel	Becquerel	27.027027	Picocuries
curie	3.70E+10	Becquerel	Becquerel	2.703E-11	Curies
Rem	0.01	sievert	sievert	100	rem

POST-REMEDIATION RADIOLOGICAL DOSE ASSESSMENT
PAINESVILLE SITE, PAINESVILLE, OHIO

1 INTRODUCTION

A post-remediation radiological dose assessment was conducted for the Formerly Utilized Sites Remedial Action Program (FUSRAP) Painesville Site by using the measured residual concentrations of the radionuclides of concern following the completion of remedial action. The site's FUSRAP-related constituents of concern (COCs) are radionuclides associated with past activities conducted by the Manhattan Engineer District (MED) and Atomic Energy Commission (AEC) in support of the Nation's early atomic energy and weapons program, and include radium-226 (Ra-226), thorium-230 (Th-230), thorium-232 (Th-232), and total uranium (Total U). Remedial actions were conducted at the site in accordance with the *Final Record of Decision for the Painesville Site, Painesville, Ohio* (ROD) (USACE 2006). In the ROD, the U.S. Army Corps of Engineers (USACE) determined that the U.S. Nuclear Regulatory Commission (NRC) standards for decommissioning of licensed facilities found in Title 10, Part 20.1402 of the *Code of Federal Regulations* (10 CFR 20.1402) and in the *Ohio Administrative Code* (OAC) 3701:1-38-22(B) are applicable or relevant and appropriate requirements (ARARs) for the site. On the basis of the ARAR analysis, a total effective dose equivalent (TEDE) goal of 25 millirem per year (mrem/yr) was assumed for the site with a construction worker considered as the average member of the critical group.

Derived concentration guideline levels (DCGLs) for residual radioactivity of the COCs in soil were developed for the Painesville Site using the RESRAD (Version 6.22) computer code (Yu et al. 2001), which was designed to estimate radiation doses and risks from RESidual RADioactive materials. The DCGLs represent activity levels above site average background activity corresponding to the 25-mrem/yr criterion for a construction worker scenario. The DCGLs are above the background activity concentrations and represent average concentration guidelines. The DCGLs and average background activity concentrations are provided in Table 1. The Final Feasibility Study Addendum (USACE 2005) provides a complete description of the derivation of the DCGLs for the Painesville Site.

A post-remediation radiological dose assessment was performed to determine the potential radiation doses to a construction worker, consistent with the approach used to develop the DCGLs for the Painesville Site given in the Final Feasibility Study Addendum (USACE 2005) and ROD (USACE 2006). A second more conservative dose assessment was performed to determine the potential radiation doses to an urban resident who is assumed to live and garden on the site. To further evaluate the long-term protectiveness of the remedial action, a third dose assessment was conducted to determine the potential radiation doses to a hypothetical subsistence farmer. The primary

difference between exposure to an urban resident versus a conservative subsistence farmer would be an increase in the amount of foodstuffs (homegrown produce, milk, and beef) produced/cultivated and consumed on-site.

2 APPROACH

USACE conducted a two-phase remedial action at the Painesville Site during 2007–2008 and 2010–2011. During the 2010–2011 remedial action, excavated soil at the Painesville Site was processed using an automatic soil segregation system to segregate soil with concentrations below the ROD criteria (or DCGLs) from soil with concentrations exceeding the DCGLs. The processed soil with activity concentrations less than the DCGLs was designated as placeback soil to be retained on-site and placed back in the excavation areas. Confirmatory soil samples were collected from the place back soils and sent to an off-site laboratory for analysis of the COCs.

The post-remediation radiological dose assessment consisted of defining a site-wide source term of the residual concentration in soil of the four COCs, Ra-226, Th-230, Th-232, and Total U. The site-wide source term was established by using weighted average activity concentrations of the COC results of the *in situ* systematic Class 1 and Class 2 final status survey samples, and confirmatory samples collected from the segregated placeback soil used to backfill the excavation areas. At the Painesville Site, 3 acres, or 10% of the total site area, was excavated and backfilled with segregated placeback soil; the remaining 31 acres, or 90% of the site area, was either excavated and backfilled with clean backfill brought from off-site, or unexcavated. There were 266 confirmatory samples collected from the segregated backfill material, and 362 *in situ* systematic final status survey samples from remaining unexcavated areas and excavated areas prior to backfilling with off-site clean backfill. (There were two *in situ* final status survey samples that were excavated as part of a Class 1 survey unit; they were not used in the development of the source term since they no longer are representative of current site conditions.) The weighted average was calculated by assigning a 10% weight to the average COC activity concentrations from the 266 segregated placeback soil samples, and a 90% weight to the average COC activity concentrations from the 362 *in situ* Class 1 and Class 2 final status survey samples. The off-site clean backfill was not used in the development of the site-wide source term because it had background COC activity concentrations and would not contribute to the overall post-remediation dose. The weighted COC site-wide average values are provided in Table 2.

For the site-wide source term, the average COC activity concentrations above background were used in the assessment. The average residual Th-230, Th-232, and Total U activity concentrations were less than the average background levels. The average residual Ra-226 activity concentration, above average background, was the only COC used in the assessment. It was assumed in the assessment that lead 210 (Pb-210), a daughter product of Ra-226, was present at the same residual average activity concentrations as Ra-226. Table 2 gives the source terms used in the post-remediation

radiological dose assessment for the site-wide area. The area of the impacted zone for the source term was conservatively assumed to be 10,000 square meters (m^2).

The RESRAD computer code (Version 6.5) was used to perform the post-remediation radiological dose assessment for the construction worker scenario, urban resident scenario, and subsistence farmer scenario using the site-wide source term (Yu et al. 2001). In general, the parameter values (including the site-specific and default values) for the construction worker post-remediation radiological dose assessment were consistent with those used in the derivation of the DCGLs (USACE 2005). For the urban resident, it was assumed that the individual can be exposed to residual radiation and radioactive materials by external gamma radiation, inhalation of airborne particulates, ingestion of garden produce, and incidental ingestion of soil. The meat and milk ingestion pathways were not considered applicable to this urban resident, and these pathways were suppressed in the RESRAD calculations. It was assumed that a small garden provided 5% of the consumed vegetables. In addition, drinking water was assumed to be provided by a municipal source, so the drinking water pathway (such as from an on-site private well) was also suppressed. For the subsistence farmer, it was assumed that the individual can be exposed to residual radiation and radioactive materials by external gamma radiation; inhalation of airborne particulates; ingestion of plants, meat, and milk; ingestion of fish captured from the on-site pond; and incidental ingestion of soil. The water used for all purposes, including drinking, was obtained from the downgradient well. The input parameters for the construction worker scenario, urban resident scenario, and subsistence farmer scenario are provided in Table 3.

3 RESULTS

The results of these dose assessments are provided in Table 4 for the construction worker scenario, Table 5 for the urban resident scenario, and Table 6 for the subsistence farmer scenario. Appendices A, B, and C provide the summary results from the RESRAD runs for the construction worker scenario, the urban resident scenario, and subsistence farmer scenario, respectively. The estimated annual radiation dose rate above average background for the construction worker is 1.2 mrem/yr, for the urban resident scenario the estimated annual radiation dose is 2.2 mrem/yr, and for the subsistence farmer scenario the estimated annual radiation dose is 7.4 mrem/yr. The highest estimated dose is less than the most restrictive site dose limit of 25 mrem/yr, as discussed in Section 1.

The maximum dose would occur at time zero (the year the post-remediation radiological survey was conducted) in all three scenarios, predominantly from Ra-226. For the construction worker scenario, the majority of the radiation dose (~87%) is from the external gamma exposure pathway. Additional pathways contributing to this radiation dose include incidental soil ingestion (~13%) and dust inhalation (< 1%). For the urban resident scenario, the majority of the radiation dose (~73%) is from the external gamma exposure pathway. Additional pathways contributing to this radiation dose include ingestion of vegetables from the garden (~22%), incidental soil ingestion (~5%), and dust inhalation (< 1%). For the subsistence farmer scenario, the majority of the radiation dose

(~66%) is from ingestion of plants. Additional pathways contributing to this radiation dose include external gamma exposure (~29%), meat ingestion (~2.1%), milk ingestion (~1.6%), and soil ingestion (~1.4%).

On the basis of this post-remediation radiological dose assessment, it can be concluded that the Painesville Site has been remediated consistent with the requirements identified in the ROD and all other supporting documentation. In addition, remedial actions have been completed in accordance with ALARA (As Low as Reasonably Achievable) considerations. The low residual concentrations of FUSRAP-related radionuclides at the site are comparable to ambient (background) levels and in accordance with site-specific ARARs.

4 REFERENCES

EPA (U.S. Environmental Protection Agency), 2011, *Exposure Factors Handbook*, EPA/600/R-090/052F.

USACE (U.S. Army Corps of Engineers), 2003, *Final Remedial Investigation/Feasibility Study, Painesville FUSRAP Site, Painesville, Ohio*, May.

USACE, 2005, *Final Feasibility Study Addendum, Painesville FUSRAP Site, Painesville, Ohio*, June.

USACE, 2006, *Final Record of Decision, Painesville FUSRAP Site, Painesville, Ohio*, Jan.

Yu, C., et al., 1993, *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8, Argonne National Laboratory, Argonne, Ill., April.

Yu, C., et al., 2001, *User's Manual for RESRAD Version 6***,** ANL/EAD-4, Argonne National Laboratory, Argonne, Ill., July.

Table 1 Site-Specific Soil Cleanup Goals and Average Background Activity Concentrations (pCi/g) for the Painesville Site

	$DCGL_w$ [b]	$DCGL_{emc}$ [b]	Background[c]
Ra-226[a]	9	12	0.95
Th-230	25	34	1.45
Th-232[d]	6	8	1.07
Total U[e]	482	810	2.72[f]

[a] Ra-226 criteria include Pb-210 contribution to dose.

[b] These cleanup goals represent activity levels above site average background activity corresponding to 25 mrem/yr. These cleanup goals are equivalent to an incremental lifetime cancer risk of approximately 2E-05 for a construction worker (for each COC). $DCGL_w$ values developed over a 10,000-m^2 area. $DCGL_{emc}$ values developed over a 100-m^2 area.

[c] Source for the average background activity concentrations: *Final Remedial Investigation/Feasibility Study Report, Painesville FUSRAP Site* (USACE 2003).

[d] Th-232 criteria include Th-228 and Ra-228 contributions to dose.

[e] Concentration represents the total uranium guideline.

[f] Total uranium background is the sum of the background values for uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238).

Table 2 Residual Radionuclide Site-Wide Average Concentrations

Radionuclide	Average Activity Concentration (pCi/g)	Average Activity Concentration Above Background (pCi/g)
Ra-226	1.40	0.45
Th-230	1.17	<Bkg
Th-232	0.82	<Bkg
Total U	2.33	<Bkg

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Dose factor library	FGR 12	FGR 12	FGR 12	FGR 12
Cut-off half-life (180 d or 30 d)	30	180	180	180
Number of points (32, 64, 128, 256, 512, and 1,024)	32	32	32	32
Linear spacing/log spacing	Log spacing	Log spacing	Log spacing	Log spacing
Maximum no. of points for dose	17	17	17	17
Maximum no. of points for risk	257	257	257	257
Use line draw character (yes/no)	Yes	Yes	Yes	Yes
Find peak pathway dose (yes/no)	Yes	Yes	Yes	Yes
Calculation Parameters				
Basic radiation dose limit (mrem/yr)	25	25	25	25
Times for calculation (yr)	1, 3, 10, 30, 100, 300,1000	1, 3, 10, 30, 100, 300,1000	1, 3, 10, 30, 100, 300,1000	1, 3, 10, 30, 100, 300,1000
Source				
Nuclide concentrations (pCi/g)[d]				
Site-wide average				
Pb-210	0	0.45	0.45	0.45
Ra-226	0	0.45	0.45	0.45
Transport Factors				
Distribution coefficient for all zones (cm^3/g)				
Pb	100	550	550	550
Ra	70	9,100	9,100	9,100
Number of unsaturated zones	1	1	1	1
Time since placement of material (yr)	0	0	0	0
Groundwater concentration (pCi/L)	0	0	0	0

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Leach rate (1/yr)	0	0	0	0
Solubility limit (mol/L)	0	0	0	0
Use plant/soil ration (check box)	No	No	No	No
Transfer Factors				
Plant transfer factor (wet-plant weight concentration pCi/g per dry soil weight concentration pCi/g)				
Pb	1.00E-02	NU[e]	1.00E-02	1.00E-02
Ra	4.00E-02	NU	4.00E-02	4.00E-02
Meat transfer factor ((pCi/kg) per (pCi/d))				
Pb	8.00E-04	NU	NU	8.00E-04
Ra	1.00E-03	NU	NU	1.00E-03
Milk transfer factor ((pCi/L) per (pCi/d))				
Pb	3.00E-04	NU	NU	3.00E-04
Ra	1.00E-03	NU	NU	1.00E-03
Fish bioaccumulation factor (L/kg)				
Pb	300	NU	NU	300
Ra	50	NU	NU	50
Crustacea and mollusk bioaccumulation factor (L/kg)				
Pb	100	NU	NU	100
Ra	250	NU	NU	250
Impacted Zone Parameters				
Area of impacted zone (m^2)				
Site-wide	10,000	10,000	10,000	10,000
Thickness of impacted zone (m)	2	2	2	2
Length parallel to aquifer flow (m)				
Site-wide	100	NU	100	100

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Does the initial contamination penetrate the water table?	No	No	No	No
Cover and Impacted Zone Hydrological Data				
Cover depth (m)	0	0	0	0
Density of primary impacted zone (g/cm^3)	1.5	1.8	1.8	1.8
Impacted zone erosion rate (m/yr)	1.00E-03	6.00E-05	6.00E-04[f]	6.00E-04
Impacted zone total porosity	0.4	0.31	0.31	0.31
Impacted zone field capacity	0.2	0.15	0.15	0.15
Impacted zone hydraulic conductivity (m/yr)	10	3.47	3.47	3.47
Impacted zone b parameter	5.3	5.3	5.3	5.3
Evapotranspiration coefficient	0.5	0.5	0.5	0.5
Wind speed (m/s)	2	2	2	2
Precipitation rate (m/yr)	1	1	1	1
Irrigation rate (m/yr)	0.2	0.2	0.2	0.2
Irrigation mode (overhead/ditch)	Overhead	Overhead	Overhead	Overhead
Runoff coefficient	0.2	0.2	0.2	0.2
Watershed area for nearby stream or pond (m^2)	1.00E+06	NU	1.00E+06	1.00E+06
Accuracy for water/soil computation	1.00E-03	NU	1.00E-03	1.00E-03
Saturated Zone Hydrological Data				
Density of saturated zone (g/cm^3)	1.5	NU	1.5	1.5
Saturated zone effective porosity	0.2	NU	0.2	0.2
Saturated zone total porosity	0.4	NU	0.4	0.4
Saturated zone field capacity	0.2	NU	0.2	0.2
Saturated zone hydraulic conductivity (m/yr)	100	NU	100	100
Saturated zone b parameter	5.3	NU	5.3	5.3

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Saturated zone hydraulic gradient	2.00E-02	NU	2.00E-02	2.00E-02
Water table drop rate (m/yr)	1.00E-03	NU	1.00E-03	1.00E-03
Well pump intake depth (m below water table)	10	NU	10	10
Model for water transportation (nondispersion/mass-balance)	Nondispersion	NU	Nondispersion	Nondispersion
Well pumping rate (m^3/yr)	250	NU	250	250
Unsaturated zone parameters				
Thickness of unsaturated zone (m)	4	NU	4	4
Density of unsaturated zone (g/cm^3)	1.5	NU	1.5	1.5
Unsaturated zone effective porosity	0.2	NU	0.2	0.2
Unsaturated zone total porosity	0.4	NU	0.4	0.4
Unsaturated zone field capacity	0.2	NU	0.2	0.2
Unsaturated zone hydraulic conductivity (m/yr)	10	NU	10	10
Unsaturated zone b parameter	5.3	NU	5.3	5.3
Occupancy, Inhalation, and External Gamma Parameters				
Inhalation rate (m^3/yr)	8,400	7,300	5,548[g]	8,400
Mass loading for inhalation (g/m^3)	1.00E-04	6.00E-04	1.00E-04	1.00E-04
Exposure duration (yr)	30	1	30	30
Indoor dust filtration factor	0.4	0.4	0.4	0.4
External gamma shielding factor	0.7	0.4	0.4	0.4
Indoor time fraction	0.5	0	0.66[g]	0.5
Outdoor time fraction	0.25	0.228	0.08[g]	0.25
Shape of impacted zone (circular/noncircular)	Circular	Circular	Circular	Circular

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Ingestion Pathway Dietary Data				
Fruit, vegetable and grain consumption (kg/yr)	160	NU	160	160
Leafy vegetable consumption (kg/yr)	14	NU	14	14
Milk ingestion (L/yr)	92	NU	NU	92
Meat ingestion (kg/yr)	63	NU	NU	63
Fish ingestion (kg/yr)	5.4	NU	NU	5.4
Other seafood consumption (kg/yr)	0.9	NU	NU	0.9
Soil ingestion (g/yr)	36.5	175	36.5	36.5
Drinking water ingestion (L/yr)	510	NU	NU	510
Drinking water impacted fraction	1	NU	NU	1
Household water impacted fraction	1	NU	NU	1
Livestock water impacted fraction	1	NU	NU	1
Irrigation water impacted fraction	1	NU	NU	1
Aquatic food impacted fraction	0.5	NU	NU	0.5
Plant food impacted fraction	0.5	NU	0.05	0.5
Meat impacted fraction	0.5	NU	NU	0.5
Milk impacted fraction	0.5	NU	NU	0.5
Ingestion Pathway, Nondietary Data				
Livestock fodder intake for meat (kg/d)	68	NU	NU	68
Livestock fodder intake for milk (kg/d)	55	NU	NU	55
Livestock water intake for meat (L/d)	50	NU	NU	50
Livestock water intake for milk (L/d)	160	NU	NU	160

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Livestock soil intake (kg/d)	0.5	NU	NU	0.5
Mass loading for foliar deposition (g/m^3)	1.00E-04	NU	1.00E-04	1.00E-4
Depth of soil mixing layer (m)	0.15	0.15	0.15	0.15
Depth of roots (m)	0.9	NU	0.9	0.9
Drinking water fraction from groundwater	1	NU	NU	1
Household water fraction from groundwater	1	NU	NU	1
Livestock water fraction from groundwater	1	NU	NU	1
Irrigation water fraction from groundwater source	1	NU	1	1
Plant Factors				
Wet weight crop yield for non-leafy vegetables (kg/m^2)	0.7	NU	0.7	0.7
Length of growing season for non-leafy vegetables (yr)	0.17	NU	0.17	0.17
Translocation factor for non-leafy vegetables	0.1	NU	0.1	0.1
Weathering removal constant (1/yr)	20	NU	20	20
Wet foliar interception fraction for non-leafy vegetables	0.25	NU	0.25	0.25
Dry foliar interception fraction for non-leafy vegetables	0.25	NU	0.25	0.25
Wet foliar interception fraction for fodder	0.25	NU	NU	0.25
Wet weight crop yield for leafy vegetables (kg/m^2)	1.5	NU	1.5	1.5
Length of growing season for leafy vegetables (yr)	0.25	NU	0.25	0.25
Translocation factor for leafy vegetables	1	NU	1	1
Wet foliar interception fraction for leafy vegetables	0.25	NU	0.25	0.25
Dry foliar interception fraction for leafy vegetables	0.25	NU	0.25	0.25

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

RESRAD Input Parameters	RESRAD Defaults	Construction Worker[a]	Urban Resident[b]	Subsistence Farmer[c]
Wet weight crop yield for Fodder (kg/m^2)	1.1	NU	NU	1.1
Growing season for fodder (yr)	0.08	NU	NU	0.08
Translocation factor for fodder	1	NU	NU	1
Wet foliar interception fraction for fodder	0.25	NU	NU	0.25
Dry foliar interception fraction for fodder	0.25	NU	NU	0.25
Storage-Times-Before-Use Data				
Storage time for fruits, non-leafy vegetables and grain (d)	14	14	14	14
Storage time for leafy vegetables (d)	1	1	1	1
Storage time for milk (d)	1	NU	NU	1
Storage time for meat and poultry (d)	20	NU	NU	20
Storage time for fish (d)	7	NU	NU	7
Storage time for crustacean and mollusk (d)	7	NU	NU	7
Storage time for well water (d)	1	NU	NU	1
Storage time for surface water (d)	1	NU	NU	1
Storage time for livestock fodder (d)	45	NU	NU	45

[a] The parameter values are from Appendix A of the Feasibility Study Addendum (USACE 2005), except for the areas of the impacted zones and the nuclide concentrations in the impacted zones which were developed for the specific post-remediation source terms.

[b] The parameter values are based on the assumption that 5% of the plant diet consumed by an urban resident is contaminated. The parameters are RESRAD defaults, selected on the basis of site conditions from Appendix A of the Feasibility Study Addendum (USACE 2005), or as noted. The nuclide concentrations in the impacted zones were developed for the specific post-remediation source terms.

[c] The parameters are RESRAD defaults, selected on the basis of site conditions from Appendix A of the Feasibility Study Addendum (USACE 2005), or as noted. The nuclide concentrations in the impacted zones were developed for the specific post-remediation source terms.

[d] The radionuclide concentration for Ra-226 is from Tables 2 and 3, and it was assumed that Pb-210 is present at the same concentration as Ra-226.

Table 3 RESRAD Input Parameters for the Construction Worker, Urban Resident, and Subsistence Farmer Scenarios (Cont.)

[e] NU indicates that the parameter was not used in the dose assessment.

[f] The impacted zone erosion rate is based on the recommendation for a site with garden/farming in the RESRAD Data Collection Handbook (Yu et. al. 1993).

[g] The values are taken from Table ES-1 of the EPA *Exposure Factors Handbook* (EPA 2011). The inhalation rate is the average long-term inhalation rate for males and females combined from ages 16 to 81; the fraction of time spent indoors is the average time spent indoors at a residence for ages 16 to over 64 years old; and the fraction of time spent outdoors is the 95th percentile time spent outdoors playing on grass or dirt for ages 16 to over 64 years old.

Table 4 Post-Remediation Radiological Dose Assessment: Estimated Maximum Dose Rates for the Construction Worker Scenario

Pathway	Dose Rates (mrem/yr)
External gamma exposure	1.08
Dust inhalation (without radon)	0.0024
Soil ingestion	0.154
Total	1.2

Table 5 Post-Remediation Radiological Dose Assessment: Estimat Maximum Dose Rates for the Urban Resident Scenario

Pathway	Dose Rates (mrem/yr)
External gamma exposure	1.63
Dust inhalation (without radon)	0.000462
Plant ingestion	0.493
Soil ingestion	0.105
Total	2.2

Table 6 Post-Remediation Dose Assessment: Estimated Maximum Dose Rates for the Subsistence Farmer

Pathway	Dose Rates (mrem/yr)
External gamma exposure	2.13
Dust inhalation (without radon)	0.000915
Plant ingestion	4.93
Meat ingestion	0.159
Milk ingestion	0.122
Water ingestion	0
Fish ingestion	0
Soil ingestion	0.106
Total	7.4

APPENDIX A:

RESRAD SUMMARY REPORT FOR THE CONSTRUCTION WORKER SCENARIO

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 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
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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(2)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(3)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(4)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(5)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(6)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(7)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(8)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(9)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(10)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(11)

```
      ³                                                     ³           ³           ³
 B-1  ³ Dose conversion factors for inhalation, mrem/pCi:   ³           ³           ³
 B-1  ³ Pb-210+D                                            ³ 2.320E-02 ³ 1.360E-02 ³ DCF2(  1)
 B-1  ³ Ra-226+D                                            ³ 8.594E-03 ³ 8.580E-03 ³ DCF2(  2)
      ³                                                     ³           ³           ³
 D-1  ³ Dose conversion factors for ingestion, mrem/pCi:    ³           ³           ³
 D-1  ³ Pb-210+D                                            ³ 7.276E-03 ³ 5.370E-03 ³ DCF3(  1)
 D-1  ³ Ra-226+D                                            ³ 1.321E-03 ³ 1.320E-03 ³ DCF3(  2)
      ³                                                     ³           ³           ³
 D-34 ³ Food transfer factors:                              ³           ³           ³
 D-34 ³ Pb-210+D  , plant/soil concentration ratio, dimensionless   ³ 1.000E-02 ³ 1.000E-02 ³ RTF(  1,1)
 D-34 ³ Pb-210+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   ³ 8.000E-04 ³ 8.000E-04 ³ RTF(  1,2)
 D-34 ³ Pb-210+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    ³ 3.000E-04 ³ 3.000E-04 ³ RTF(  1,3)
 D-34 ³                                                     ³           ³           ³
 D-34 ³ Ra-226+D  , plant/soil concentration ratio, dimensionless   ³ 4.000E-02 ³ 4.000E-02 ³ RTF(  2,1)
 D-34 ³ Ra-226+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,2)
 D-34 ³ Ra-226+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,3)
      ³                                                     ³           ³           ³
 D-5  ³ Bioaccumulation factors, fresh water, L/kg:         ³           ³           ³
 D-5  ³ Pb-210+D  , fish                                    ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(  1,1)
 D-5  ³ Pb-210+D  , crustacea and mollusks                  ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(  1,2)
 D-5  ³                                                     ³           ³           ³
 D-5  ³ Ra-226+D  , fish                                    ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(  2,1)
 D-5  ³ Ra-226+D  , crustacea and mollusks                  ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(  2,2)
 ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
 #For DCF1(xxx) only, factors are for infinite depth & area.  See ETFG table in Ground Pathway of Detailed Report.
 *Base Case means Default.Lib w/o Associate Nuclide contributions.
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                                                Site-Specific Parameter Summary
0     ³                                                    ³   User    ³           ³        Used by RESRAD          ³  Parameter
 Menu ³                    Parameter                       ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 R011 ³ Area of contaminated zone (m**2)                   ³ 1.000E+04 ³ 1.000E+04 ³              ---               ³ AREA
 R011 ³ Thickness of contaminated zone (m)                 ³ 2.000E+00 ³ 2.000E+00 ³              ---               ³ THICK0
 R011 ³ Fraction of contamination that is submerged        ³ 0.000E+00 ³ 0.000E+00 ³              ---               ³ SUBMFRACT
 R011 ³ Length parallel to aquifer flow (m)                ³ not used  ³ 1.000E+02 ³              ---               ³ LCZPAQ
 R011 ³ Basic radiation dose limit (mrem/yr)               ³ 2.500E+01 ³ 3.000E+01 ³              ---               ³ BRDL
 R011 ³ Time since placement of material (yr)              ³ 0.000E+00 ³ 0.000E+00 ³              ---               ³ TI
 R011 ³ Times for calculations (yr)                        ³ 1.000E+00 ³ 1.000E+00 ³              ---               ³ T( 2)
 R011 ³ Times for calculations (yr)                        ³ 3.000E+00 ³ 3.000E+00 ³              ---               ³ T( 3)
 R011 ³ Times for calculations (yr)                        ³ 1.000E+01 ³ 1.000E+01 ³              ---               ³ T( 4)
 R011 ³ Times for calculations (yr)                        ³ 3.000E+01 ³ 3.000E+01 ³              ---               ³ T( 5)
 R011 ³ Times for calculations (yr)                        ³ 1.000E+02 ³ 1.000E+02 ³              ---               ³ T( 6)
 R011 ³ Times for calculations (yr)                        ³ 3.000E+02 ³ 3.000E+02 ³              ---               ³ 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): Pb-210	4.500E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	4.500E-01	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
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)	1.800E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.100E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.470E+00	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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW

R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.525E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.526E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	1.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.280E-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)

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0 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)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.750E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW

R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

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Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	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
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 ³   Surface water                              ³ 1.000E+00 ³ 1.000E+00 ³               ---              ³ STOR_T(8)
 STOR ³   Livestock fodder                           ³ 4.500E+01 ³ 4.500E+01 ³               ---              ³ STOR_T(9)
      ³                                              ³           ³           ³                                ³
 R021 ³ Thickness of building foundation (m)         ³ not used  ³ 1.500E-01 ³               ---              ³ FLOOR1
 R021 ³ Bulk density of building foundation (g/cm**3)³ not used  ³ 2.400E+00 ³               ---              ³ DENSFL
 R021 ³ Total porosity of the cover material         ³ not used  ³ 4.000E-01 ³               ---              ³ TPCV
 R021 ³ Total porosity of the building foundation    ³ not used  ³ 1.000E-01 ³               ---              ³ TPFL
 R021 ³ Volumetric water content of the cover material ³ not used ³ 5.000E-02 ³             ---              ³ PH2OCV
 R021 ³ Volumetric water content of the foundation   ³ not used  ³ 3.000E-02 ³               ---              ³ PH2OFL
 R021 ³ Diffusion coefficient for radon gas (m/sec): ³           ³           ³                                ³
 R021 ³   in cover material                          ³ not used  ³ 2.000E-06 ³               ---              ³ DIFCV
 R021 ³   in foundation material                     ³ not used  ³ 3.000E-07 ³               ---              ³ DIFFL
 R021 ³   in contaminated zone soil                  ³ not used  ³ 2.000E-06 ³               ---              ³ DIFCZ
 R021 ³ Radon vertical dimension of mixing (m)       ³ not used  ³ 2.000E+00 ³               ---              ³ HMIX
 R021 ³ Average building air exchange rate (1/hr)    ³ not used  ³ 5.000E-01 ³               ---              ³ REXG
 R021 ³ Height of the building (room) (m)            ³ not used  ³ 2.500E+00 ³               ---              ³ HRM
 R021 ³ Building interior area factor                ³ not used  ³ 0.000E+00 ³               ---              ³ FAI
 R021 ³ Building depth below ground surface (m)      ³ not used  ³-1.000E+00 ³               ---              ³ DMFL
 R021 ³ Emanating power of Rn-222 gas                ³ not used  ³ 2.500E-01 ³               ---              ³ EMANA(1)
 R021 ³ Emanating power of Rn-220 gas                ³ not used  ³ 1.500E-01 ³               ---              ³ EMANA(2)
      ³                                              ³           ³           ³                                ³
 TITL ³ Number of graphical time points              ³     32    ³    ---    ³               ---              ³ NPTS
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                                         Site-Specific Parameter Summary (continued)
0     ³                                              ³   User    ³           ³         Used by RESRAD         ³  Parameter
 Menu ³                    Parameter                 ³   Input   ³  Default  ³ (If different from user input) ³    Name
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 TITL ³ Maximum number of integration points for dose ³    17    ³    ---    ³               ---              ³ LYMAX
 TITL ³ Maximum number of integration points for risk ³   257    ³    ---    ³               ---              ³ KYMAX
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                     Summary of Pathway Selections

                    Pathway             ³   User Selection
          ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
             1 -- external gamma        ³       active
             2 -- inhalation (w/o radon)³       active
             3 -- plant ingestion       ³     suppressed
             4 -- meat ingestion        ³     suppressed
             5 -- milk ingestion        ³     suppressed
             6 -- aquatic foods         ³     suppressed
             7 -- drinking water        ³     suppressed
```

```
              8 -- soil ingestion        ³       active
              9 -- radon                 ³     suppressed
              Find peak pathway doses    ³       active
           ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
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      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:  10000.00 square meters                Pb-210     4.500E-01
   Thickness:      2.00 meters                       Ra-226     4.500E-01
 Cover Depth:      0.00 meters
0
                                    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)
              ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    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):  1.237E+00  1.236E+00  1.235E+00  1.231E+00  1.221E+00  1.183E+00  1.082E+00  7.902E-01
         M(t):  4.946E-02  4.944E-02  4.940E-02  4.925E-02  4.882E-02  4.732E-02  4.326E-02  3.161E-02
0Maximum TDOSE(t):  1.237E+00 mrem/yr   at t = 0.000E+00 years
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground           Inhalation           Radon             Plant              Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  5.917E-04 0.0005  1.737E-03 0.0014  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.286E-01 0.1040
 Ra-226  1.079E+00 0.8727  6.809E-04 0.0006  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.572E-02 0.0208
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 Total   1.080E+00 0.8732  2.418E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.543E-01 0.1248
0
                        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
0                                                      Water Dependent Pathways
0              Water              Fish              Radon             Plant              Meat              Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.310E-01 0.1059
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.106E+00 0.8941
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 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  1.237E+00 1.0000
0*Sum of all water independent and dependent pathways.
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  5.735E-04 0.0005  1.684E-03 0.0014  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.247E-01 0.1009
 Ra-226  1.079E+00 0.8727  7.337E-04 0.0006  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.964E-02 0.0240
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 Total   1.079E+00 0.8732  2.418E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.543E-01 0.1248
0
                        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
0                                                 Water Dependent Pathways
0             Water             Fish             Radon            Plant            Meat             Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.269E-01 0.1027
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.109E+00 0.8973
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 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  1.236E+00 1.0000
0*Sum of all water independent and dependent pathways.
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  5.386E-04 0.0004  1.582E-03 0.0013  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.171E-01 0.0948
 Ra-226  1.078E+00 0.8727  8.345E-04 0.0007  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.713E-02 0.0301
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 Total   1.078E+00 0.8732  2.416E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.542E-01 0.1249
0
```

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.192E-01	0.0965
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.116E+00	0.9035
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	1.235E+00	1.0000

0*Sum of all water independent and dependent pathways.

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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

0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pb-210	4.325E-04	0.0004	1.270E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.402E-02	0.0764
Ra-226	1.075E+00	0.8727	1.140E-03	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.985E-02	0.0486
Total	1.075E+00	0.8731	2.410E-03	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.539E-01	0.1250

0

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.572E-02	0.0777
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.136E+00	0.9223
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	1.231E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:11 Page 13
Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.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

0 Water Independent Pathways (Inhalation excludes radon)

```
0             Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  2.311E-04 0.0002  6.786E-04 0.0006  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.024E-02 0.0412
 Ra-226  1.065E+00 0.8727  1.714E-03 0.0014  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.025E-01 0.0840
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.065E+00 0.8729  2.393E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.528E-01 0.1252
0
                    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
0                                          Water Dependent Pathways
0             Water             Fish             Radon             Plant             Meat              Milk           All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.115E-02 0.0419
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.169E+00 0.9581
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 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  1.221E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:11  Page  14
 Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.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
0                                     Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  2.578E-05 0.0000  7.569E-05 0.0001  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.603E-03 0.0047
 Ra-226  1.032E+00 0.8726  2.247E-03 0.0019  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.427E-01 0.1206
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.032E+00 0.8727  2.322E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.483E-01 0.1254
0
                    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
0                                          Water Dependent Pathways
0             Water             Fish             Radon             Plant             Meat              Milk           All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.705E-03 0.0048
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.177E+00 0.9952
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
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 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  1.183E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:11  Page  15
 Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation           Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  4.892E-08 0.0000  1.436E-07 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.063E-05 0.0000
 Ra-226  9.439E-01 0.8726  2.123E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.356E-01 0.1254
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 Total   9.439E-01 0.8726  2.123E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.356E-01 0.1254
0
                        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
0                                                 Water Dependent Pathways
0              Water             Fish              Radon             Plant             Meat              Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.083E-05 0.0000
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.082E+00 1.0000
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 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  1.082E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:11  Page  16
 Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation           Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  1.457E-17 0.0000  4.277E-17 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.166E-15 0.0000
 Ra-226  6.896E-01 0.8726  1.551E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  9.908E-02 0.1254
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 Total   6.896E-01 0.8726  1.551E-03 0.0020  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  9.908E-02 0.1254
0
                        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
0                                                   Water Dependent Pathways
0             Water              Fish               Radon              Plant              Meat               Milk           All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.224E-15 0.0000
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  7.902E-01 1.0000
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 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  7.902E-01 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:11  Page  17
 Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.RAD

                                  Dose/Source Ratios Summed Over All Pathways
                         Parent and Progeny Principal Radionuclide Contributions Indicated
0  Parent    Product    Thread                    DSR(j,t) At Time in Years   (mrem/yr)/(pCi/g)
    (i)        (j)     Fraction   0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Pb-210+D   Pb-210+D   1.000E+00  2.910E-01 2.820E-01 2.649E-01 2.127E-01 1.137E-01 1.268E-02 2.406E-05 7.164E-15
0Ra-226+D   Ra-226+D   1.000E+00  2.452E+00 2.451E+00 2.449E+00 2.441E+00 2.420E+00 2.345E+00 2.144E+00 1.566E+00
 Ra-226+D   Pb-210+D   1.000E+00  4.546E-03 1.345E-02 3.042E-02 8.199E-02 1.790E-01 2.716E-01 2.599E-01 1.899E-01
 Ra-226+D   äDSR(j)               2.457E+00 2.465E+00 2.479E+00 2.523E+00 2.599E+00 2.616E+00 2.404E+00 1.756E+00
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 The DSR includes contributions from associated (half-life ó 180 days) daughters.
0
                              Single Radionuclide Soil Guidelines G(i,t) in pCi/g
                                 Basic Radiation Dose Limit = 2.500E+01 mrem/yr
0Nuclide
   (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
 ÄÄÄÄÄÄÄ     ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ
 Pb-210      8.591E+01   8.864E+01   9.438E+01   1.175E+02   2.199E+02   1.972E+03   1.039E+06  *7.634E+13
 Ra-226      1.018E+01   1.014E+01   1.008E+01   9.907E+00   9.620E+00   9.555E+00   1.040E+01   1.424E+01
 ÍÍÍÍÍÍÍ     ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ
 *At specific activity limit
0
             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
0Nuclide  Initial         tmin       DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
   (i)    (pCi/g)       (years)                  (pCi/g)               (pCi/g)
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ
 Pb-210  4.500E-01     0.000E+00      2.910E-01  8.591E+01  2.910E-01  8.591E+01
 Ra-226  4.500E-01     64.9 ñ 0.1     2.633E+00  9.496E+00  2.457E+00  1.018E+01
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ
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1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:11  Page  18
 Summary : Painesville Construction Worker Scenario Using Site Average for Post Remediatio
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-CON-SITE-AVG-APR-2013.RAD

                              Individual Nuclide Dose Summed Over All Pathways
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ    ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Pb-210  Pb-210  1.000E+00    1.310E-01 1.269E-01 1.192E-01 9.572E-02 5.115E-02 5.705E-03 1.083E-05 3.224E-15
 Pb-210  Ra-226  1.000E+00    2.045E-03 6.051E-03 1.369E-02 3.690E-02 8.056E-02 1.222E-01 1.170E-01 8.546E-02
 Pb-210  äDOSE(j)             1.330E-01 1.330E-01 1.329E-01 1.326E-01 1.317E-01 1.279E-01 1.170E-01 8.546E-02
0Ra-226  Ra-226  1.000E+00    1.104E+00 1.103E+00 1.102E+00 1.099E+00 1.089E+00 1.055E+00 9.646E-01 7.047E-01
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ    ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.


                                 Individual Nuclide Soil Concentration
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ    ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Pb-210  Pb-210  1.000E+00    4.500E-01 4.361E-01 4.096E-01 3.289E-01 1.758E-01 1.960E-02 3.720E-05 1.108E-14
 Pb-210  Ra-226  1.000E+00    0.000E+00 1.377E-02 4.002E-02 1.198E-01 2.699E-01 4.133E-01 3.958E-01 2.892E-01
 Pb-210  äS(j):               4.500E-01 4.499E-01 4.496E-01 4.487E-01 4.457E-01 4.329E-01 3.958E-01 2.892E-01
0Ra-226  Ra-226  1.000E+00    4.500E-01 4.498E-01 4.494E-01 4.480E-01 4.440E-01 4.303E-01 3.934E-01 2.874E-01
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ    ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =    1.44 seconds
```

APPENDIX B:

RESRAD SUMMARY REPORT FOR THE URBAN RESIDENT SCENARIO

```
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page   1
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.RAD
```

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 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
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```


```
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 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.RAD
```

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(2)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(3)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(4)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(5)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(6)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(7)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(8)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(9)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(10)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(11)

```
      ³                                                     ³           ³           ³
 B-1  ³ Dose conversion factors for inhalation, mrem/pCi:   ³           ³           ³
 B-1  ³ Pb-210+D                                            ³ 2.320E-02 ³ 1.360E-02 ³ DCF2(  1)
 B-1  ³ Ra-226+D                                            ³ 8.594E-03 ³ 8.580E-03 ³ DCF2(  2)
      ³                                                     ³           ³           ³
 D-1  ³ Dose conversion factors for ingestion, mrem/pCi:    ³           ³           ³
 D-1  ³ Pb-210+D                                            ³ 7.276E-03 ³ 5.370E-03 ³ DCF3(  1)
 D-1  ³ Ra-226+D                                            ³ 1.321E-03 ³ 1.320E-03 ³ DCF3(  2)
      ³                                                     ³           ³           ³
 D-34 ³ Food transfer factors:                              ³           ³           ³
 D-34 ³ Pb-210+D  , plant/soil concentration ratio, dimensionless   ³ 1.000E-02 ³ 1.000E-02 ³ RTF(  1,1)
 D-34 ³ Pb-210+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   ³ 8.000E-04 ³ 8.000E-04 ³ RTF(  1,2)
 D-34 ³ Pb-210+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    ³ 3.000E-04 ³ 3.000E-04 ³ RTF(  1,3)
 D-34 ³                                                     ³           ³           ³
 D-34 ³ Ra-226+D  , plant/soil concentration ratio, dimensionless   ³ 4.000E-02 ³ 4.000E-02 ³ RTF(  2,1)
 D-34 ³ Ra-226+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,2)
 D-34 ³ Ra-226+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,3)
      ³                                                     ³           ³           ³
 D-5  ³ Bioaccumulation factors, fresh water, L/kg:         ³           ³           ³
 D-5  ³ Pb-210+D  , fish                                    ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(  1,1)
 D-5  ³ Pb-210+D  , crustacea and mollusks                  ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(  1,2)
 D-5  ³                                                     ³           ³           ³
 D-5  ³ Ra-226+D  , fish                                    ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(  2,1)
 D-5  ³ Ra-226+D  , crustacea and mollusks                  ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(  2,2)
 ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
 #For DCF1(xxx) only, factors are for infinite depth & area.  See ETFG table in Ground Pathway of Detailed Report.
 *Base Case means Default.Lib w/o Associate Nuclide contributions.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page   3
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.RAD

                                         Site-Specific Parameter Summary
0     ³                                          ³   User    ³           ³        Used by RESRAD         ³  Parameter
 Menu ³                   Parameter              ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 R011 ³ Area of contaminated zone (m**2)         ³ 1.000E+04 ³ 1.000E+04 ³              ---               ³ AREA
 R011 ³ Thickness of contaminated zone (m)       ³ 2.000E+00 ³ 2.000E+00 ³              ---               ³ THICK0
 R011 ³ Fraction of contamination that is submerged ³ 0.000E+00 ³ 0.000E+00 ³           ---               ³ SUBMFRACT
 R011 ³ Length parallel to aquifer flow (m)      ³ 1.000E+02 ³ 1.000E+02 ³              ---               ³ LCZPAQ
 R011 ³ Basic radiation dose limit (mrem/yr)     ³ 2.500E+01 ³ 3.000E+01 ³              ---               ³ BRDL
 R011 ³ Time since placement of material (yr)    ³ 0.000E+00 ³ 0.000E+00 ³              ---               ³ TI
 R011 ³ Times for calculations (yr)              ³ 1.000E+00 ³ 1.000E+00 ³              ---               ³ T( 2)
 R011 ³ Times for calculations (yr)              ³ 3.000E+00 ³ 3.000E+00 ³              ---               ³ T( 3)
 R011 ³ Times for calculations (yr)              ³ 1.000E+01 ³ 1.000E+01 ³              ---               ³ T( 4)
 R011 ³ Times for calculations (yr)              ³ 3.000E+01 ³ 3.000E+01 ³              ---               ³ T( 5)
 R011 ³ Times for calculations (yr)              ³ 1.000E+02 ³ 1.000E+02 ³              ---               ³ T( 6)
 R011 ³ Times for calculations (yr)              ³ 3.000E+02 ³ 3.000E+02 ³              ---               ³ 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): Pb-210	4.500E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	4.500E-01	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
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)	1.800E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-04	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.100E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.470E+00	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

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Summary : Painsville Site Average Residential Use - Resident
File   : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

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 Pb-210				
R016	Contaminated zone (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.525E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.526E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	5.548E+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	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.600E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-02	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)

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Site-Specific Parameter Summary (continued)

0 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)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	5.000E-02	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	1.000E+00	---	FGWDW

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 R019 ³ Household water fraction from ground water       ³ not used  ³ 1.000E+00 ³             ---              ³ FGWHH
 R019 ³ Livestock water fraction from ground water       ³ not used  ³ 1.000E+00 ³             ---              ³ FGWLW
 R019 ³ Irrigation fraction from ground water            ³ 1.000E+00 ³ 1.000E+00 ³             ---              ³ FGWIR
      ³                                                  ³           ³           ³                              ³
 R19B ³ Wet weight crop yield for Non-Leafy (kg/m**2)    ³ 7.000E-01 ³ 7.000E-01 ³             ---              ³ YV(1)
 R19B ³ Wet weight crop yield for Leafy     (kg/m**2)    ³ 1.500E+00 ³ 1.500E+00 ³             ---              ³ YV(2)
 R19B ³ Wet weight crop yield for Fodder    (kg/m**2)    ³ not used  ³ 1.100E+00 ³             ---              ³ YV(3)
 R19B ³ Growing Season for  Non-Leafy (years)            ³ 1.700E-01 ³ 1.700E-01 ³             ---              ³ TE(1)
 R19B ³ Growing Season for  Leafy     (years)            ³ 2.500E-01 ³ 2.500E-01 ³             ---              ³ TE(2)
 R19B ³ Growing Season for  Fodder    (years)            ³ not used  ³ 8.000E-02 ³             ---              ³ TE(3)
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                                           Site-Specific Parameter Summary (continued)
0     ³                                                  ³   User    ³           ³       Used by RESRAD         ³  Parameter
 Menu ³                      Parameter                   ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 R19B ³ Translocation Factor for  Non-Leafy              ³ 1.000E-01 ³ 1.000E-01 ³             ---              ³ TIV(1)
 R19B ³ Translocation Factor for  Leafy                  ³ 1.000E+00 ³ 1.000E+00 ³             ---              ³ TIV(2)
 R19B ³ Translocation Factor for  Fodder                 ³ not used  ³ 1.000E+00 ³             ---              ³ TIV(3)
 R19B ³ Dry Foliar Interception Fraction for  Non-Leafy  ³ 2.500E-01 ³ 2.500E-01 ³             ---              ³ RDRY(1)
 R19B ³ Dry Foliar Interception Fraction for  Leafy      ³ 2.500E-01 ³ 2.500E-01 ³             ---              ³ RDRY(2)
 R19B ³ Dry Foliar Interception Fraction for  Fodder     ³ not used  ³ 2.500E-01 ³             ---              ³ RDRY(3)
 R19B ³ Wet Foliar Interception Fraction for  Non-Leafy  ³ 2.500E-01 ³ 2.500E-01 ³             ---              ³ RWET(1)
 R19B ³ Wet Foliar Interception Fraction for  Leafy      ³ 2.500E-01 ³ 2.500E-01 ³             ---              ³ RWET(2)
 R19B ³ Wet Foliar Interception Fraction for  Fodder     ³ not used  ³ 2.500E-01 ³             ---              ³ RWET(3)
 R19B ³ Weathering Removal Constant for Vegetation       ³ 2.000E+01 ³ 2.000E+01 ³             ---              ³ WLAM
      ³                                                  ³           ³           ³                              ³
 C14  ³ C-12 concentration in water (g/cm**3)            ³ not used  ³ 2.000E-05 ³             ---              ³ C12WTR
 C14  ³ C-12 concentration in contaminated soil (g/g)    ³ not used  ³ 3.000E-02 ³             ---              ³ C12CZ
 C14  ³ Fraction of vegetation carbon from soil          ³ not used  ³ 2.000E-02 ³             ---              ³ CSOIL
 C14  ³ Fraction of vegetation carbon from air           ³ not used  ³ 9.800E-01 ³             ---              ³ CAIR
 C14  ³ C-14 evasion layer thickness in soil (m)         ³ not used  ³ 3.000E-01 ³             ---              ³ DMC
 C14  ³ C-14 evasion flux rate from soil (1/sec)         ³ not used  ³ 7.000E-07 ³             ---              ³ EVSN
 C14  ³ C-12 evasion flux rate from soil (1/sec)         ³ not used  ³ 1.000E-10 ³             ---              ³ REVSN
 C14  ³ Fraction of grain in beef cattle feed            ³ not used  ³ 8.000E-01 ³             ---              ³ AVFG4
 C14  ³ Fraction of grain in milk cow feed               ³ not used  ³ 2.000E-01 ³             ---              ³ AVFG5
      ³                                                  ³           ³           ³                              ³
 STOR ³ Storage times of contaminated foodstuffs (days): ³           ³           ³                              ³
 STOR ³   Fruits, non-leafy vegetables, and grain        ³ 1.400E+01 ³ 1.400E+01 ³             ---              ³ STOR_T(1)
 STOR ³   Leafy vegetables                               ³ 1.000E+00 ³ 1.000E+00 ³             ---              ³ STOR_T(2)
 STOR ³   Milk                                           ³ 1.000E+00 ³ 1.000E+00 ³             ---              ³ STOR_T(3)
 STOR ³   Meat and poultry                               ³ 2.000E+01 ³ 2.000E+01 ³             ---              ³ STOR_T(4)
 STOR ³   Fish                                           ³ 7.000E+00 ³ 7.000E+00 ³             ---              ³ STOR_T(5)
 STOR ³   Crustacea and mollusks                         ³ 7.000E+00 ³ 7.000E+00 ³             ---              ³ STOR_T(6)
 STOR ³   Well water                                     ³ 1.000E+00 ³ 1.000E+00 ³             ---              ³ STOR_T(7)
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 STOR ³   Surface water                                ³ 1.000E+00 ³ 1.000E+00 ³              ---              ³ STOR_T(8)
 STOR ³   Livestock fodder                             ³ 4.500E+01 ³ 4.500E+01 ³              ---              ³ STOR_T(9)
      ³                                                ³           ³           ³                               ³
 R021 ³ Thickness of building foundation (m)           ³ not used  ³ 1.500E-01 ³              ---              ³ FLOOR1
 R021 ³ Bulk density of building foundation (g/cm**3)  ³ not used  ³ 2.400E+00 ³              ---              ³ DENSFL
 R021 ³ Total porosity of the cover material           ³ not used  ³ 4.000E-01 ³              ---              ³ TPCV
 R021 ³ Total porosity of the building foundation      ³ not used  ³ 1.000E-01 ³              ---              ³ TPFL
 R021 ³ Volumetric water content of the cover material ³ not used  ³ 5.000E-02 ³              ---              ³ PH2OCV
 R021 ³ Volumetric water content of the foundation     ³ not used  ³ 3.000E-02 ³              ---              ³ PH2OFL
 R021 ³ Diffusion coefficient for radon gas (m/sec):   ³           ³           ³                               ³
 R021 ³   in cover material                            ³ not used  ³ 2.000E-06 ³              ---              ³ DIFCV
 R021 ³   in foundation material                       ³ not used  ³ 3.000E-07 ³              ---              ³ DIFFL
 R021 ³   in contaminated zone soil                    ³ not used  ³ 2.000E-06 ³              ---              ³ DIFCZ
 R021 ³ Radon vertical dimension of mixing (m)         ³ not used  ³ 2.000E+00 ³              ---              ³ HMIX
 R021 ³ Average building air exchange rate (1/hr)      ³ not used  ³ 5.000E-01 ³              ---              ³ REXG
 R021 ³ Height of the building (room) (m)              ³ not used  ³ 2.500E+00 ³              ---              ³ HRM
 R021 ³ Building interior area factor                  ³ not used  ³ 0.000E+00 ³              ---              ³ FAI
 R021 ³ Building depth below ground surface (m)        ³ not used  ³-1.000E+00 ³              ---              ³ DMFL
 R021 ³ Emanating power of Rn-222 gas                  ³ not used  ³ 2.500E-01 ³              ---              ³ EMANA(1)
 R021 ³ Emanating power of Rn-220 gas                  ³ not used  ³ 1.500E-01 ³              ---              ³ EMANA(2)
      ³                                                ³           ³           ³                               ³
 TITL ³ Number of graphical time points                ³     32    ³    ---    ³              ---              ³ NPTS
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                                     Site-Specific Parameter Summary (continued)
0     ³                                                ³   User    ³           ³         Used by RESRAD        ³  Parameter
 Menu ³                  Parameter                     ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 TITL ³ Maximum number of integration points for dose  ³     17    ³    ---    ³              ---              ³ LYMAX
 TITL ³ Maximum number of integration points for risk  ³    257    ³    ---    ³              ---              ³ KYMAX
 ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ



                     Summary of Pathway Selections

                    Pathway             ³   User Selection
           ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
              1 -- external gamma       ³       active
              2 -- inhalation (w/o radon)³       active
              3 -- plant ingestion      ³       active
              4 -- meat ingestion       ³     suppressed
              5 -- milk ingestion       ³     suppressed
              6 -- aquatic foods        ³     suppressed
              7 -- drinking water       ³     suppressed
```

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              8 -- soil ingestion        ³       active
              9 -- radon                 ³     suppressed
              Find peak pathway doses    ³       active
           ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
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      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:  10000.00 square meters               Pb-210     4.500E-01
   Thickness:      2.00 meters                      Ra-226     4.500E-01
 Cover Depth:      0.00 meters
0
                                      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)
              ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    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):  2.227E+00  2.226E+00  2.224E+00  2.217E+00  2.198E+00  2.131E+00  1.948E+00  1.423E+00
         M(t):  8.906E-02  8.903E-02  8.896E-02  8.870E-02  8.794E-02  8.525E-02  7.794E-02  5.694E-02
0Maximum TDOSE(t):  2.227E+00 mrem/yr   at t = 0.000E+00 years
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground           Inhalation            Radon              Plant              Meat               Milk               Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  8.928E-04 0.0004  3.320E-04 0.0001  0.000E+00 0.0000  2.805E-01 0.1260  0.000E+00 0.0000  0.000E+00 0.0000  8.707E-02 0.0391
 Ra-226  1.628E+00 0.7313  1.301E-04 0.0001  0.000E+00 0.0000  2.120E-01 0.0952  0.000E+00 0.0000  0.000E+00 0.0000  1.741E-02 0.0078
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 Total   1.629E+00 0.7317  4.622E-04 0.0002  0.000E+00 0.0000  4.925E-01 0.2212  0.000E+00 0.0000  0.000E+00 0.0000  1.045E-01 0.0469
0
                        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
0                                                  Water Dependent Pathways
0              Water              Fish              Radon              Plant              Meat               Milk         All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.688E-01 0.1656
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.858E+00 0.8344
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 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  2.227E+00 1.0000
0*Sum of all water independent and dependent pathways.
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  8.652E-04 0.0004  3.218E-04 0.0001  0.000E+00 0.0000  2.718E-01 0.1221  0.000E+00 0.0000  0.000E+00 0.0000  8.438E-02 0.0379
 Ra-226  1.628E+00 0.7312  1.402E-04 0.0001  0.000E+00 0.0000  2.206E-01 0.0991  0.000E+00 0.0000  0.000E+00 0.0000  2.007E-02 0.0090
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.628E+00 0.7316  4.620E-04 0.0002  0.000E+00 0.0000  4.925E-01 0.2212  0.000E+00 0.0000  0.000E+00 0.0000  1.045E-01 0.0469
0
                        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
0                                          Water Dependent Pathways
0             Water            Fish            Radon            Plant            Meat             Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.574E-01 0.1606
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.868E+00 0.8394
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 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  2.226E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page  11
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  8.127E-04 0.0004  3.022E-04 0.0001  0.000E+00 0.0000  2.553E-01 0.1148  0.000E+00 0.0000  0.000E+00 0.0000  7.926E-02 0.0356
 Ra-226  1.626E+00 0.7312  1.595E-04 0.0001  0.000E+00 0.0000  2.368E-01 0.1065  0.000E+00 0.0000  0.000E+00 0.0000  2.513E-02 0.0113
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.627E+00 0.7316  4.617E-04 0.0002  0.000E+00 0.0000  4.921E-01 0.2213  0.000E+00 0.0000  0.000E+00 0.0000  1.044E-01 0.0469
0
```

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.357E-01	0.1509
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.888E+00	0.8491
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	2.224E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:17 Page 12
Summary : Painsville Site Average Residential Use - Resident
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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

0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pb-210	6.526E-04	0.0003	2.427E-04	0.0001	0.000E+00	0.0000	2.050E-01	0.0925	0.000E+00	0.0000	0.000E+00	0.0000	6.365E-02	0.0287
Ra-226	1.621E+00	0.7311	2.179E-04	0.0001	0.000E+00	0.0000	2.859E-01	0.1289	0.000E+00	0.0000	0.000E+00	0.0000	4.051E-02	0.0183
Total	1.622E+00	0.7314	4.606E-04	0.0002	0.000E+00	0.0000	4.909E-01	0.2214	0.000E+00	0.0000	0.000E+00	0.0000	1.042E-01	0.0470

0

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.696E-01	0.1216
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.948E+00	0.8784
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	2.217E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:17 Page 13
Summary : Painsville Site Average Residential Use - Resident
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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

0 Water Independent Pathways (Inhalation excludes radon)

```
0             Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  3.487E-04 0.0002  1.297E-04 0.0001  0.000E+00 0.0000  1.096E-01 0.0498  0.000E+00 0.0000  0.000E+00 0.0000  3.401E-02 0.0155
 Ra-226  1.607E+00 0.7310  3.275E-04 0.0001  0.000E+00 0.0000  3.775E-01 0.1717  0.000E+00 0.0000  0.000E+00 0.0000  6.940E-02 0.0316
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.607E+00 0.7312  4.572E-04 0.0002  0.000E+00 0.0000  4.871E-01 0.2216  0.000E+00 0.0000  0.000E+00 0.0000  1.034E-01 0.0470
0
                    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
0                                                Water Dependent Pathways
0             Water             Fish             Radon             Plant             Meat              Milk           All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.440E-01 0.0655
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.054E+00 0.9345
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 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  2.198E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page  14
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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
0                                   Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  3.889E-05 0.0000  1.446E-05 0.0000  0.000E+00 0.0000  1.222E-02 0.0057  0.000E+00 0.0000  0.000E+00 0.0000  3.793E-03 0.0018
 Ra-226  1.558E+00 0.7309  4.293E-04 0.0002  0.000E+00 0.0000  4.604E-01 0.2160  0.000E+00 0.0000  0.000E+00 0.0000  9.661E-02 0.0453
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.558E+00 0.7309  4.438E-04 0.0002  0.000E+00 0.0000  4.726E-01 0.2218  0.000E+00 0.0000  0.000E+00 0.0000  1.004E-01 0.0471
0
                    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
0                                                Water Dependent Pathways
0             Water             Fish             Radon             Plant             Meat              Milk           All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.607E-02 0.0075
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.115E+00 0.9925
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
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 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  2.131E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page  15
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation           Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  7.381E-08 0.0000  2.745E-08 0.0000  0.000E+00 0.0000  2.319E-05 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  7.199E-06 0.0000
 Ra-226  1.424E+00 0.7309  4.058E-04 0.0002  0.000E+00 0.0000  4.321E-01 0.2218  0.000E+00 0.0000  0.000E+00 0.0000  9.180E-02 0.0471
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ
 Total   1.424E+00 0.7309  4.058E-04 0.0002  0.000E+00 0.0000  4.322E-01 0.2218  0.000E+00 0.0000  0.000E+00 0.0000  9.181E-02 0.0471
0
                        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
0                                                  Water Dependent Pathways
0              Water             Fish              Radon             Plant             Meat              Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.049E-05 0.0000
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.948E+00 1.0000
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 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  1.948E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:17  Page  16
 Summary : Painsville Site Average Residential Use - Resident
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0             Ground          Inhalation           Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  2.198E-17 0.0000  8.174E-18 0.0000  0.000E+00 0.0000  6.905E-15 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.143E-15 0.0000
 Ra-226  1.040E+00 0.7309  2.965E-04 0.0002  0.000E+00 0.0000  3.157E-01 0.2218  0.000E+00 0.0000  0.000E+00 0.0000  6.707E-02 0.0471
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 Total   1.040E+00 0.7309  2.965E-04 0.0002  0.000E+00 0.0000  3.157E-01 0.2218  0.000E+00 0.0000  0.000E+00 0.0000  6.707E-02 0.0471
0
                        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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.079E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E+00	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	1.423E+00	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : Painsville Site Average Residential Use - Resident

File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-RES-SITE-AVG-FEB5-2013.RAD

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

0 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
Pb-210+D	Pb-210+D	1.000E+00	8.195E-01	7.942E-01	7.460E-01	5.991E-01	3.201E-01	3.570E-02	6.775E-05	2.018E-14
0Ra-226+D	Ra-226+D	1.000E+00	4.114E+00	4.112E+00	4.108E+00	4.095E+00	4.059E+00	3.933E+00	3.596E+00	2.627E+00
Ra-226+D	Pb-210+D	1.000E+00	1.459E-02	3.996E-02	8.776E-02	2.330E-01	5.063E-01	7.669E-01	7.339E-01	5.362E-01
Ra-226+D	äDSR(j)		4.128E+00	4.152E+00	4.196E+00	4.328E+00	4.565E+00	4.700E+00	4.330E+00	3.163E+00

The DSR includes contributions from associated (half-life ó 180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (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
Pb-210	3.051E+01	3.148E+01	3.351E+01	4.173E+01	7.810E+01	7.003E+02	3.690E+05	*7.634E+13
Ra-226	6.055E+00	6.021E+00	5.958E+00	5.776E+00	5.476E+00	5.319E+00	5.774E+00	7.903E+00

*At specific activity limit

0

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

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pb-210	4.500E-01	0.000E+00	8.195E-01	3.051E+01	8.195E-01	3.051E+01
Ra-226	4.500E-01	79.4 ñ 0.2	4.712E+00	5.306E+00	4.128E+00	6.055E+00

```
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                              Individual Nuclide Dose Summed Over All Pathways
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
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 Pb-210  Pb-210  1.000E+00    3.688E-01 3.574E-01 3.357E-01 2.696E-01 1.440E-01 1.607E-02 3.049E-05 9.079E-15
 Pb-210  Ra-226  1.000E+00    6.565E-03 1.798E-02 3.949E-02 1.048E-01 2.278E-01 3.451E-01 3.302E-01 2.413E-01
 Pb-210  äDOSE(j)             3.753E-01 3.754E-01 3.752E-01 3.744E-01 3.719E-01 3.612E-01 3.303E-01 2.413E-01
0Ra-226  Ra-226  1.000E+00    1.851E+00 1.850E+00 1.849E+00 1.843E+00 1.827E+00 1.770E+00 1.618E+00 1.182E+00
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 THF(i) is the thread fraction of the parent nuclide.


                                 Individual Nuclide Soil Concentration
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
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 Pb-210  Pb-210  1.000E+00    4.500E-01 4.361E-01 4.096E-01 3.289E-01 1.758E-01 1.960E-02 3.720E-05 1.108E-14
 Pb-210  Ra-226  1.000E+00    0.000E+00 1.377E-02 4.002E-02 1.198E-01 2.699E-01 4.133E-01 3.958E-01 2.892E-01
 Pb-210  äS(j):               4.500E-01 4.499E-01 4.496E-01 4.487E-01 4.457E-01 4.329E-01 3.958E-01 2.892E-01
0Ra-226  Ra-226  1.000E+00    4.500E-01 4.498E-01 4.494E-01 4.480E-01 4.440E-01 4.303E-01 3.934E-01 2.874E-01
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 THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =    0.59 seconds
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APPENDIX C:

RESRAD SUMMARY REPORT FOR THE SUBSISTENCE FARMER SCENARIO

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Summary : Painsville Site Average Residential Use - Subsistence Farmer
File   : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.RAD

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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
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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(2)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(3)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(4)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(5)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(6)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(7)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(8)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(9)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(10)

```
 A-1  ³ Tl-210   (Source: no data)                                 ³ 0.000E+00 ³-2.000E+00 ³ DCF1( 11)
      ³                                                            ³           ³           ³
 B-1  ³ Dose conversion factors for inhalation, mrem/pCi:          ³           ³           ³
 B-1  ³ Pb-210+D                                                   ³ 2.320E-02 ³ 1.360E-02 ³ DCF2(  1)
 B-1  ³ Ra-226+D                                                   ³ 8.594E-03 ³ 8.580E-03 ³ DCF2(  2)
      ³                                                            ³           ³           ³
 D-1  ³ Dose conversion factors for ingestion, mrem/pCi:           ³           ³           ³
 D-1  ³ Pb-210+D                                                   ³ 7.276E-03 ³ 5.370E-03 ³ DCF3(  1)
 D-1  ³ Ra-226+D                                                   ³ 1.321E-03 ³ 1.320E-03 ³ DCF3(  2)
      ³                                                            ³           ³           ³
 D-34 ³ Food transfer factors:                                     ³           ³           ³
 D-34 ³ Pb-210+D  , plant/soil concentration ratio, dimensionless  ³ 1.000E-02 ³ 1.000E-02 ³ RTF(  1,1)
 D-34 ³ Pb-210+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  ³ 8.000E-04 ³ 8.000E-04 ³ RTF(  1,2)
 D-34 ³ Pb-210+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   ³ 3.000E-04 ³ 3.000E-04 ³ RTF(  1,3)
 D-34 ³                                                            ³           ³           ³
 D-34 ³ Ra-226+D  , plant/soil concentration ratio, dimensionless  ³ 4.000E-02 ³ 4.000E-02 ³ RTF(  2,1)
 D-34 ³ Ra-226+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,2)
 D-34 ³ Ra-226+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   ³ 1.000E-03 ³ 1.000E-03 ³ RTF(  2,3)
      ³                                                            ³           ³           ³
 D-5  ³ Bioaccumulation factors, fresh water, L/kg:                ³           ³           ³
 D-5  ³ Pb-210+D  , fish                                           ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(  1,1)
 D-5  ³ Pb-210+D  , crustacea and mollusks                         ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(  1,2)
 D-5  ³                                                            ³           ³           ³
 D-5  ³ Ra-226+D  , fish                                           ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(  2,1)
 D-5  ³ Ra-226+D  , crustacea and mollusks                         ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(  2,2)
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 #For DCF1(xxx) only, factors are for infinite depth & area.  See ETFG table in Ground Pathway of Detailed Report.
 *Base Case means Default.Lib w/o Associate Nuclide contributions.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:28  Page   3
 Summary : Painsville Site Average Residential Use - Subsistence Farmer
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.RAD

                                                              Site-Specific Parameter Summary
0     ³                                                ³   User    ³           ³         Used by RESRAD          ³  Parameter
 Menu ³                      Parameter                 ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 R011 ³ Area of contaminated zone (m**2)               ³ 1.000E+04 ³ 1.000E+04 ³              ---               ³ AREA
 R011 ³ Thickness of contaminated zone (m)             ³ 2.000E+00 ³ 2.000E+00 ³              ---               ³ THICK0
 R011 ³ Fraction of contamination that is submerged    ³ 0.000E+00 ³ 0.000E+00 ³              ---               ³ SUBMFRACT
 R011 ³ Length parallel to aquifer flow (m)            ³ 1.000E+02 ³ 1.000E+02 ³              ---               ³ LCZPAQ
 R011 ³ Basic radiation dose limit (mrem/yr)           ³ 2.500E+01 ³ 3.000E+01 ³              ---               ³ BRDL
 R011 ³ Time since placement of material (yr)          ³ 0.000E+00 ³ 0.000E+00 ³              ---               ³ TI
 R011 ³ Times for calculations (yr)                    ³ 1.000E+00 ³ 1.000E+00 ³              ---               ³ T( 2)
 R011 ³ Times for calculations (yr)                    ³ 3.000E+00 ³ 3.000E+00 ³              ---               ³ T( 3)
 R011 ³ Times for calculations (yr)                    ³ 1.000E+01 ³ 1.000E+01 ³              ---               ³ T( 4)
 R011 ³ Times for calculations (yr)                    ³ 3.000E+01 ³ 3.000E+01 ³              ---               ³ T( 5)
 R011 ³ Times for calculations (yr)                    ³ 1.000E+02 ³ 1.000E+02 ³              ---               ³ 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): Pb-210	4.500E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	4.500E-01	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
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)	1.800E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-04	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.100E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	3.470E+00	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

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name

R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
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 Pb-210				
R016	Contaminated zone (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.500E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.525E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	9.100E+03	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.526E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
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	4.000E-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)

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Site-Specific Parameter Summary (continued)

0 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	0.500E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E+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 ³ Drinking water fraction from ground water        ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ FGWDW
 R019 ³ Household water fraction from ground water       ³ not used  ³ 1.000E+00 ³               ---                ³ FGWHH
 R019 ³ Livestock water fraction from ground water       ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ FGWLW
 R019 ³ Irrigation fraction from ground water            ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ FGWIR
      ³                                                  ³           ³           ³                                  ³
 R19B ³ Wet weight crop yield for Non-Leafy (kg/m**2)    ³ 7.000E-01 ³ 7.000E-01 ³               ---                ³ YV(1)
 R19B ³ Wet weight crop yield for Leafy     (kg/m**2)    ³ 1.500E+00 ³ 1.500E+00 ³               ---                ³ YV(2)
 R19B ³ Wet weight crop yield for Fodder    (kg/m**2)    ³ 1.100E+00 ³ 1.100E+00 ³               ---                ³ YV(3)
 R19B ³ Growing Season for  Non-Leafy (years)            ³ 1.700E-01 ³ 1.700E-01 ³               ---                ³ TE(1)
 R19B ³ Growing Season for  Leafy     (years)            ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ TE(2)
 R19B ³ Growing Season for  Fodder    (years)            ³ 8.000E-02 ³ 8.000E-02 ³               ---                ³ TE(3)
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                                          Site-Specific Parameter Summary (continued)
0     ³                                                  ³   User    ³           ³         Used by RESRAD           ³  Parameter
 Menu ³                    Parameter                     ³   Input   ³  Default  ³ (If different from user input) ³    Name
 ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 R19B ³ Translocation Factor for  Non-Leafy              ³ 1.000E-01 ³ 1.000E-01 ³               ---                ³ TIV(1)
 R19B ³ Translocation Factor for  Leafy                  ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ TIV(2)
 R19B ³ Translocation Factor for  Fodder                 ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ TIV(3)
 R19B ³ Dry Foliar Interception Fraction for  Non-Leafy  ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RDRY(1)
 R19B ³ Dry Foliar Interception Fraction for  Leafy      ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RDRY(2)
 R19B ³ Dry Foliar Interception Fraction for  Fodder     ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RDRY(3)
 R19B ³ Wet Foliar Interception Fraction for  Non-Leafy  ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RWET(1)
 R19B ³ Wet Foliar Interception Fraction for  Leafy      ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RWET(2)
 R19B ³ Wet Foliar Interception Fraction for  Fodder     ³ 2.500E-01 ³ 2.500E-01 ³               ---                ³ RWET(3)
 R19B ³ Weathering Removal Constant for Vegetation       ³ 2.000E+01 ³ 2.000E+01 ³               ---                ³ WLAM
      ³                                                  ³           ³           ³                                  ³
 C14  ³ C-12 concentration in water (g/cm**3)            ³ not used  ³ 2.000E-05 ³               ---                ³ C12WTR
 C14  ³ C-12 concentration in contaminated soil (g/g)    ³ not used  ³ 3.000E-02 ³               ---                ³ C12CZ
 C14  ³ Fraction of vegetation carbon from soil          ³ not used  ³ 2.000E-02 ³               ---                ³ CSOIL
 C14  ³ Fraction of vegetation carbon from air           ³ not used  ³ 9.800E-01 ³               ---                ³ CAIR
 C14  ³ C-14 evasion layer thickness in soil (m)         ³ not used  ³ 3.000E-01 ³               ---                ³ DMC
 C14  ³ C-14 evasion flux rate from soil (1/sec)         ³ not used  ³ 7.000E-07 ³               ---                ³ EVSN
 C14  ³ C-12 evasion flux rate from soil (1/sec)         ³ not used  ³ 1.000E-10 ³               ---                ³ REVSN
 C14  ³ Fraction of grain in beef cattle feed            ³ not used  ³ 8.000E-01 ³               ---                ³ AVFG4
 C14  ³ Fraction of grain in milk cow feed               ³ not used  ³ 2.000E-01 ³               ---                ³ AVFG5
      ³                                                  ³           ³           ³                                  ³
 STOR ³ Storage times of contaminated foodstuffs (days): ³           ³           ³                                  ³
 STOR ³   Fruits, non-leafy vegetables, and grain        ³ 1.400E+01 ³ 1.400E+01 ³               ---                ³ STOR_T(1)
 STOR ³   Leafy vegetables                               ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ STOR_T(2)
 STOR ³   Milk                                           ³ 1.000E+00 ³ 1.000E+00 ³               ---                ³ STOR_T(3)
 STOR ³   Meat and poultry                               ³ 2.000E+01 ³ 2.000E+01 ³               ---                ³ STOR_T(4)
 STOR ³   Fish                                           ³ 7.000E+00 ³ 7.000E+00 ³               ---                ³ STOR_T(5)
 STOR ³   Crustacea and mollusks                         ³ 7.000E+00 ³ 7.000E+00 ³               ---                ³ 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

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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        ³       active
               8 -- soil ingestion        ³       active
               9 -- radon                 ³     suppressed
               Find peak pathway doses    ³       active
            ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
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      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:  10000.00 square meters                Pb-210     4.500E-01
   Thickness:      2.00 meters                       Ra-226     4.500E-01
 Cover Depth:      0.00 meters
0
                                     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)
              ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    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):  7.443E+00  7.442E+00  7.436E+00  7.416E+00  7.357E+00  7.136E+00  6.524E+00  4.766E+00
         M(t):  2.977E-01  2.977E-01  2.975E-01  2.967E-01  2.943E-01  2.854E-01  2.610E-01  1.907E-01
0Maximum TDOSE(t):  7.443E+00 mrem/yr   at t = 0.000E+00 years
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                        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
0                                       Water Independent Pathways (Inhalation excludes radon)
0              Ground           Inhalation           Radon              Plant               Meat                Milk                Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  1.168E-03 0.0002  6.576E-04 0.0001  0.000E+00 0.0000  2.805E+00 0.3769  9.589E-02 0.0129  4.672E-02 0.0063  8.825E-02 0.0119
 Ra-226  2.130E+00 0.2862  2.577E-04 0.0000  0.000E+00 0.0000  2.120E+00 0.2848  6.267E-02 0.0084  7.482E-02 0.0101  1.765E-02 0.0024
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   2.131E+00 0.2863  9.154E-04 0.0001  0.000E+00 0.0000  4.925E+00 0.6617  1.586E-01 0.0213  1.215E-01 0.0163  1.059E-01 0.0142
0
                        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
0                                                           Water Dependent Pathways
0               Water              Fish              Radon              Plant               Meat                Milk         All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.038E+00 0.4081
```

Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.405E+00	0.5919
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	7.443E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:28 Page 10
Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pb-210	1.132E-03	0.0002	6.373E-04	0.0001	0.000E+00	0.0000	2.718E+00	0.3653	9.293E-02	0.0125	4.528E-02	0.0061	8.552E-02	0.0115
Ra-226	2.129E+00	0.2861	2.777E-04	0.0000	0.000E+00	0.0000	2.206E+00	0.2965	6.573E-02	0.0088	7.626E-02	0.0102	2.034E-02	0.0027
Total	2.130E+00	0.2863	9.151E-04	0.0001	0.000E+00	0.0000	4.925E+00	0.6617	1.587E-01	0.0213	1.215E-01	0.0163	1.059E-01	0.0142

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
0 Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.944E+00	0.3956
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.498E+00	0.6044
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	7.442E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:28 Page 11
Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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
0 Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pb-210	1.063E-03	0.0001	5.986E-04	0.0001	0.000E+00	0.0000	2.553E+00	0.3434	8.728E-02	0.0117	4.253E-02	0.0057	8.033E-02	0.0108
Ra-226	2.127E+00	0.2861	3.159E-04	0.0000	0.000E+00	0.0000	2.368E+00	0.3184	7.127E-02	0.0096	7.892E-02	0.0106	2.547E-02	0.0034
Total	2.128E+00	0.2862	9.145E-04	0.0001	0.000E+00	0.0000	4.921E+00	0.6618	1.586E-01	0.0213	1.214E-01	0.0163	1.058E-01	0.0142

0

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.765E+00	0.3718
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.671E+00	0.6282
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	7.436E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:28 Page 12
Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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

0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Pb-210	8.537E-04	0.0001	4.807E-04	0.0001	0.000E+00	0.0000	2.050E+00	0.2765	7.009E-02	0.0095	3.415E-02	0.0046	6.451E-02	0.0087
Ra-226	2.121E+00	0.2860	4.316E-04	0.0001	0.000E+00	0.0000	2.859E+00	0.3854	8.807E-02	0.0119	8.696E-02	0.0117	4.106E-02	0.0055
Total	2.122E+00	0.2861	9.124E-04	0.0001	0.000E+00	0.0000	4.909E+00	0.6619	1.582E-01	0.0213	1.211E-01	0.0163	1.056E-01	0.0142

0

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.220E+00	0.2994
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.196E+00	0.7006
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	7.416E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:28 Page 13
Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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

0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ
Pb-210	4.562E-04	0.0001	2.569E-04	0.0000	0.000E+00	0.0000	1.096E+00	0.1489	3.745E-02	0.0051	1.825E-02	0.0025	3.447E-02	0.0047
Ra-226	2.102E+00	0.2858	6.487E-04	0.0001	0.000E+00	0.0000	3.775E+00	0.5132	1.195E-01	0.0162	1.019E-01	0.0138	7.034E-02	0.0096
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Total	2.103E+00	0.2858	9.056E-04	0.0001	0.000E+00	0.0000	4.871E+00	0.6621	1.570E-01	0.0213	1.201E-01	0.0163	1.048E-01	0.0142

0

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

0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.186E+00	0.1613
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.170E+00	0.8387
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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	7.357E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T« Limit = 180 days 04/10/2013 14:28 Page 14
Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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

0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ
Pb-210	5.088E-05	0.0000	2.865E-05	0.0000	0.000E+00	0.0000	1.222E-01	0.0171	4.177E-03	0.0006	2.035E-03	0.0003	3.844E-03	0.0005
Ra-226	2.038E+00	0.2856	8.504E-04	0.0001	0.000E+00	0.0000	4.604E+00	0.6452	1.481E-01	0.0208	1.145E-01	0.0160	9.792E-02	0.0137
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ
Total	2.038E+00	0.2856	8.790E-04	0.0001	0.000E+00	0.0000	4.726E+00	0.6624	1.523E-01	0.0213	1.165E-01	0.0163	1.018E-01	0.0143

0

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

0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.323E-01	0.0185
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.003E+00	0.9815

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 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  7.136E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:28  Page  15
 Summary : Painsville Site Average Residential Use - Subsistence Farmer
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 Pb-210  9.655E-08 0.0000  5.437E-08 0.0000  0.000E+00 0.0000  2.319E-04 0.0000  7.928E-06 0.0000  3.863E-06 0.0000  7.296E-06 0.0000
 Ra-226  1.863E+00 0.2855  8.037E-04 0.0001  0.000E+00 0.0000  4.321E+00 0.6624  1.393E-01 0.0213  1.065E-01 0.0163  9.304E-02 0.0143
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 Total   1.863E+00 0.2855  8.038E-04 0.0001  0.000E+00 0.0000  4.322E+00 0.6624  1.393E-01 0.0213  1.065E-01 0.0163  9.305E-02 0.0143
0
                        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
0                                                 Water Dependent Pathways
0             Water             Fish              Radon            Plant            Meat             Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.511E-04 0.0000
 Ra-226  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  6.524E+00 1.0000
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 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  6.524E+00 1.0000
0*Sum of all water independent and dependent pathways.
1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:28  Page  16
 Summary : Painsville Site Average Residential Use - Subsistence Farmer
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.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
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk             Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
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 Pb-210  2.875E-17 0.0000  1.619E-17 0.0000  0.000E+00 0.0000  6.905E-14 0.0000  2.361E-15 0.0000  1.150E-15 0.0000  2.172E-15 0.0000
 Ra-226  1.361E+00 0.2855  5.872E-04 0.0001  0.000E+00 0.0000  3.157E+00 0.6624  1.017E-01 0.0213  7.783E-02 0.0163  6.798E-02 0.0143
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 Total   1.361E+00 0.2855  5.872E-04 0.0001  0.000E+00 0.0000  3.157E+00 0.6624  1.017E-01 0.0213  7.783E-02 0.0163  6.798E-02 0.0143
0
```

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

0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.478E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.766E+00	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	4.766E+00	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : Painsville Site Average Residential Use - Subsistence Farmer
File : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 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
Pb-210+D	Pb-210+D	1.000E+00	6.750E+00	6.542E+00	6.145E+00	4.934E+00	2.637E+00	2.941E-01	5.581E-04	1.662E-13
0Ra-226+D	Ra-226+D	1.000E+00	9.664E+00	9.660E+00	9.651E+00	9.621E+00	9.535E+00	9.240E+00	8.447E+00	6.171E+00
Ra-226+D	Pb-210+D	1.000E+00	1.259E-01	3.358E-01	7.296E-01	1.926E+00	4.176E+00	6.323E+00	6.050E+00	4.421E+00
Ra-226+D	äDSR(j)		9.790E+00	9.995E+00	1.038E+01	1.155E+01	1.371E+01	1.556E+01	1.450E+01	1.059E+01

The DSR includes contributions from associated (half-life ó 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (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
Pb-210	3.704E+00	3.821E+00	4.069E+00	5.067E+00	9.482E+00	8.502E+01	4.480E+04	*7.634E+13
Ra-226	2.554E+00	2.501E+00	2.408E+00	2.165E+00	1.823E+00	1.606E+00	1.724E+00	2.360E+00

*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

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pb-210	4.500E-01	0.000E+00	6.750E+00	3.704E+00	6.750E+00	3.704E+00
Ra-226	4.500E-01	108.6 ñ 0.2	1.557E+01	1.605E+00	9.790E+00	2.554E+00

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1RESRAD, Version 6.5      T« Limit = 180 days        04/10/2013  14:28  Page  18
 Summary : Painsville Site Average Residential Use - Subsistence Farmer
 File    : E:\FUSRAP\PAINSVILLE\RESRAD-FILES\PAINESVILLE-SUB-SITE-AVG-APR11.RAD

                              Individual Nuclide Dose Summed Over All Pathways
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
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 Pb-210  Pb-210  1.000E+00    3.038E+00 2.944E+00 2.765E+00 2.220E+00 1.186E+00 1.323E-01 2.511E-04 7.478E-14
 Pb-210  Ra-226  1.000E+00    5.665E-02 1.511E-01 3.283E-01 8.666E-01 1.879E+00 2.845E+00 2.723E+00 1.989E+00
 Pb-210  äDOSE(j)             3.094E+00 3.095E+00 3.093E+00 3.087E+00 3.066E+00 2.978E+00 2.723E+00 1.989E+00
0Ra-226  Ra-226  1.000E+00    4.349E+00 4.347E+00 4.343E+00 4.329E+00 4.291E+00 4.158E+00 3.801E+00 2.777E+00
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 THF(i) is the thread fraction of the parent nuclide.


                                 Individual Nuclide Soil Concentration
                                Parent Nuclide and Branch Fraction Indicated
0Nuclide 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
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 Pb-210  Pb-210  1.000E+00    4.500E-01 4.361E-01 4.096E-01 3.289E-01 1.758E-01 1.960E-02 3.720E-05 1.108E-14
 Pb-210  Ra-226  1.000E+00    0.000E+00 1.377E-02 4.002E-02 1.198E-01 2.699E-01 4.133E-01 3.958E-01 2.892E-01
 Pb-210  äS(j):               4.500E-01 4.499E-01 4.496E-01 4.487E-01 4.457E-01 4.329E-01 3.958E-01 2.892E-01
0Ra-226  Ra-226  1.000E+00    4.500E-01 4.498E-01 4.494E-01 4.480E-01 4.440E-01 4.303E-01 3.934E-01 2.874E-01
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 THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =    0.71 seconds
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