CSX TRANSPORTATION

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File: MI, Livonia
Inkster Road
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September 13, 2000

Mr. Bruce Jorgensen
Chief of Decommissioning Branch
Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60543

Request for Closure Determination

Dear Mr. Jorgensen:

Enclosed is the RESRAD Modeling Report prepared for the CSX Transportation, Inc. (CSXT) site in Livonia, Michigan. The CSXT site is located adjacent to the AAR Manufacturing, Inc. (AAR) facility formerly licensed by the Atomic Energy Commission to use radioactive thorium in on-site manufacturing processes. The AAR facility was located at 12633 Inkster Road in Livonia, Michigan, and the CSXT right-of-way is located adjacent to the south of the AAR facility.

As presented in the attached document, the results of the RESRAD modeling demonstrate that the CSXT site does not exceed the total dose exposure standard of 25 millirem per year (mrem/yr) referenced in Title 10 of the Code of Federal Regulations, Part 20, Appendix E (10 CFR 20, App. E). Thus, CSXT requests the Nuclear Regulatory Commission (NRC) make a determination to that effect in writing.

Our environmental consultant, ARCADIS Geraghty & Miller, completed the RESRAD modeling and summary report. Therefore, CSXT requests that you contact Mr. Gary Blinkiewicz of ARCADIS Geraghty & Miller directly at (248) 305-9400 with any questions and/or comments you may have during your review of this document.

Very truly yours,

Paul J. Kurzanski
Director Environmental Remediation

Attachment

cc: Mr. Gary Blinkiewicz, ARCADIS Geraghty & Miller – 41511 Eleven Mile Rd., Novi, MI 48375
Mr. C. Keith Meiser, Senior Counsel - CSXT

ARCADIS
GERAGHTY & MILLER

**Refined RESRAD Modeling Report**

Inkster Road Site
Livonia, Michigan
CSXT 9717003;
ENV993955PJKK

**PREPARED FOR**

CSX Transportation, Inc.

ARCADIS GERAGHTY&MILLER

Katherine A. Panczak
Project Engineer

Scott Potter, Ph.D.
Senior Scientist

# Refined RESRAD Modeling Report

Inkster Road Site
Livonia, Michigan
CSXT 9717003;
ENV993955PJKK

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15 August 2000

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11 Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, All Pathways Considered, and Assumed Industrial Use With No Soil Cover.

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## Introduction

On behalf of CSX Transportation, Inc. (CSXT), ARCADIS Geraghty & Miller conducted a refined analysis of thorium impacts at the CSXT site located in Livonia, Michigan. The refined analysis was completed for the following reasons:

- To evaluate the total dose exposure represented by the site.
- To evaluate whether the thorium-impacted soil can be left in place without exceeding the Nuclear Regulatory Commission (NRC) guideline concentrations.

The maximum-acceptable total site dose exposure established by the NRC is 25 millirem per year (mrem/year).

Consistent with NRC guidance, ARCADIS Geraghty & Miller completed an initial analysis of the site in October 1999 using the NRC-approved RESRAD (RESidual RADioactivity) model and conservative site assumptions based on four samples collected in June 1999. The results of the initial modeling indicated a potential that site conditions could slightly exceed the NRC dose exposure threshold. Because the original four samples were biased toward site hot spots, ARCADIS Geraghty & Miller contacted the NRC and received additional guidance to refine the analysis to be more representative of general site conditions. Based on the NRC's direction, ten additional samples were collected in November 1999, and a more refined analysis was conducted.

ARCADIS Geraghty & Miller completed the refined site analysis using the expanded soil database and the updated version of the computer code RESRAD (Yu et al., Ver. 5.95 11/99), the results of which indicated that the total dose exposure represented by this site does not exceed 25 millirem (mrem/yr). Thus, no remedial action, site restriction, or other similar activity is required at this site.

## Site Background

The CSXT site is located adjacent to the south of the AAR Manufacturing, Inc. (AAR) property in Livonia, Michigan (see Figure 1). AAR purchased the property in 1981 from the Brooks and Perkins Corporation, a corporation that was licensed by the Atomic Energy Commission to use radioactive thorium in on-site manufacturing processes. In March 1994, the NRC informed AAR that radioactive impacts had been detected at the site and requested that AAR complete follow-up remedial activities. In a June 12, 1997 letter, the NRC informed CSXT that radioactive impacts related to the AAR site were believed to be present on the CSXT site.

## Radiometric Survey

In February 1998, ARCADIS Geraghty & Miller completed field-screening activities at the site to evaluate potential radioactivity. Total alpha, beta, and gamma count field-screening measurements were obtained at approximately 5-foot intervals within a rectangular grid that overlaid the thorium investigation area (1,210 feet in length and 38 feet in width) (see Figure 2). The measurements indicated above-background levels of radioactivity were present in the upper 1.5 feet of soil at various points in the grid.

A detailed summary of the February 1998 field screening radiometric survey was presented to CSXT in a June 5, 1998 ARCADIS Geraghty & Miller Results of the Radiometric Survey letter report, and the measurements recorded during this screening event are presented on Figures 3 through 4E. As can be seen on these figures, no distinct patterns of total alpha, beta, and gamma counts were observed at the site, and the field screening measurements were noted to be variable throughout the site. This random pattern of field measurements is consistent with thorium impacts from atmospheric deposition, with the source being the vents at the adjacent AAR former thorium manufacturing facility.

## Site Characterization

A numerical distribution of February 1998 field-screening measurement of total alpha, beta, and gamma activity counts is presented on the graph attached as Figure 5. Consistent with the NRC guidance, the initial site characterization dataset was designed to be conservatively biased. Therefore, in June 1999, isotopic thorium sample collection was completed at sample points where the field sample activity count measurements were 31, 48, 64, and 72 microroentgen per hour (uR/hr). As can be seen on Figure 5, however, the majority of site field-screening measurements were recorded between approximately 5 and 20 uR/hr. Thus, when the initial modeling results (using the conservative analytical data set) indicated site conditions slightly exceeded the NRC total site dose exposure limit, ARCADIS Geraghty & Miller completed a subsequent sampling event in November 1999 and collected ten additional site samples from areas more representative of the total site impacts (with field sample activity count measurements from 5 to 20 uR/hr). In general, the November 1999 sampling event consisted of collecting a sample approximately every 150 feet along a traverse running the length of the site. The sample collection locations for both sampling events are shown on Figure 6.

During each of the two sampling events, ARCADIS Geraghty & Miller scanned the soils prior to sample collection. To ensure the appropriate site areas were sampled, the same field instrument model used during the February 1998 field-screening survey was used during both 1999 sampling events (Victoreen Survey and Count Meter Model 190 fitted with a Victoreen GM Probe Model RP-1). The soil samples collected in June 1999 were submitted to Core Laboratories of Casper Wyoming for isotopic thorium analysis. Due to the closure of the Core Laboratory facility in October 1999, the soil samples collected in November 1999 were submitted to Severn Trent Laboratories (STL) in Whippany, New Jersey for isotopic thorium analysis. The analytical results for both sampling events are summarized in Table 1.

## Model Construction

The computer program RESRAD was used to evaluate this site. RESRAD was designed specifically for the implementation of the United States Department of Energy requirements for radioactive material. Using site-specific input parameters, RESRAD evaluates potential human exposure to radiation through various pathways including direct exposure, inhalation, and ingestion through air, surface water, groundwater, soil, and food (plants and meat) over a 1,000-year period.

Site-specific parameters, initial site concentrations of radioisotopes (in picoCuries per gram [pCi/g]) and a maximum allowable exposure (25 mrem/yr total from all radioisotopes) are input to the program. The program evaluates each pathway and calculates the exposure resulting from the initial impact levels observed at the site. The program then calculates the concentration of radioisotopes (pCi/g) that would need to exist initially at the site to result in exactly the maximum exposure which becomes the guideline concentrations. The guideline concentration can be compared with site measurements to determine whether site activities are necessary to reduce and/or prevent exposure.

The RESRAD model constructed for the CSXT site required several site-specific parameters to characterize the area of impacts and the site conditions. Parameter values were based on site-specific data, where available; otherwise, RESRAD default parameter values were used. ARCADIS Geraghty & Miller utilized the following site-specific RESRAD input parameters for the model:

- The volume of impacted soil was delineated as a 1,210-foot by 38-foot rectangle extending 1.5 feet in depth from the ground surface, based on the February 1998 field-screening survey.

- The radioactive material was assumed to have been placed at least 15 years ago, based on the known site history.
- Simulations were performed for 1,000 years, based on the NRC requirements.
- The amount of precipitation percolating into the ground was set at 4 inches per year, based on groundwater modeling studies in the area.
- Surface water was not assumed to leave the site as run-off, based on the site topography and field observations.
- No significant level of erosion was assumed to occur at the site, based on the site topography and field observations.
- The following three thorium isotopes were included in the analysis: thorium-228, thorium-230, and thorium-232, based on the known site source.

As part of the refined analysis, the entire grid area was modeled in RESRAD with the initial thorium isotope concentrations based on the average of the November 1999 samples (see Table 1). The sampling event in June specifically targeted locations with the highest activity; thus, simulations performed using those thorium concentrations are extremely conservatively biased because they assume the high activity counts are uniformly present across the site. Alternately, the November 1999 sampling event was designed to develop a data set characteristic of the total site. Therefore, simulations performed with the initial thorium concentrations based on the average November 1999 sampling results provide the most accurate representation of the total site dose exposure.

## Model Results

To account for various assumptions about the potential future use of the site, several alternatives were evaluated using the RESRAD model. The assumptions can be divided into three categories: site zoning, soil cover thickness, and site vegetation. Two alternatives are presented for each category of assumption.

### Site Zoning

The alternatives considered for the site zoning are based on the assumption that the site could be used in the future either for industrial or residential use. The model input data

that vary between the alternatives are the length and type of daily exposure. If the site is maintained as an industrial facility, the potential daily exposure for any single person can be limited to eight hours of outdoor exposure. If the site is rezoned as residential, the daily exposure for a single person will be increased to twelve hours of indoor exposure and six hours of outdoor exposure. The additional indoor exposure will affect guidance concentrations because radon, which is a decay product of thorium-230 and thorium-232, will accumulate in a building and cause additional long-term exposure to radiation. In the outdoor case, the wind will mix the radon with the surrounding clean air and result in lower levels of exposure.

#### Soil Cover

The presence of non-impacted cover soil will reduce exposure to direct radiation and also reduce exposure along inhalation and soil ingestion pathways. Two cases were assessed in the analysis—no cover and 6 inches of cover. In general, impacts at the site are present at the surface or within the first 6 inches of the soil column.

#### Site Vegetation

One of the exposure pathways evaluated by RESRAD is the ingestion of plants growing in the area of contamination. The first alternative included plant ingestion by humans as an exposure pathway. However, because it is unlikely the site will be zoned for agricultural use, plant ingestion is probably not a relevant pathway. Therefore, a second alternative was modeled in which plant ingestion was excluded from the simulation.

#### Results Summary

Table 2 summarizes the guideline concentrations for each thorium isotope calculated by the RESRAD model for each alternative considered in the analysis. As can be seen by comparing the average site concentration with the calculated guideline concentrations, the average site concentrations do not exceed any guideline concentrations under site use scenario.

In addition, ARCADIS Geraghty & Miller has included graphical representations of the total site dose exposures calculated during the model simulations. Figures 7 through 14 present the simulated dose exposure rates over 1,000 years using the averages of the November 1999 data set as the initial thorium concentrations. As is

shown in Figures 7 through 14, the total site dose exposure rates do not approach 25 mrem/yr for any future site use alternative.

## Conclusions

The modeling results demonstrate that neither remedial measures nor restrictions in site usage are required at this site. The total site dose exposure does not exceed the NRC acceptable exposure criteria of 25 mrem/yr.

ARCADIS GERAGHTY & MILLER



Table 1. Thorium Isotope Concentrations Measured in June and November 1999 at the CSX Site, Livonia, Michigan.

| Sample ID | Date Sampled | Thorium Concentration (pCi/g) Th-228 | Th-230 | Th-232 |
|---|---|---|---|---|
| **Conservative Samples** | | | | |
| S-1 54 | Jun-99 | 2.4 ± 0.6 | 6.0 ± 1.3 | 2.6 ± 0.7 |
| S-2 54 | Jun-99 | 12.8 ± 3.0 | 19.9 ± 4.5 | 12.0 ± 2.8 |
| S-3 32 | Jun-99 | 0.5 ± 0.3 | 1.2 ± 0.4 | 0.2 ± 0.2 |
| S-4 56 | Jun-99 | 21.8 ± 6.6 | 45.2 ± 13.3 | 22.8 ± 6.8 |
| **Representative Site Samples** | | | | |
| E2 11 | Nov-99 | -0.01 ± 0.13[1] | 0.27 ± 0.16 | 0.05 ± 0.07 |
| E32 9.9 | Nov-99 | 0.17 ± 0.13 | 0.29 ± 0.16 | 0.04 ± 0.05 |
| E46 20.2 | Nov-99 | 0.16 ± 0.23 | 0.37 ± 0.20 | 0.13 ± 0.14 |
| E62 8.6 | Nov-99 | 0.37 ± 0.15 | 0.34 ± 0.17 | 0.09 ± 0.07 |
| E82 12.7 | Nov-99 | 0.22 ± 0.16 | 0.73 ± 0.24 | 0.21 ± 0.13 |
| E122 13.3 | Nov-99 | 0.20 ± 0.12 | 0.55 ± 0.20 | 0.36 ± 0.15 |
| E132 7.6 | Nov-99 | 0.04 ± 0.10 | 0.21 ± 0.12 | 0.10 ± 0.07 |
| E162 16.1 | Nov-99 | 0.02 ± 0.13 | 0.27 ± 0.12 | 0.11 ± 0.08 |
| E212 25 | Nov-99 | 0.26 ± 0.14 | 0.41 ± 0.16 | 0.21 ± 0.11 |
| E232 16.1 | Nov-99 | 0.28 ± 0.18 | 0.79 ± 0.27 | 0.16 ± 0.11 |
| **Average of November 1999 Samples** | | 0.171 | 0.423 | 0.146 |
| **Average of All Samples** | | 2.8 | 5.47 | 2.79 |

Notes:

1 Negative value indicates that the sample has less activity than the instrument background.
pCi/g PicoCuries per gram.
Th-228 Thorium-228
Th-230 Thorium-230
Th-232 Thorium-232

Table 2. RESRAD-calculated Guidance Concentrations for Acceptable Dose Exposure, Inkster Road, Livonia, Michigan.

| Model Simulation Assumptions | Thorium Isotope | Guidance Concentration (pCi/g) | | | |
|---|---|---|---|---|---|
| | | Industrial Use[1] | | Residential Use[2] | |
| | | No Soil Cover | 6 inches Cover | No Soil Cover | 6 inches Cover |
| All Exposure Pathways (Plant Ingestion Included) | $Th^{228}$ | 18.30 | 103.30 | 9.64 | 60.20 |
| | $Th^{230}$ | 19.99 | 26.28 | 2.77 | 2.95 |
| | $Th^{232}$ | 4.64 | 8.12 | 3.26 | 7.42 |
| No Plant Ingestion | $Th^{228}$ | 18.71 | 117.90 | 9.75 | 64.87 |
| | $Th^{230}$ | 71.16 | 480.30 | ~~480.30~~ 3.08 | 3.29 |
| | $Th^{232}$ | 9.18 | 60.63 | ~~60.63~~ 5.00 | 35.58 |

Notes:

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$Th^{228}$ Thorium-228 isotope.
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1 Industrial use assumes 8 hours of outdoor exposure per day.
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Areas shaded in gray represent alternatives where the average November 1999 site sample results are below guidance concentrations for all isotopes present.

ARCADIS

*Infrastructure, environment, buildings*

**Refined RESRAD Modeling Report**

Inkster Road Site
Livonia, Michigan
CSXT 9717003;
ENV993955PJKK

**PREPARED FOR**

CSX Transportation, Inc.

ARCADIS

# Refined RESRAD Modeling Report

Inkster Road Site
Livonia, Michigan
CSXT 9717003;
ENV993955PJKK

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Project Engineer

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Senior Scientist

Prepared for:
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Our Ref.:
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Date:
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## Model Construction

The computer program RESRAD was used to evaluate this site. RESRAD was designed specifically for the implementation of the United States Department of Energy requirements for radioactive material. Using site-specific input parameters, RESRAD evaluates potential human exposure to radiation through various pathways including direct exposure, inhalation, and ingestion through air, surface water, groundwater, soil, and food (plants and meat) over a 1,000-year period.

Site-specific parameters, initial site concentrations of radioisotopes (in picoCuries per gram [pCi/g]) and a maximum allowable exposure (25 mrem/yr total from all radioisotopes) are input to the program. The program evaluates each pathway and calculates the exposure resulting from the initial impact levels observed at the site. The program then calculates the concentration of radioisotopes (pCi/g) that would need to exist initially at the site to result in exactly the maximum exposure which becomes the guideline concentrations. The guideline concentration can be compared with site measurements to determine whether site activities are necessary to reduce and/or prevent exposure.

The RESRAD model constructed for the CSXT site required several site-specific parameters to characterize the area of impacts and the site conditions. Parameter values were based on site-specific data, where available; otherwise, RESRAD default parameter values were used. ARCADIS Geraghty & Miller utilized the following site-specific RESRAD input parameters for the model:

- The volume of impacted soil was delineated as a 1,210-foot by 38-foot rectangle extending 1.5 feet in depth from the ground surface, based on the February 1998 field-screening survey.

- The radioactive material was assumed to have been placed at least 15 years ago, based on the known site history.
- Simulations were performed for 1,000 years, based on the NRC requirements.
- The amount of precipitation percolating into the ground was set at 4 inches per year, based on groundwater modeling studies in the area.
- Surface water was not assumed to leave the site as run-off, based on the site topography and field observations.
- No significant level of erosion was assumed to occur at the site, based on the site topography and field observations.
- The following three thorium isotopes were included in the analysis: thorium-228, thorium-230, and thorium-232, based on the known site source.

As part of the refined analysis, the entire grid area was modeled in RESRAD with the initial thorium isotope concentrations based on the average of the November 1999 samples (see Table 1). The sampling event in June specifically targeted locations with the highest activity; thus, simulations performed using those thorium concentrations are extremely conservatively biased because they assume the high activity counts are uniformly present across the site. Alternately, the November 1999 sampling event was designed to develop a data set characteristic of the total site. Therefore, simulations performed with the initial thorium concentrations based on the average November 1999 sampling results provide the most accurate representation of the total site dose exposure.

## Model Results

To account for various assumptions about the potential future use of the site, several alternatives were evaluated using the RESRAD model. The assumptions can be divided into three categories: site zoning, soil cover thickness, and site vegetation. Two alternatives are presented for each category of assumption.

### Site Zoning

The alternatives considered for the site zoning are based on the assumption that the site could be used in the future either for industrial or residential use. The model input data

that vary between the alternatives are the length and type of daily exposure. If the site is maintained as an industrial facility, the potential daily exposure for any single person can be limited to eight hours of outdoor exposure. If the site is rezoned as residential, the daily exposure for a single person will be increased to twelve hours of indoor exposure and six hours of outdoor exposure. The additional indoor exposure will affect guidance concentrations because radon, which is a decay product of thorium-230 and thorium-232, will accumulate in a building and cause additional long-term exposure to radiation. In the outdoor case, the wind will mix the radon with the surrounding clean air and result in lower levels of exposure.

#### Soil Cover

The presence of non-impacted cover soil will reduce exposure to direct radiation and also reduce exposure along inhalation and soil ingestion pathways. Two cases were assessed in the analysis—no cover and 6 inches of cover. In general, impacts at the site are present at the surface or within the first 6 inches of the soil column.

#### Site Vegetation

One of the exposure pathways evaluated by RESRAD is the ingestion of plants growing in the area of contamination. The first alternative included plant ingestion by humans as an exposure pathway. However, because it is unlikely the site will be zoned for agricultural use, plant ingestion is probably not a relevant pathway. Therefore, a second alternative was modeled in which plant ingestion was excluded from the simulation.

#### Results Summary

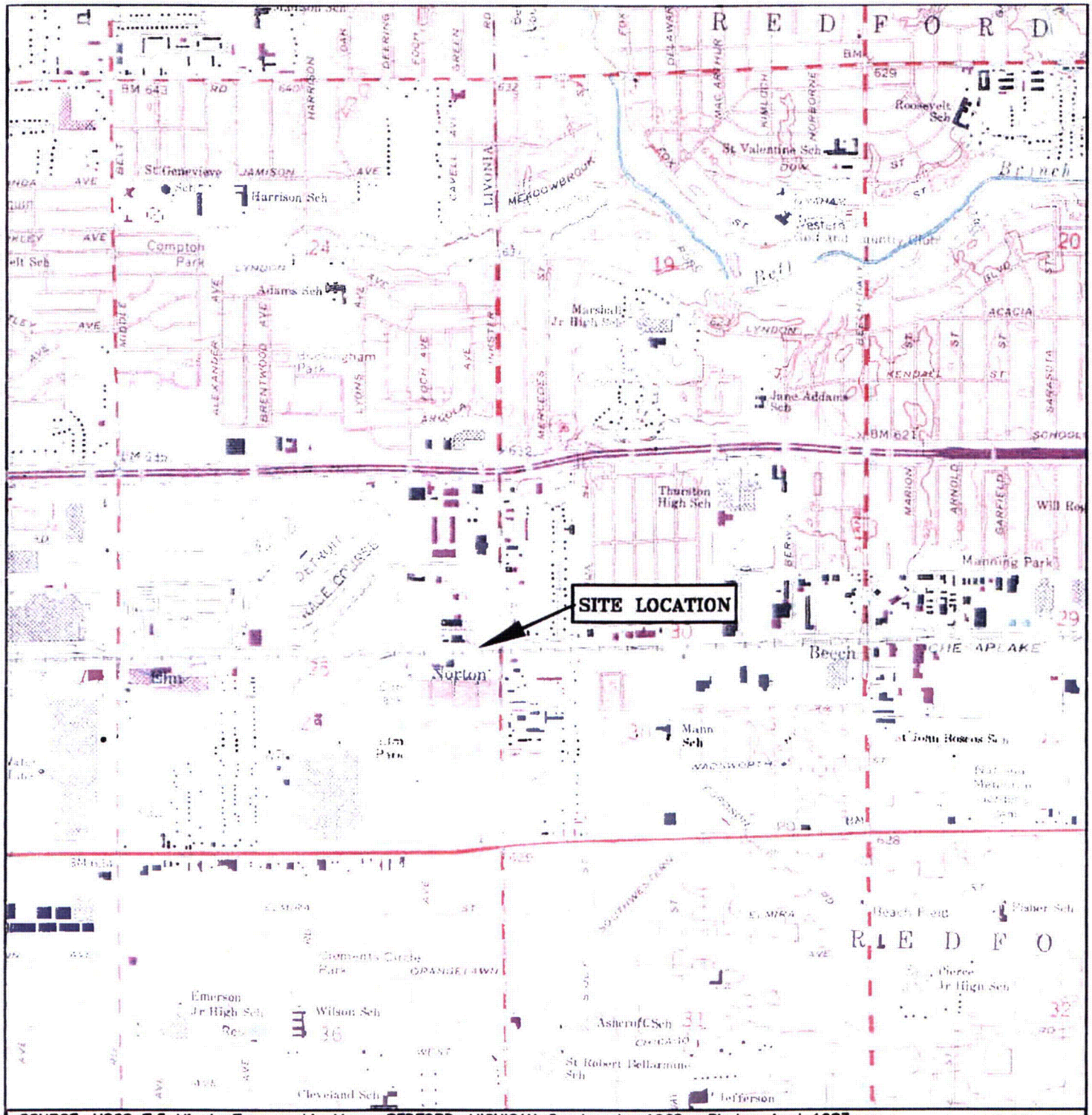
Table 2 summarizes the guideline concentrations for each thorium isotope calculated by the RESRAD model for each alternative considered in the analysis. As can be seen by comparing the average site concentration with the calculated guideline concentrations, the average site concentrations do not exceed any guideline concentrations under site use scenario.

In addition, ARCADIS Geraghty & Miller has included graphical representations of the total site dose exposures calculated during the model simulations. Figures 7 through 14 present the simulated dose exposure rates over 1,000 years using the averages of the November 1999 data set as the initial thorium concentrations. As is

shown in Figures 7 through 14, the total site dose exposure rates do not approach 25 mrem/yr for any future site use alternative.

## Conclusions

The modeling results demonstrate that neither remedial measures nor restrictions in site usage are required at this site. The total site dose exposure does not exceed the NRC acceptable exposure criteria of 25 mrem/yr.




SOURCE: USGS 7.5 Minute Topographic Maps, REDFORD, MICHIGAN Quadrangle, 1968. Photorevised 1983.
USGS 7.5 Minute Topographic Maps, INKSTER, MICHIGAN Quadrangle, 1968. Photorevised 1983.

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SCALE IN FEET

SITE LOCATION

ARCADIS GERAGHTY&MILLER

SITE LOCATION MAP
CSX TRANSPORTATION
CSXT 9717003; ENV993955PJKK
INKSTER ROAD SITE
LIVONIA, MICHIGAN

| DATE 30MAY00 | PROJECT MANAGER K. PANEZAK | DRAWING NAME TOPO |
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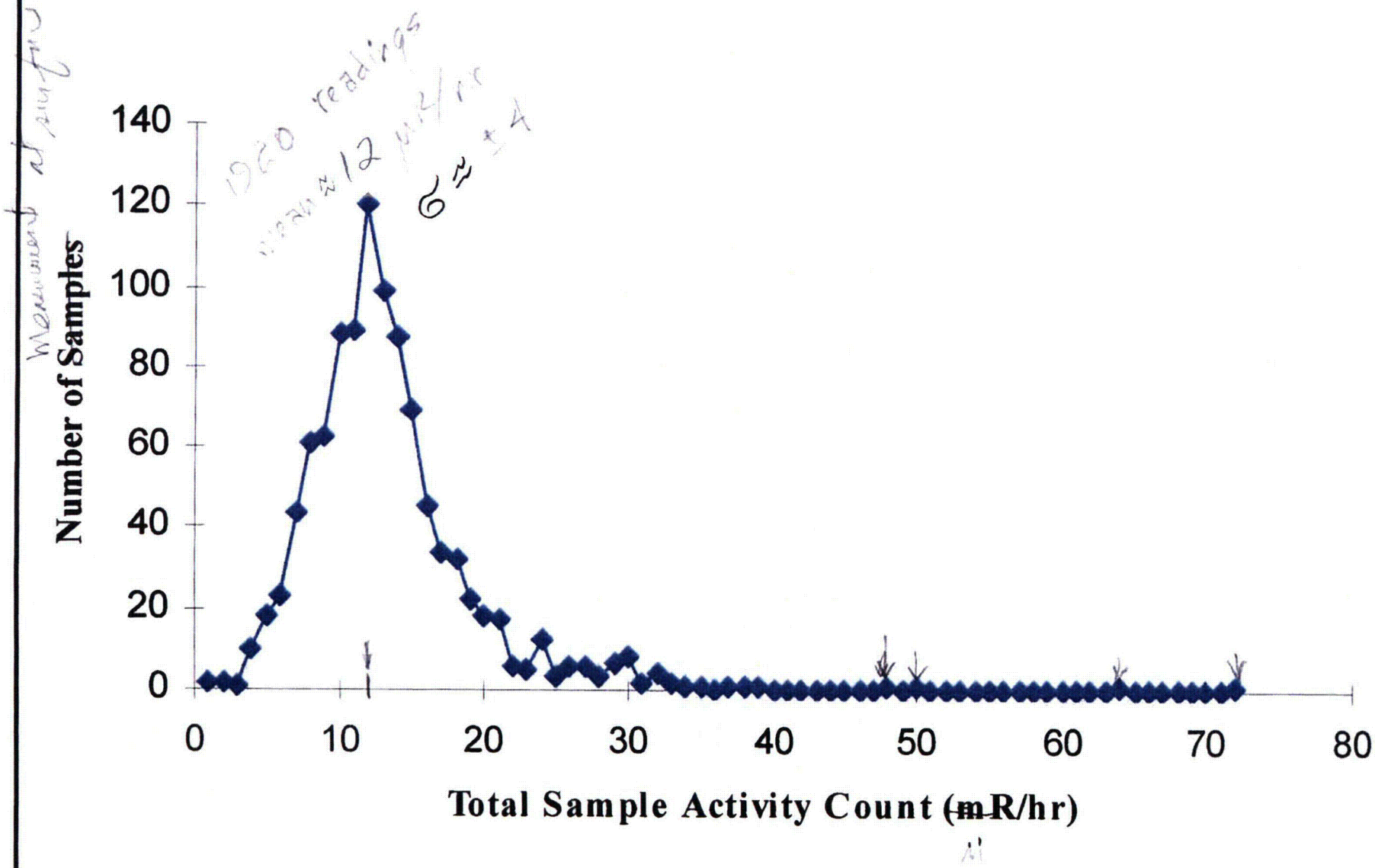
| DRAWN S. JERG | LEAD DESIGN PROF. | CHECKED S. JERG |
| PROJECT NUMBER MI000703.003.00001 | | FIGURE NUMBER 1 |

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DISTRIBUTION OF FEBRUARY 1998
FIELD-SCREENING MEASUREMENTS
CSX TRANSPORTATION
CSXT 9717003; ENV993955PJKK
INKSTER ROAD SITE
LIVONIA, MICHIGAN

| DATE | PROJECT MANAGER | DRAWING NAME |
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| 30MAY00 | K. PANCZAK | GRAPH |
| DRAWN | LEAD DESIGN PROF. | CHECKED |
| S. JENIC | | K. PANCZAK |
| PROJECT NUMBER | | FIGURE NUMBER |
| MI000703.0003.00001 | | 5 |

Figure 7. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, All Pathways Considered, and Assumed Residential Use With No Soil Cover.

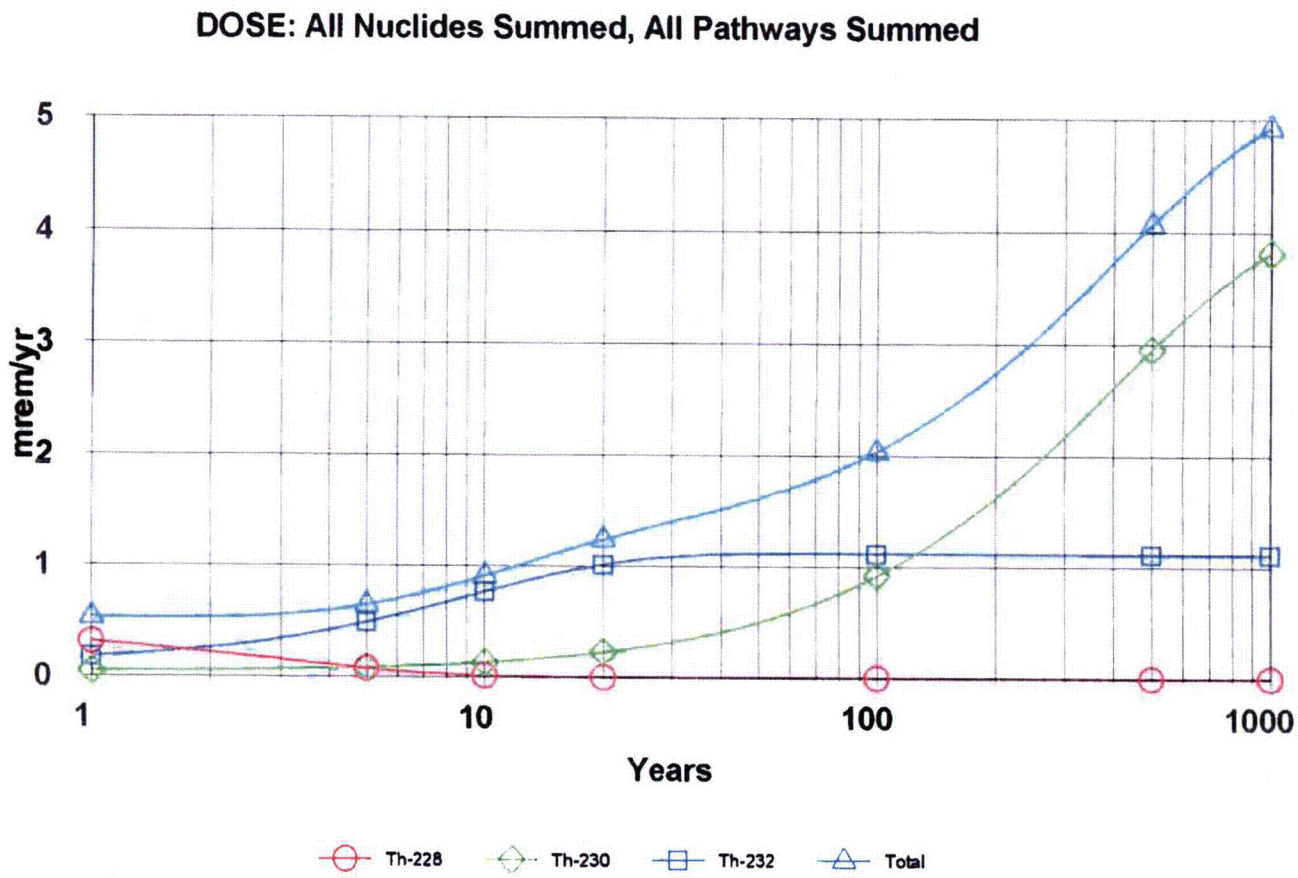

Figure 8. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, All Pathways Considered, and Assumed Residential Use With 6-inch Soil Cover.

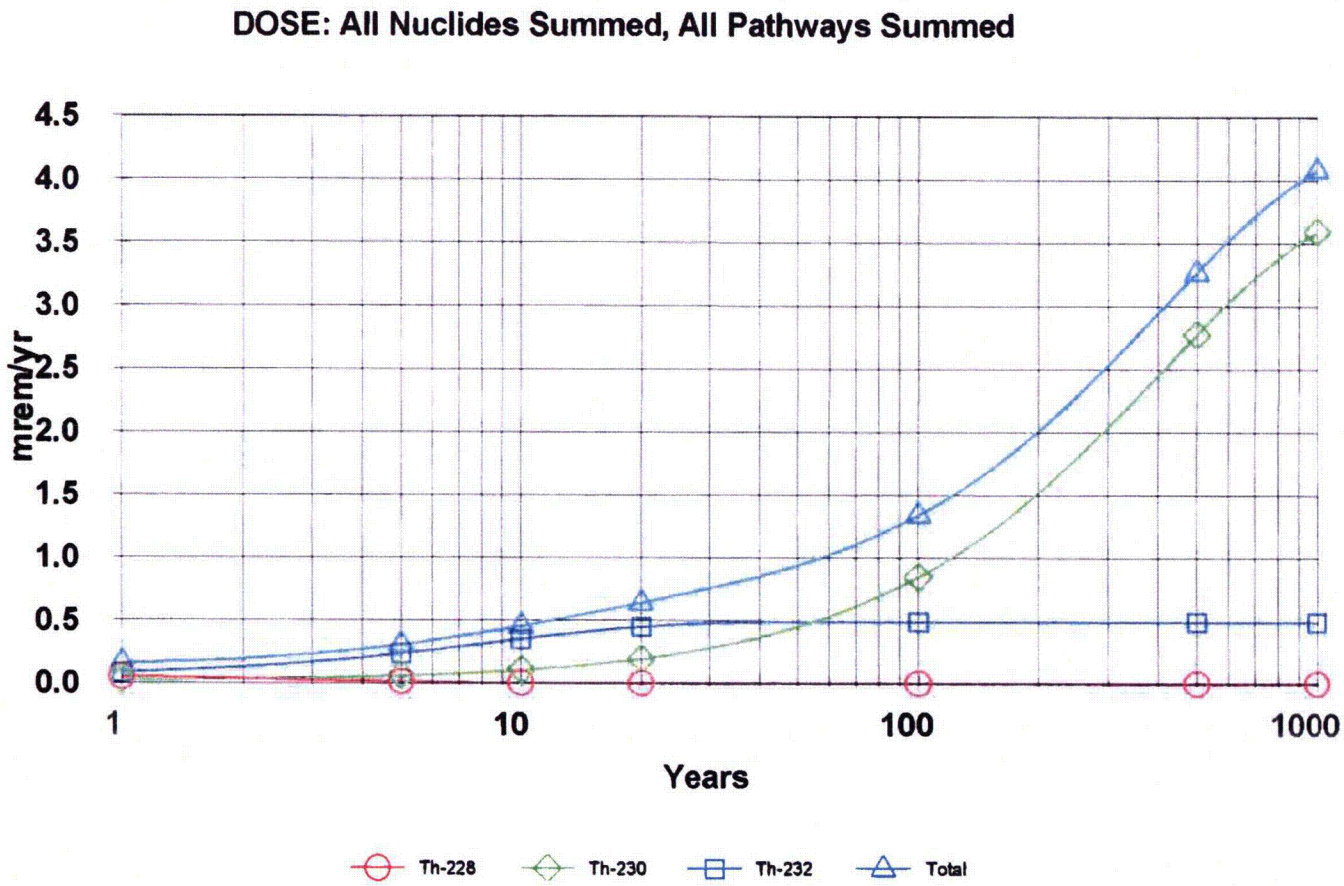

Figure 9. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, No Plant Ingestion, and Assumed Residential Use With No Soil Cover.

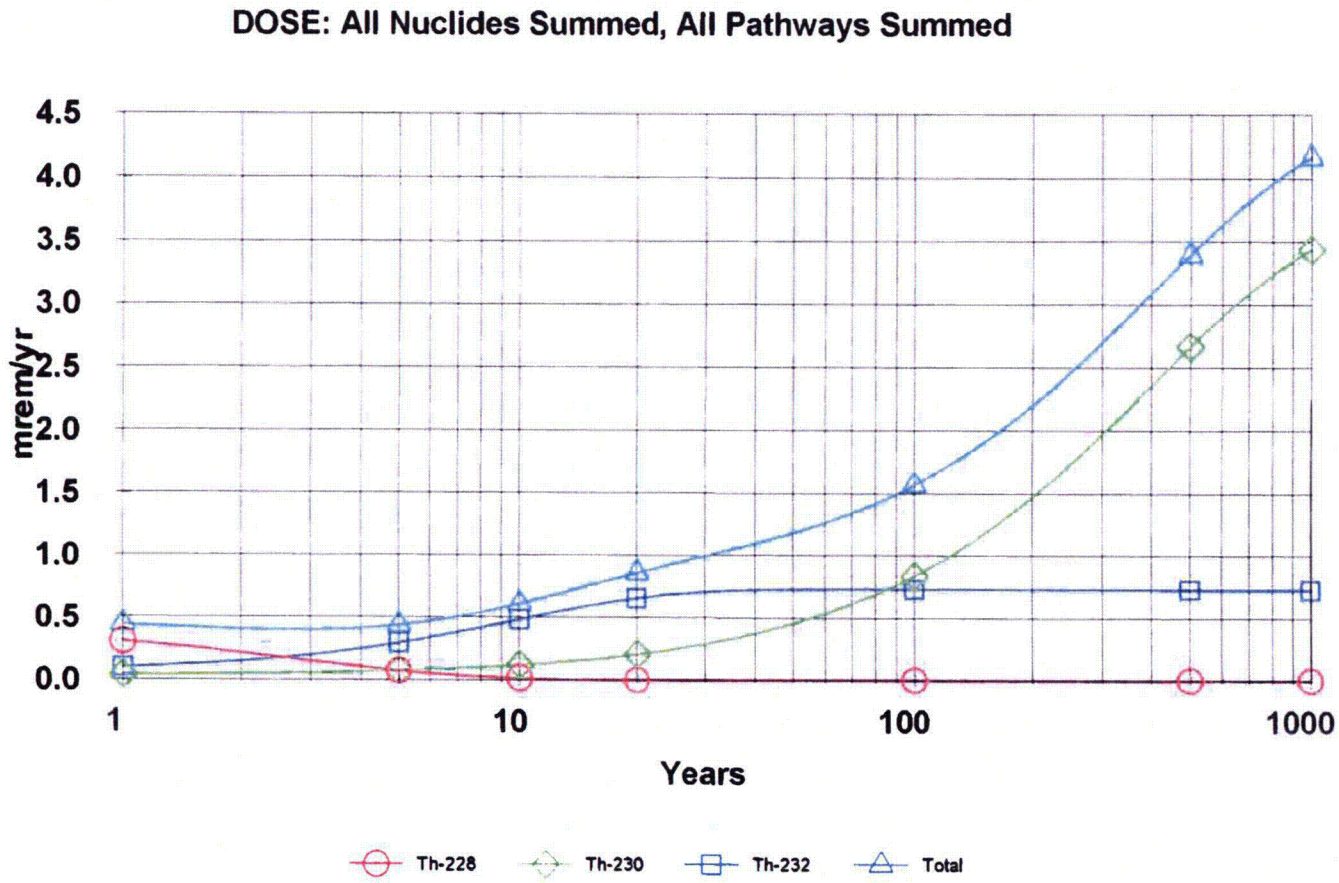

Figure 10. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, No Plant Ingestion, and Assumed Residential Use With 6-inch Soil Cover.

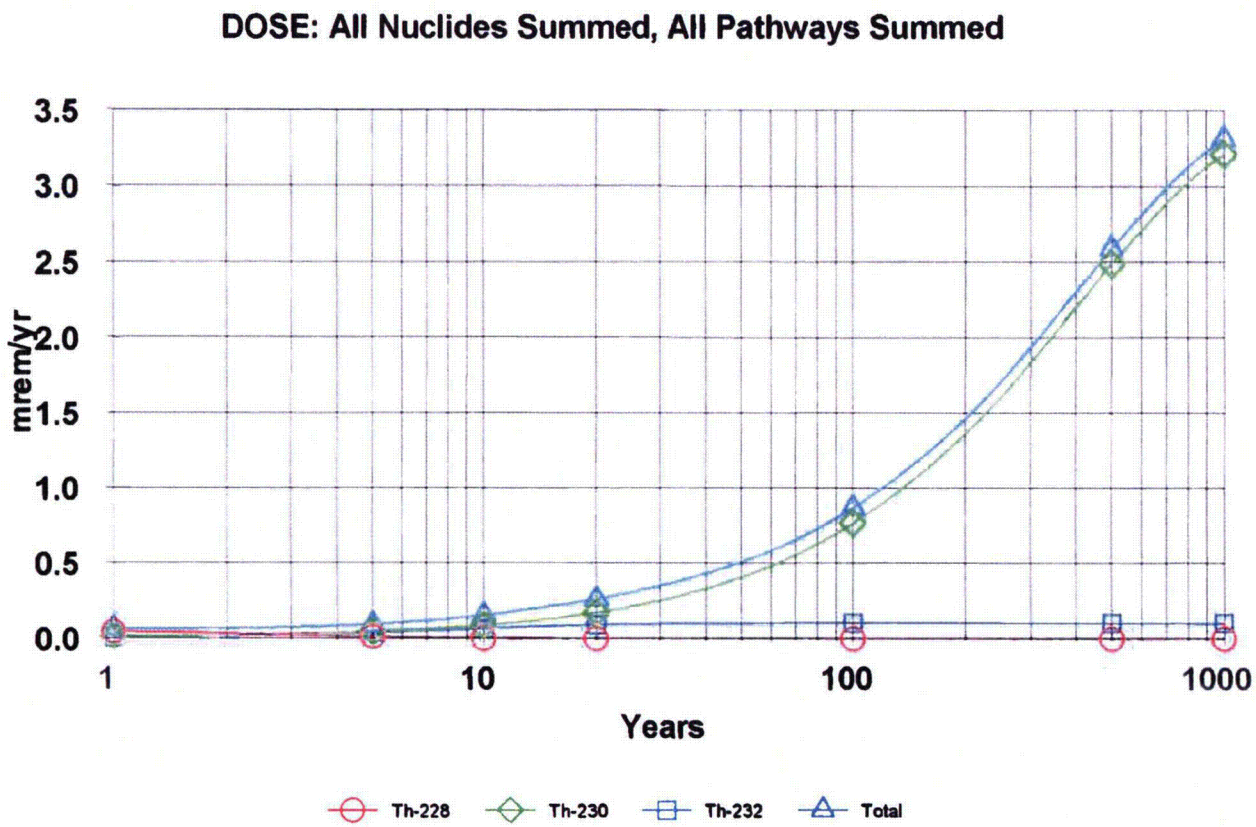

Figure 11. Dose Versus Time Using Average Isotopic Concentrations of November Samples As Initial Conditions, All Pathways Considered, and Assumed Industrial Use With No Soil Cover.

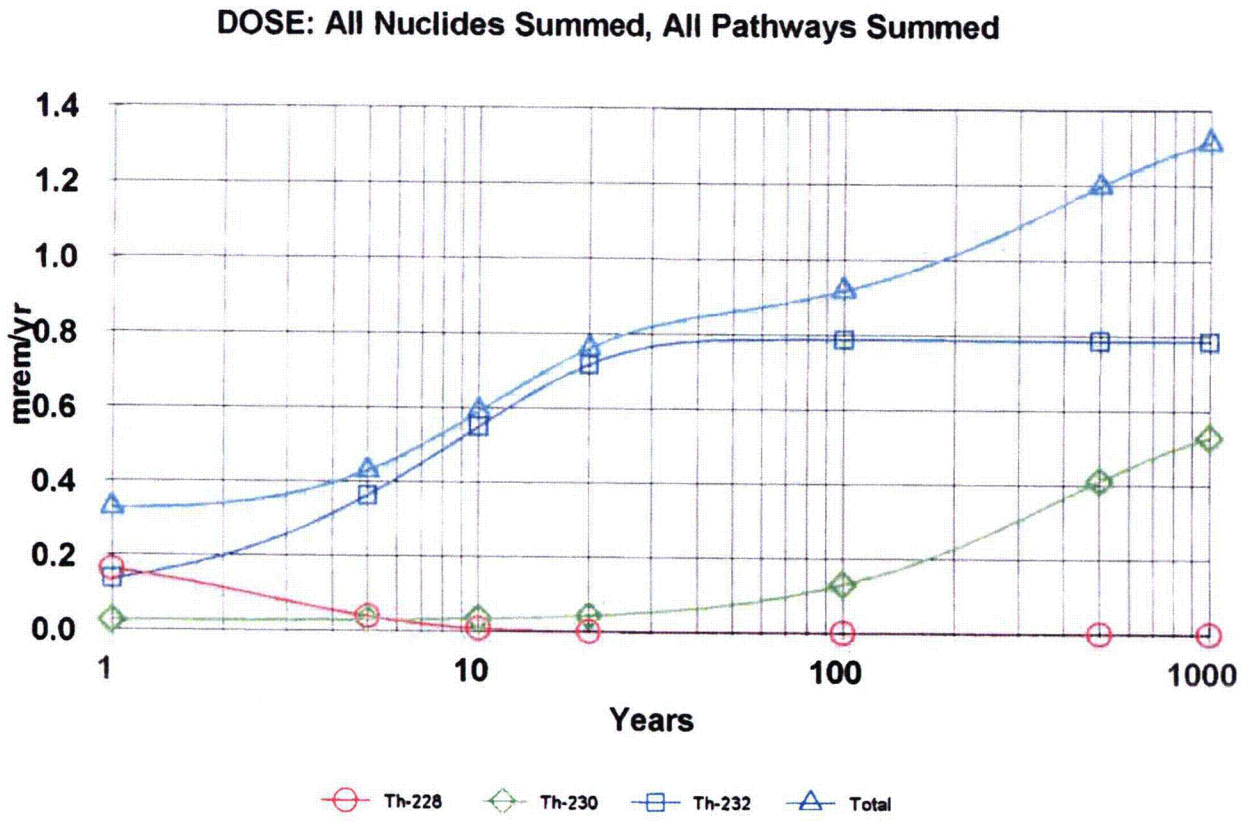

Figure 12. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, All Pathways Considered, and Assumed Industrial Use With 6-inch Soil Cover.

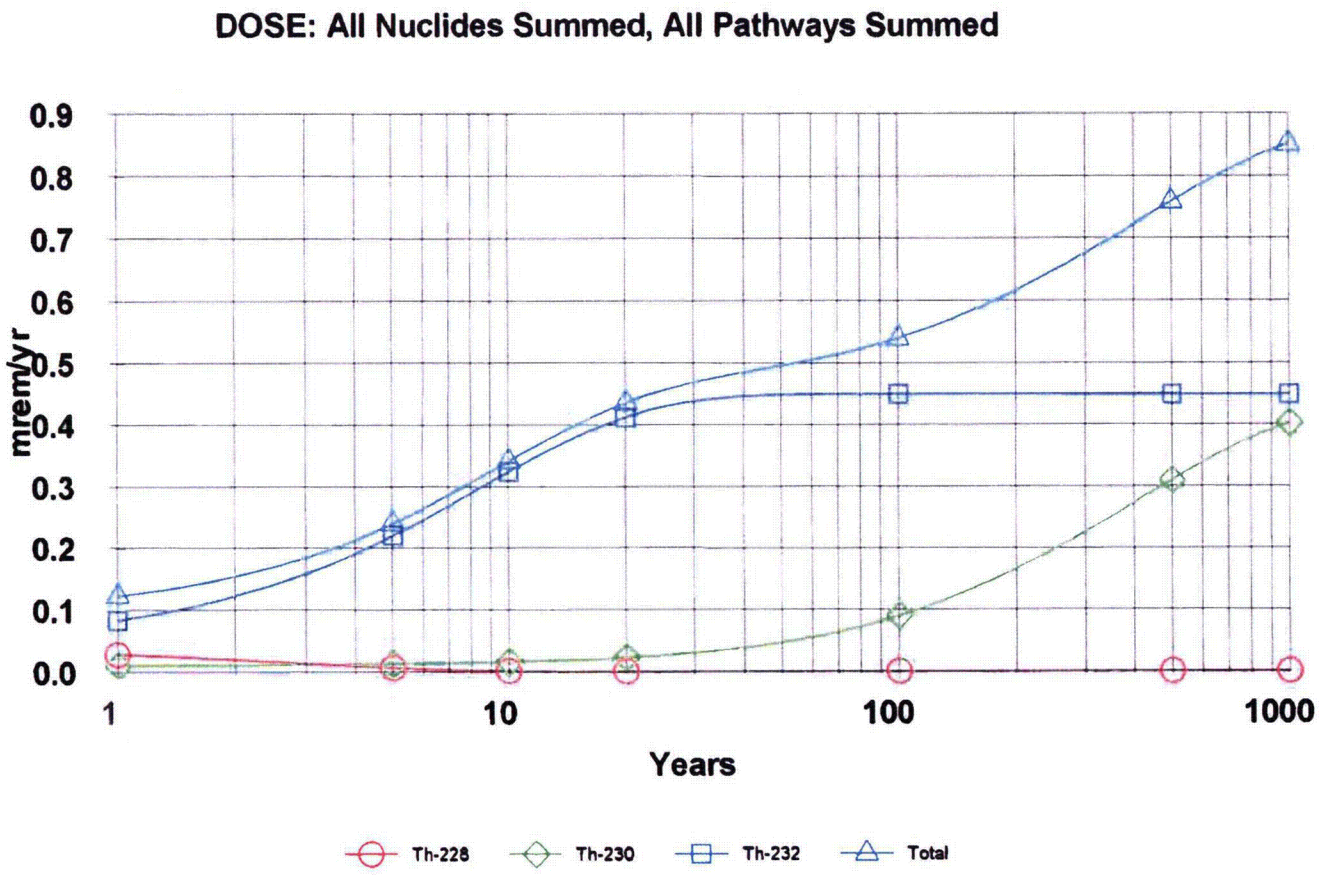

Figure 13. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, No Plant Ingestion, and Assumed Industrial Use With No Soil Cover.

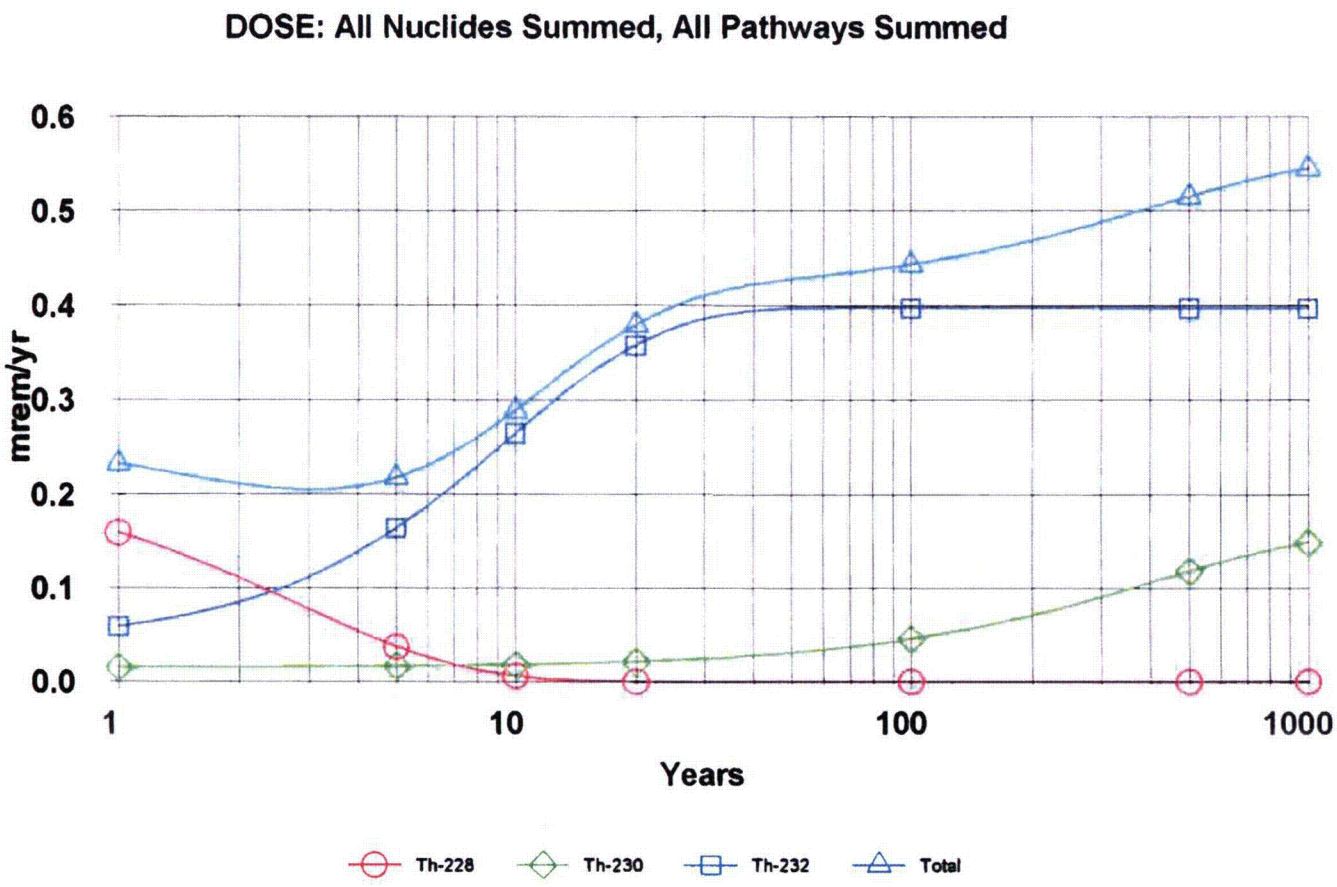
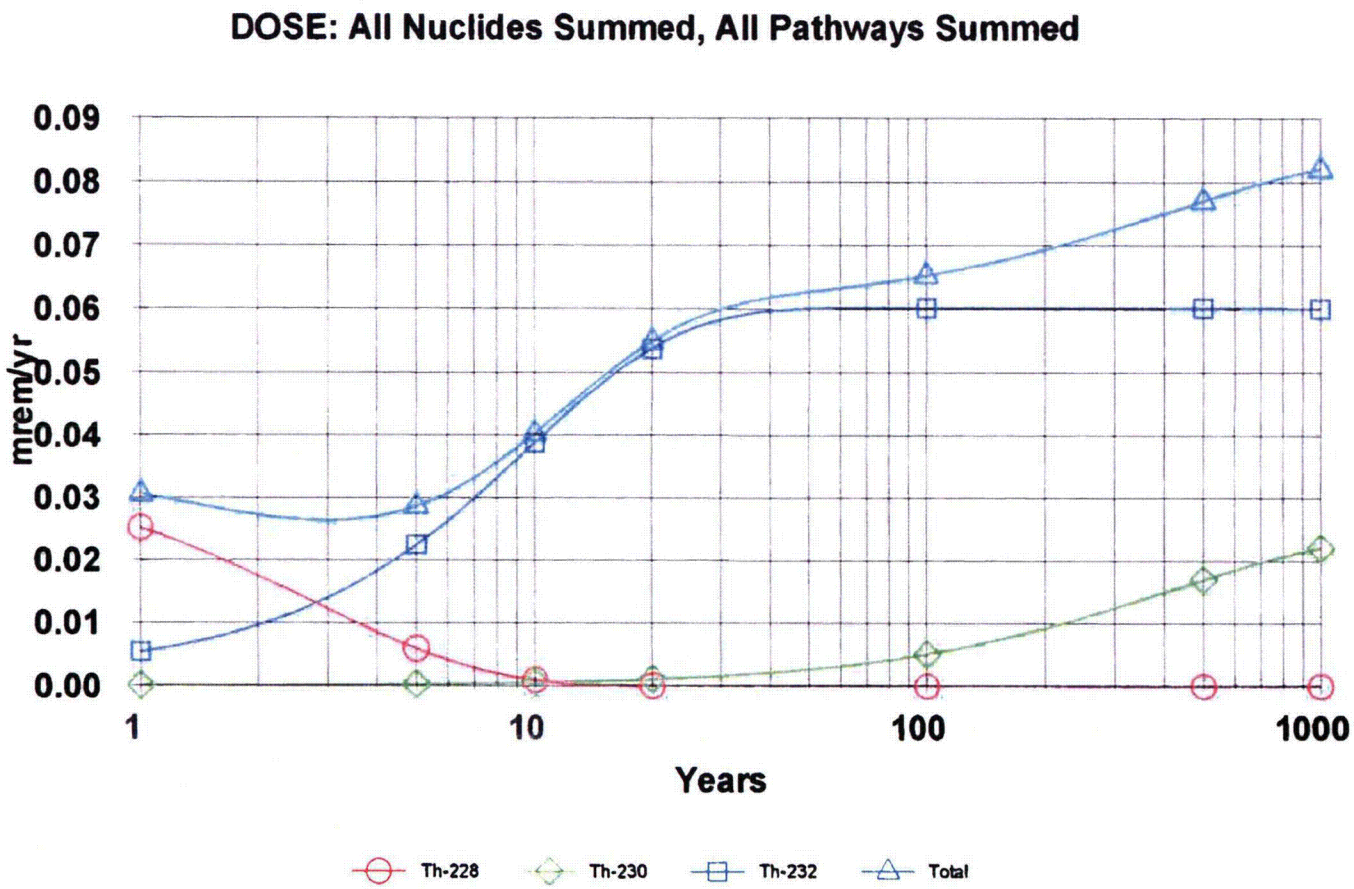
Figure 14. Dose Versus Time Using Average Isotopic Concentrations of November Samples as Initial Conditions, No Plant Ingestion, and Assumed Industrial Use With 6-inch Soil Cover.