

**HEALTH AND SAFETY RESEARCH DIVISION**

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**Radiological Survey Results at 9 and 11 Congress Street,  
Beverly, Massachusetts (VB002)**

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## ABSTRACT

At the request of the U.S. Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at 9 and 11 Congress Street, Beverly, Massachusetts. The survey was performed in May 1991. The purpose of the survey was to determine if uranium from work performed under government contract at the former Ventron facility had migrated off-site to neighboring areas. The survey included a surface gamma scan, a beta-gamma scan of paved areas, and the collection of soil samples for radionuclide analyses.

Results of the survey demonstrated no radionuclide concentrations or radiation measurements in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines.

# Radiological Survey Results at 9 and 11 Congress Street, Beverly, Massachusetts (VB002)\*

## INTRODUCTION

The Metal Hydrides Corporation in Beverly, Massachusetts (which became the Ventron Corporation in 1965), was one of many companies performing work during the 1940s associated with the development of nuclear energy for defense-related projects under contract to the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC). Operations conducted under government contract at such sites included the procurement, storage, and processing of uranium oxides, salts, and metals, and the subsequent machining of these products. As a result of activities involving these materials, equipment, buildings, and land at some of the sites became radiologically contaminated with small amounts of material resulting in low levels of contamination on the properties. At contract termination, release limits and decontamination operations were typically applied in conformance with standards currently deemed adequate for purposes of health and environmental protection. Subsequent to original assessments and the release of these facilities, new research and information have resulted in the development of more stringent guidelines for release of such facilities for unrestricted use. Furthermore, in some instances, documentation is limited or nonexistent, and conditions at a specific site may be unknown. It is the policy of the U.S. Department of Energy (DOE) to verify that radiological conditions at such facilities comply with existing guidelines.<sup>1</sup> The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established in 1974 to assist in assessment and cleanup activities at these sites.

The radiological survey detailed in this report was performed under the FUSRAP program and is one of several surveys conducted in May 1991 on properties in the vicinity of the former Ventron facility by members of the Oak Ridge National Laboratory (ORNL) at the request of DOE. The city of Beverly lies on Beverly Harbor ~15 miles northeast of the central Boston area. The former Ventron facility, now owned by Morton International, is located at the confluence of the Bass and Danvers rivers on Congress Street near the Beverly-Salem bridge<sup>2</sup> (Fig. 1).

From 1942 to 1948 the Metal Hydrides Corporation (later to become the Ventron facility) converted uranium oxide to uranium metal powder at the facility under contract to MED in support of the war effort. As better methods for production of uranium metal were developed, Metal Hydrides shifted its operations toward recovering uranium from scrap uranium and turnings from the slug fabrication plant at Hanford, Washington.<sup>1</sup> Contracts between Metal Hydrides and the government were completed in 1954.

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\*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

Following a radiological screening survey at the site in 1977, a comprehensive survey was performed in 1982.<sup>2</sup> In 1987 DOE contractors removed the uranium-contaminated roof from a Ventron building, which had begun to leak. Radioactive materials remaining on the site do not pose a health hazard under present-use conditions but could cause radiation exposure to workers if excavation or major renovation took place on the property. DOE plans a complete characterization study of the site in 1992 and the initiation of remedial action soon thereafter.

The survey of the property reported in this document and of other surrounding properties is part of DOE's continuing effort to assess the former Ventron site and plan for remedial action. The objective of the surveys was to determine if uranium from plant operations had migrated off-site to neighboring areas including Beverly Harbor and, if so, to what degree. The location of this vicinity property in relation to the former Ventron site is shown in Fig. 2. The property at 9 and 11 Congress Street consists of a large paved parking area, a residence, and a vacant lot to the north. The radiological survey included measurements of radiation levels over the surface of the property and analysis of soil samples for the presence of radionuclides.

## SURVEY METHODS

A comprehensive description of the survey methods and instrumentation used in this survey is given in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600 (April 1987).<sup>3</sup>

### SURFACE RADIATION MEASUREMENTS

Gamma radiation levels were determined using a portable NaI gamma scintillation meter. Because NaI gamma scintillators are energy dependent, measurements of gamma radiation levels in counts per minute are normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates in  $\mu\text{R}/\text{h}$ . Using a Geiger-Mueller pancake detector, beta-gamma radiation levels in counts per minute were determined over paved surfaces and then converted to mrad/h.

### SOIL SAMPLING AND ANALYSES

Surface and subsurface soil samples were systematically collected over the property in a pattern sufficient to obtain a characterization of the radionuclide content of the soil. Surface and subsurface soil samples were also collected in areas of elevated gamma exposure rates. Such samples are referred to as biased samples and are more likely to contain elevated concentrations of radionuclides than are systematically chosen samples. All soil samples were analyzed to determine concentrations of  $^{238}\text{U}$ ,  $^{232}\text{Th}$ , and  $^{226}\text{Ra}$ .

## SURVEY RESULTS

DOE guidelines are summarized in Table 1. Typical background radiation levels for the Beverly, Massachusetts, area are presented in Table 2. These data are provided for comparison with survey results presented in this section. All direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in soil samples.

Photographs taken in May 1991 of the property at 9 and 11 Congress Street, Beverly, Massachusetts are shown in Figs. 3 through 5.

### SURFACE RADIATION MEASUREMENTS

Results of the surface gamma scan over the property surface are shown in Fig. 6. Surface gamma exposure rates ranged from 4 to 9  $\mu\text{R/h}$  over the asphalt on the parking area, from 6 to 9  $\mu\text{R/h}$  over the soil area at the rear of the property, and from 8 to 9  $\mu\text{R/h}$  over the grass in front of the house. These values are comparable to typical background measurements in the Beverly, Massachusetts, area (6 to 9  $\mu\text{R/h}$ , Table 2).

Maximum beta-gamma dose rates of 0.08 mrad/h were measured over paved surfaces on the property, which is comparable to background levels of 0.02 mrad/h measured in the immediate vicinity.

### SOIL SAMPLES

Soil sample locations are shown in Fig. 6, and results of analyses are listed in Table 3. Maximum concentrations of  $^{226}\text{Ra}$  and  $^{232}\text{Th}$  in surface soil (0–15 cm) were 1.0 and 1.2 pCi/g, respectively; maximum concentrations in subsurface soil were 1.2 pCi/g for both  $^{226}\text{Ra}$  and  $^{232}\text{Th}$ . These values are slightly above typical background levels in the Beverly area (Table 2) but well below DOE guidelines (Table 1). Uranium-238 concentrations in surface soil ranged from 1.9 to 13 pCi/g in systematic samples and from 14 to 34 pCi/g in biased samples. Subsurface  $^{238}\text{U}$  concentrations ranged from 0.83 to 12 pCi/g. Uranium-238 levels in most of the soil samples from 9 and 11 Congress Street were above typical background levels in the Beverly area (Table 2); however, all samples except B1A were well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites (Table 1). Sample B1A, containing 34 pCi/g of  $^{238}\text{U}$ , was collected at the outfall of a gutter downspout. Dry deposition from airborne contamination is often found in the runoff from a roof and is often concentrated at drip lines and downspout outfalls.

## SIGNIFICANCE OF FINDINGS

The results of the radiological survey at 9 and 11 Congress Street, Beverly, Massachusetts, demonstrated no radionuclide concentrations or radiation measurements above established DOE guidelines.

## REFERENCES

1. U. S. Department of Energy, *A Background Report for the Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites Program*, DOE/EV-0097, September 1980.
2. W. D. Cottrell and R. F. Carrier, *Results of the Radiological Survey at the Ventron Site, Beverly, Massachusetts*, ORNL/TM-10053, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., May 1988.
3. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., April 1987.

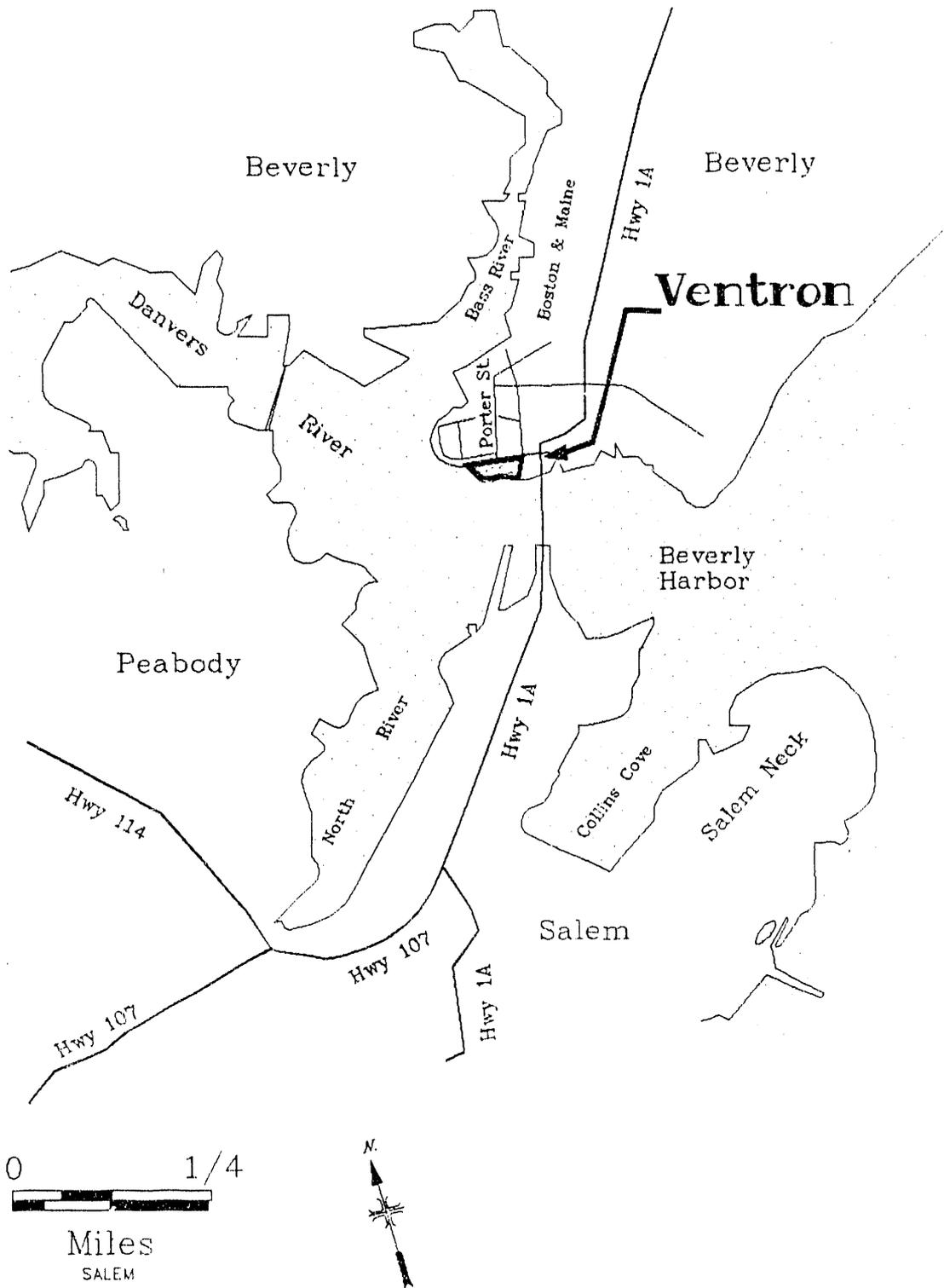


Fig. 1. Diagram showing general location of the former Ventron site.

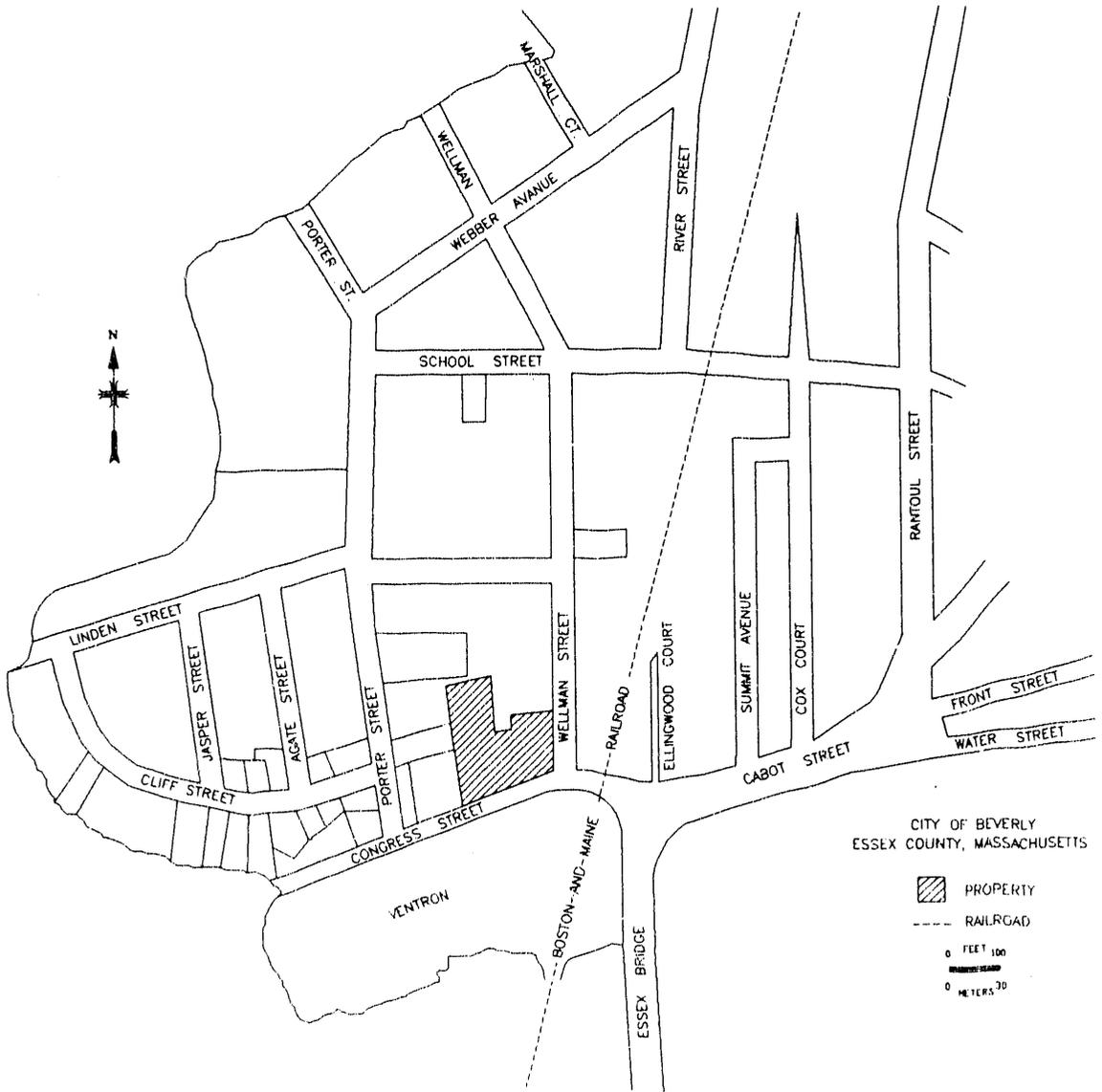


Fig. 2. Diagram showing location of 9 and 11 Congress Street, Beverly, Massachusetts, in relation to the former Ventron site.

ORNL-PHOTO 907-92



**Fig. 3. View looking north at the house at 11 Congress Street, Beverly, Massachusetts.**

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**Fig. 4. View looking north at the parking area at 9 Congress Street, Beverly, Massachusetts.**

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**Fig. 5. View looking northwest at the parking area and vacant lot, 9 and 11 Congress Street, Beverly, Massachusetts.**

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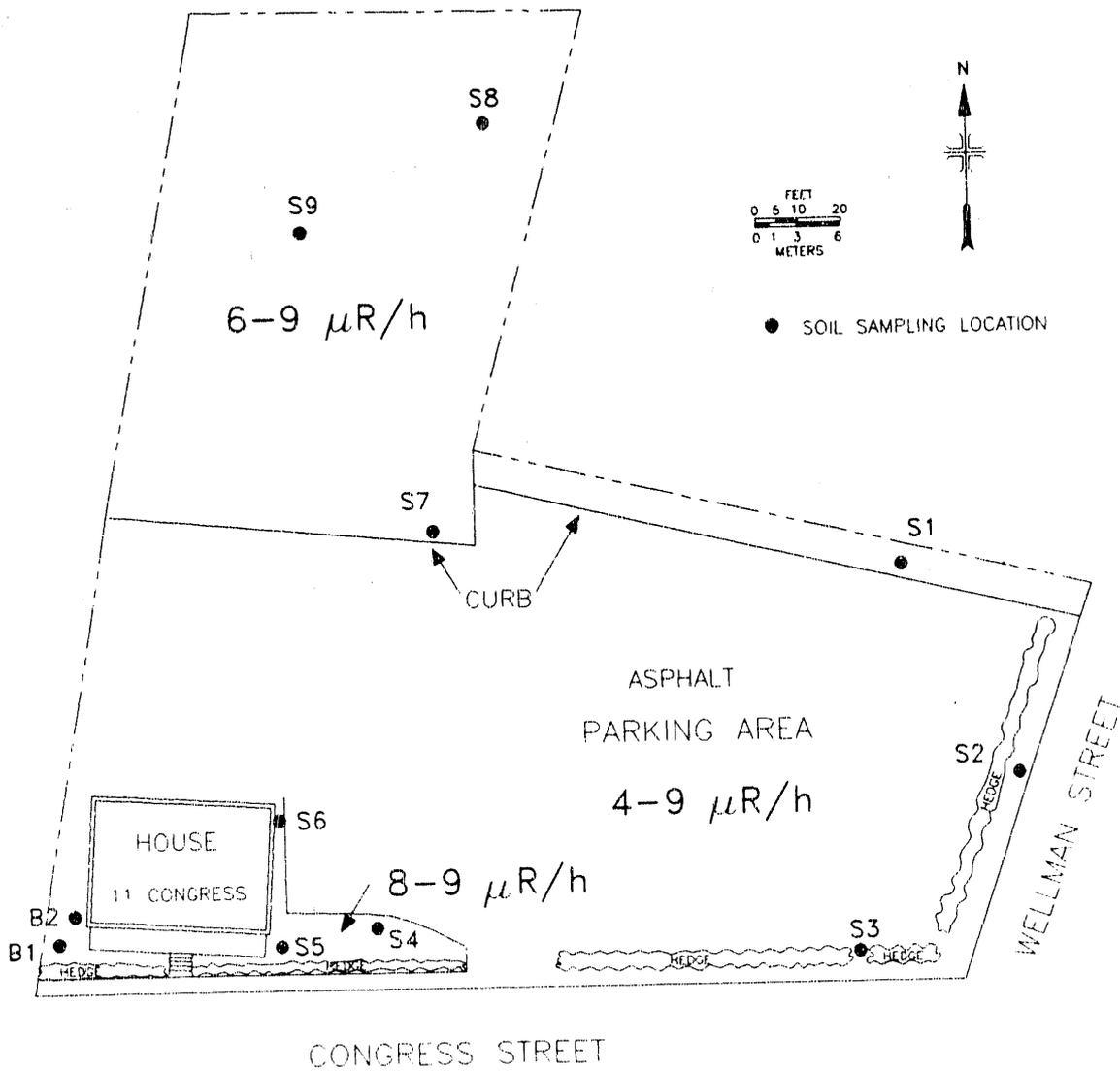


Fig. 6. Surface gamma exposure rates and soil sampling locations at 9 and 11 Congress Street, Beverly, Massachusetts.

**Table 1. Applicable guidelines for protection against radiation**  
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 $\mu\text{R/h}^a$
Radionuclide concentrations in soil (generic)	Maximum permissible concentration of the following radionuclides in soil above background levels, averaged over a 100-m <sup>2</sup> area $^{226}\text{Ra}$ $^{232}\text{Th}$ $^{230}\text{Th}$	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15-cm-thick soil layers >15 cm below the surface
Derived concentrations	$^{238}\text{U}$	Site specific <sup>b</sup>
Guideline for non-homogeneous contamination (used in addition to the 100-m <sup>2</sup> guideline) <sup>c</sup>	Applicable to locations with an area $\leq 25$ m <sup>2</sup> , with significantly elevated concentrations of radionuclides ("hot spots")	$G_A = G_i(100/A)^{1/2}$ , where $G_A$ = guideline for "hot spot" of area (A) $G_i$ = guideline averaged over a 100-m <sup>2</sup> area

<sup>a</sup>The 20  $\mu\text{R/h}$  shall comply with the basic dose limit (100 mrem/year) when an appropriate-use scenario is considered.

<sup>b</sup>DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 35–40 pCi/g have been applied at other FUSRAP sites. Source: J. L. Marley and R. F. Carrier, *Results of the Radiological Survey at 4 Elmhurst Avenue, Colonie, New York (AL219)*, ORNL/RASA-87/117, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1988; B. A. Berven et al., *Radiological Survey of the Former Kellex Research Facility, Jersey City, New Jersey*, DOE/EV-0005/29, ORNL-5734, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1982.

<sup>c</sup>DOE guidelines specify that every reasonable effort shall be made to identify and to remove any source that has a concentration exceeding 30 times the guideline value, irrespective of area (adapted from *Revised Guidelines for Residual Radioactive Material at FUSRAP and Remote SFMP Sites*, April 1987).

Sources: Adapted from U.S. Department of Energy, DOE Order 5400.5, April 1990, and U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March 1987.

**Table 2. Background radiation levels and concentrations of selected radionuclides in soil in the Beverly, Massachusetts, area**

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at ground surface ( $\mu\text{R/h}$ ) <sup>a</sup>	6-9	7
Concentration of radionuclides in soil (pCi/g) <sup>a</sup>		
<sup>238</sup> U	0.69-1.05	0.89
<sup>226</sup> Ra	0.70-0.94	0.84
<sup>232</sup> Th	0.76-0.94	0.84

<sup>a</sup>Values obtained from three locations in the Beverly area.

**Table 3. Concentrations of radionuclides in soil samples from 9 and 11 Congress Street, Beverly, Massachusetts**

Sample <sup>a</sup>	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>		
		<sup>226</sup> Ra	<sup>232</sup> Th	<sup>238</sup> U
<i>Systematic samples<sup>c</sup></i>				
S1A	0-15	0.82±0.02	0.91±0.04	13 ±1
S1B	15-30	0.73±0.03	0.78±0.03	12 ±1
S1C	30-46	1.00±0.02	1.2 ±0.04	7.7 ±0.7
S2A	0-15	0.74±0.02	0.79±0.04	2.4 ±0.7
S2B	15-30	0.74±0.02	0.86±0.03	0.83±0.8
S3A	0-15	0.97±0.06	0.87±0.09	1.9 ±0.8
S3B	15-23	1.2 ±0.02	1.0 ±0.03	1.6 ±1
S4A	0-15	0.83±0.04	0.84±0.07	6.3 ±1
S4B	15-30	0.79±0.02	0.88±0.03	2.3 ±0.5
S5A	0-15	0.79±0.02	0.83±0.04	12 ±1
S5B	15-30	0.91±0.02	0.94±0.03	3.5 ±1
S6A	0-15	0.70±0.02	0.70±0.04	2.2 ±0.9
S6B	15-30	0.81±0.02	0.78±0.03	2.5 ±0.5
S7	0-15	0.99±0.02	0.94±0.04	3.0 ±1
S8A	0-15	0.83±0.02	0.99±0.03	3.6 ±0.6
S8B	15-30	0.66±0.01	0.72±0.02	0.90±0.5
S9A	0-15	1.0 ±0.03	1.2 ±0.05	4.7 ±0.9
S9B	15-30	0.99±0.02	1.2 ±0.03	3.8 ±0.9
S9C	30-46	0.97±0.02	1.1 ±0.04	1.9 ±0.8
<i>Biased samples<sup>d</sup></i>				
B1A	0-15	0.66±0.05	0.81±0.08	34 ±2
B1B	15-23	0.70±0.04	0.95±0.07	12 ±1
B2	0-15	0.95±0.04	0.96±0.07	14 ±1

<sup>a</sup>Sample locations are shown on Fig. 6.

<sup>b</sup>Indicated counting error is at the 95% confidence level ( $\pm 2\sigma$ ).

<sup>c</sup>Systematic samples are taken at locations irrespective of gamma exposure rates.

<sup>d</sup>Biased samples are taken from areas with elevated gamma exposure rates.

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