

5/9-30-92 QSD

ornl

ORNL/RASA-91/15

**OAK RIDGE
NATIONAL
LABORATORY**

MARTIN MARIETTA

**RADIOLOGICAL SURVEY
RESULTS
AT 9 PORTER STREET,
BEVERLY, MASSACHUSETTS
(VB020)**

**R. D. Foley
C. A. Johnson**

**MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY**

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401, FTS 626-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

HEALTH AND SAFETY RESEARCH DIVISION

Environmental Restoration and Waste Management Non-Defense Programs
(Activity No. EX 20 20 01 0; ADS3170000)

**Radiological Survey Results at 9 Porter Street,
Beverly, Massachusetts (VB020)**

R. D. Foley and C. A. Johnson

Date Issued —July 1992

Investigation Team

R. E. Swaja — Measurement Applications and Development Manager
W. D. Cottrell — FUSRAP Project Director
R. D. Foley — Survey Team Leader

Survey Team Members

J. F. Allred	M. E. Murray
A. C. Butler*	V. P. Patania
R. D. Foley	D. E. Rice
D. Mackenzie†	D. A. Rose
W. H. Shinpaugh*	

*D. R. Stone and Associates, Inc.

†H&R Technical Associates

Work performed by the
MEASUREMENT APPLICATIONS AND DEVELOPMENT GROUP

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

MASTER

EB

CONTENTS

LIST OF FIGURES.....	v
LIST OF TABLES.....	vii
ACKNOWLEDGMENTS.....	ix
ABSTRACT.....	xi
INTRODUCTION.....	1
SURVEY METHODS.....	2
SURFACE RADIATION MEASUREMENTS.....	2
SOIL SAMPLING AND ANALYSES.....	2
SURVEY RESULTS.....	3
SURFACE RADIATION MEASUREMENTS.....	3
SOIL SAMPLES.....	3
SIGNIFICANCE OF FINDINGS.....	4
REFERENCES.....	4

LIST OF FIGURES

1	Diagram showing general location of the former Ventron site.....	5
2	Diagram showing relative location of 9 Porter Street, Beverly, Massachusetts, to the former Ventron site.....	6
3	View of the front of the property at 9 Porter Street, Beverly, Massachusetts.....	7
4	View of the rear of the property at 9 Porter Street, Beverly, Massachusetts.....	7
5	Surface gamma exposure rates and soil sampling locations at 9 Porter Street, Beverly, Massachusetts.....	8

LIST OF TABLES

1	Applicable guidelines for protection against radiation.....	9
2	Background radiation levels and concentrations of selected radionuclides in soil in the Beverly, Massachusetts, area.....	10
3	Concentrations of radionuclides in soil samples from 9 Porter Street, Beverly, Massachusetts.....	11

ACKNOWLEDGMENTS

Research for this project was sponsored by the Office of Environmental Restoration, U.S. Department of Energy, under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the contributions of R. F. Carrier, W. D. Cottrell, M. S. Uziel, D. A. Roberts, D. A. Rose, V. P. Patania, J. F. Allred, and T. R. Stewart of the Measurement Applications and Development Group for participation in the sample preparation and analyses, editing, graphics, and reporting of data for this survey.

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 Porter 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 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 PORTER STREET, BEVERLY, MASSACHUSETTS (VB020)*

INTRODUCTION

The Metal Hydrides Corporation facility 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 the 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 Department of Energy (DOE) to verify that radiological conditions at such facilities comply with existing guidelines.¹ The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established by DOE 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 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 approximately 15 miles northeast of the central Boston area. The former Ventron facility, now owned by Morton International, Inc., is located at the confluence of the Bass and Danvers rivers on Congress Street near the Beverly-Salem bridge (Fig. 1 p. 5).

From 1942 through 1948, the Metal Hydrides Corporation (later to become the Ventron facility), converted uranium oxide to uranium metal powder at the facility under contract to the MED in support of the war effort. Other operations conducted at the facility included the recovery of uranium from scrap uranium and turnings from the slug fabrication plant at Hanford, Washington. Contracts between Metal Hydrides and the government were completed in 1954.

*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division of 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 1982.² 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 program 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 offsite to neighboring areas including Beverly Harbor, and if so, to what degree. The relative location of this vicinity property to the former Ventron site is shown in Fig. 2 (p. 6). The radiological surveys consisted of measurements of radiation levels over the ground surface of the properties and analysis of soil, sediment, and other material samples for the presence of radionuclides in concentrations exceeding guidelines.

Views of the vicinity property at 9 Porter Street are shown in Figs. 3 and 4 (p. 7).

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).³

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 (cpm) are normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates in $\mu\text{R/h}$.

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 ^{238}U , ^{232}Th , and ^{226}Ra concentrations.

SURVEY RESULTS

Current guidelines for sites included within the FUSRAP are summarized in Table 1 (p. 9). Typical background radiation levels for the Beverly, Massachusetts, area are presented in Table 2 (p. 10). These data are provided for comparison with the survey results presented in this section. All direct measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil, debris, and other samples.

SURFACE RADIATION MEASUREMENTS

A general gamma scan was conducted at this property where exposure rates at the ground surface ranged from 7 to 12 $\mu\text{R/h}$, with a maximum of 16 $\mu\text{R/h}$ measured on contact with a granite wall in the back yard. These values are slightly higher than the typical background measurements in the Beverly, Massachusetts, area (6 to 9 $\mu\text{R/h}$, Table 2), but well below DOE guidelines. Concrete, brick, and granite were present over most of the property. These materials typically contain slightly higher concentrations of naturally occurring radionuclides than soil, and contributed to the higher gamma readings. Results of the gamma scan over the ground surface of the property are shown on Fig. 5 (p. 8).

SOIL SAMPLES

Soil sample locations are shown in Fig. 5, and results of analyses are listed in Table 3 (p. 11). The soil over most of this property has been disturbed and graded within the last 10-15 years, and rocks and granite were encountered in much of the soil. Maximum concentrations of ^{226}Ra and ^{232}Th in surface soil (0-15 cm) were 1.1, and 1.6 pCi/g, respectively. In subsurface soil, maximum values were 1.1 pCi/g for ^{226}Ra and 1.2 pCi/g for ^{232}Th . These values are only slightly above typical background levels in the Beverly area (Table 2), and well below DOE guidelines (Table 1). Although potassium-40 (^{40}K), was not associated with any MED operations or processing activities at the Ventron site, samples are routinely analyzed for its presence. These analyses showed that samples B1A, B1B, and S5A contained 29, 34, and 32 pCi/g ^{40}K , respectively, while all other samples from this property ranged from 14 to 18 pCi/g. Potassium-40 is a naturally occurring radionuclide found in many normal biological and environmental materials, including food and human tissues. Worldwide, the concentration of ^{40}K in soil ranges from 3.5 to 22 pCi/g; an individual weighing 70 kg (~188 lb) would normally contain about 140 pCi/g.⁴ Potassium is added in large amounts as potash to fertilizers and frequently results in increased concentrations of ^{40}K in locations subjected to agricultural activities, including areas impacted by runoff or gardening.

Maximum ^{238}U concentrations in surface soil were 3.4 pCi/g in systematic samples and 2.9 pCi/g in biased samples. Subsurface ^{238}U concentrations ranged from 1.3 to 2.5 pCi/g in both systematic and biased samples. All ^{238}U concentrations were near or slightly above

typical background soil concentrations in the Beverly area (Table 2), but well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites (Table 1).

SIGNIFICANCE OF FINDINGS

The results of the radiological survey at 9 Porter 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.
4. National Committee on radiation Protection (NCRP) Report No. 50, December 27, 1976.

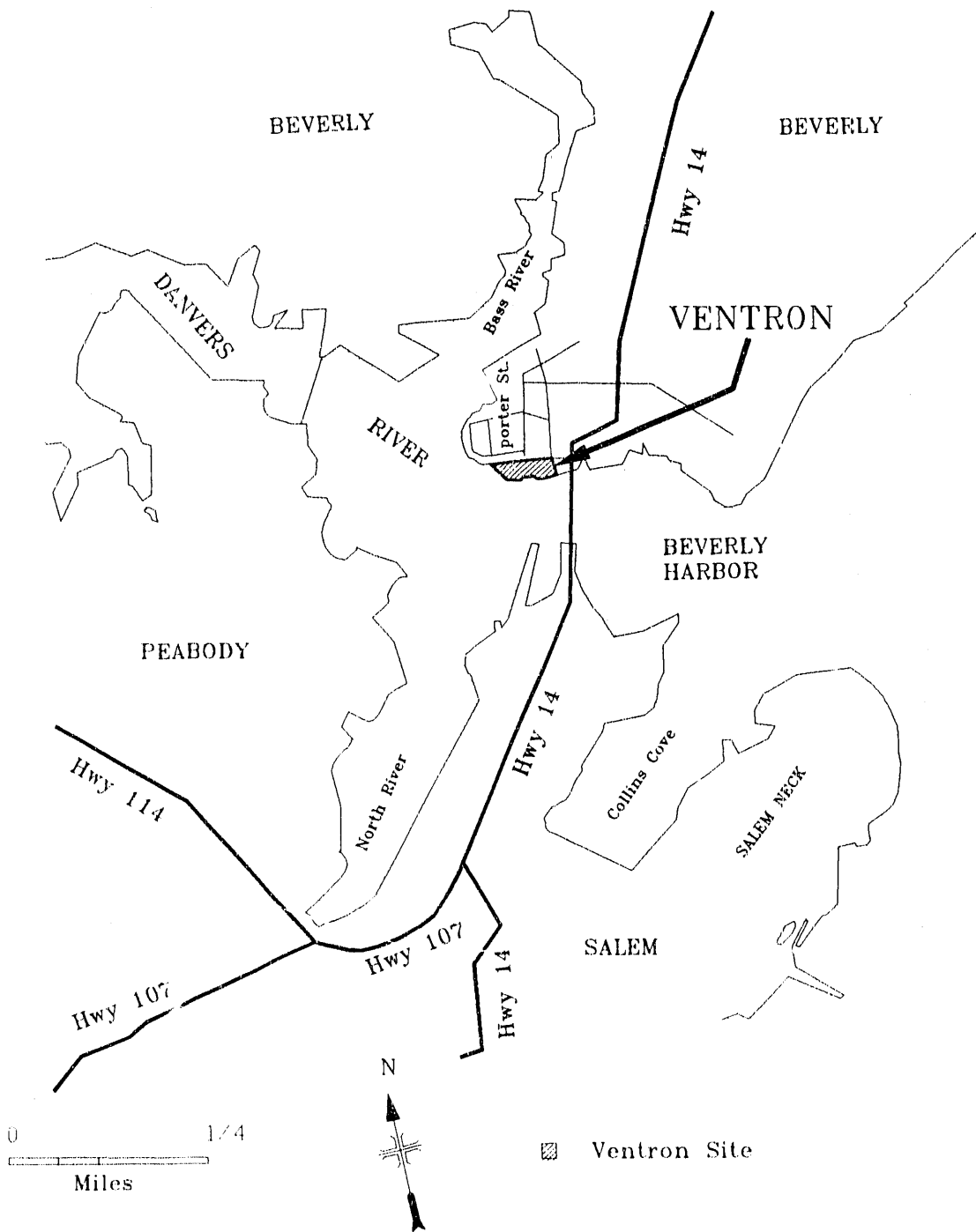


Fig. 1. Diagram showing general location of the former Ventron site.

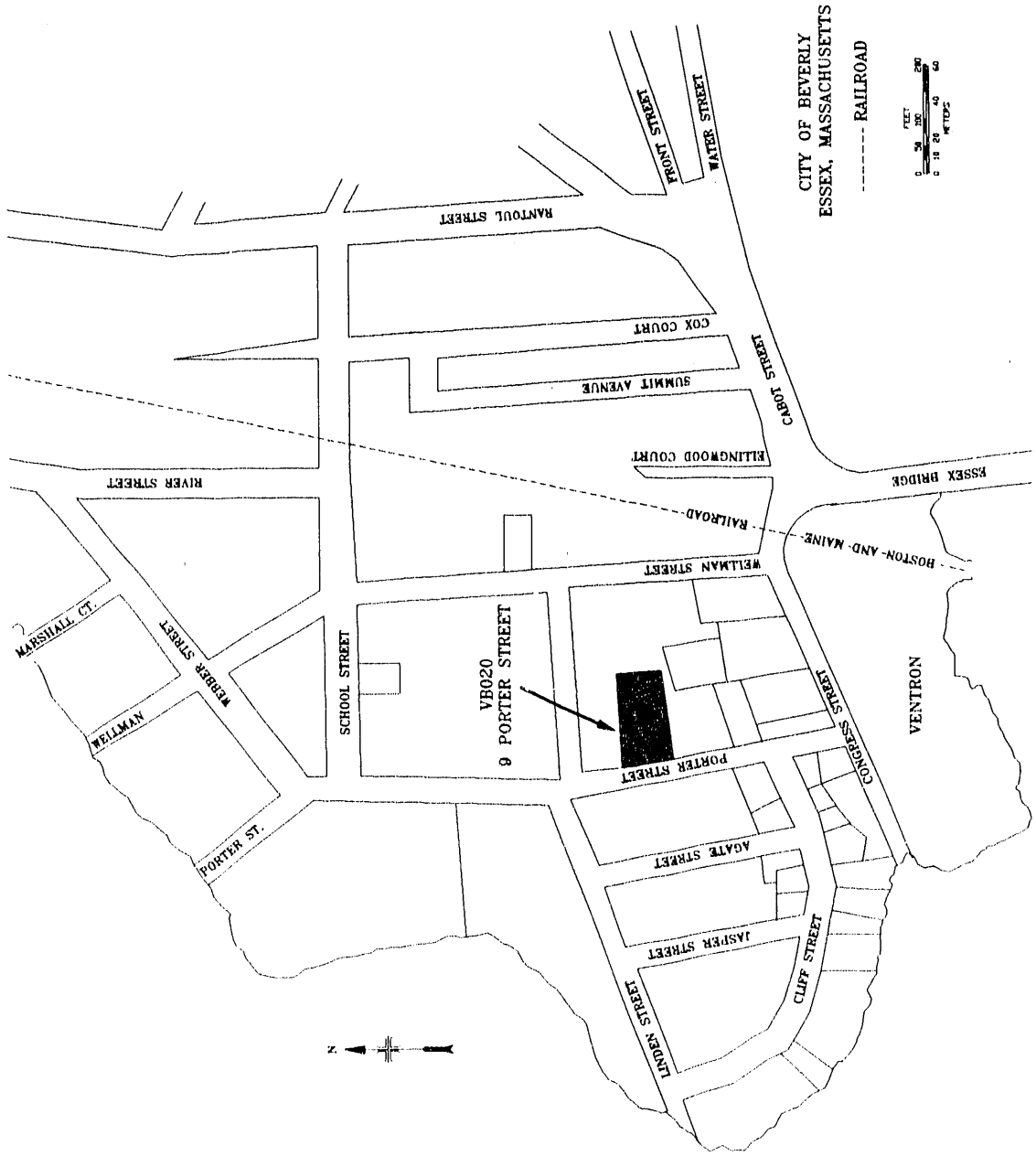


Fig. 2. Diagram showing relative location of 9 Porter Street, Beverly, Massachusetts, to the former Ventron site.

ORNL-PHOTO 3859-92



Fig. 3. View of the front of the property at 9 Porter Street, Beverly, Massachusetts.

ORNL-PHOTO 3860-92



Fig. 4. View of the rear of the property at 9 Porter Street, Beverly, Massachusetts.

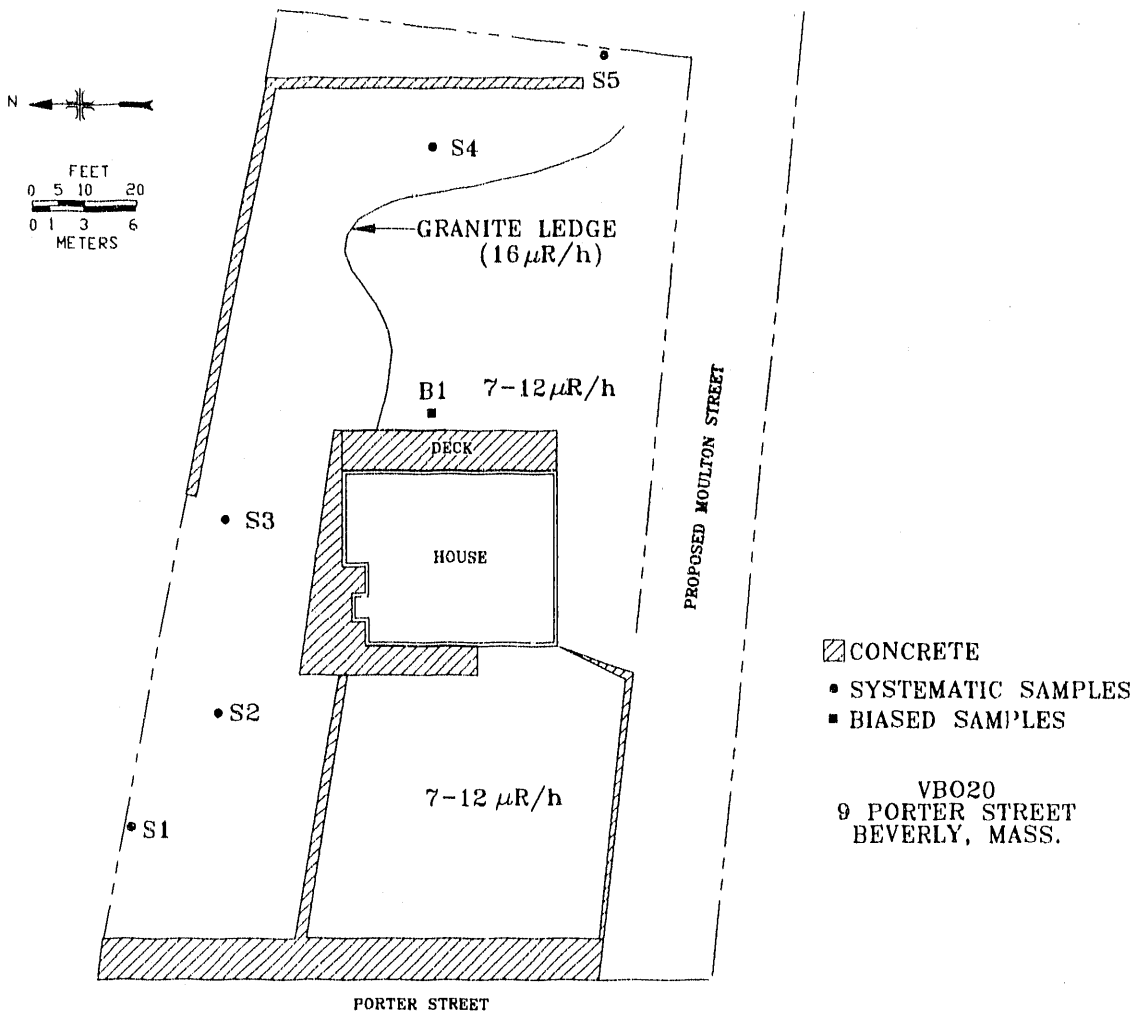


Fig. 5. Surface gamma exposure rates and soil sampling locations at 9 Porter Street, Beverly, Massachusetts.

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 μ 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 ² area ²²⁶ Ra ²³² Th ²³⁰ 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 U	Site specific ^b
Guideline for non-homogeneous contamination (used in addition to the 100-m ² guideline) ^c	Applicable to locations with an area ≤ 25 m ² , 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 ² area

^aThe 20 μ R/h shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

^bDOE guidelines for uranium are derived on a site-specific basis. Guidelines of 35-40 pCi/g have been applied at other FUSRAP sites. Sources: 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.

^cDOE 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 ($\mu\text{R/h}$) ^a	6-9	7
Concentration of radionuclides in soil (pCi/g) ^a		
²²⁶ Ra	0.70-0.94	0.84
²³² Th	0.76-0.94	0.84
²³⁸ U	0.69-1.05	0.89

^aValues obtained from three locations in the Beverly area.

Table 3. Concentrations of radionuclides in soil samples from 9 Porter Street, Beverly, Massachusetts

Sample number ^a	Depth (cm)	Radionuclide concentration (pCi/g) ^b		
		²²⁶ Ra	²³² Th	²³⁸ U
<i>Systematic samples^c</i>				
S1A	0-15	0.94 ± 0.02	0.99 ± 0.04	3.0 ± 1
S2A	0-15	1.1 ± 0.03	1.0 ± 0.04	2.6 ± 1
S2B	15-30	1.1 ± 0.04	1.2 ± 0.06	2.5 ± 0.5
S3A	0-15	0.94 ± 0.03	0.96 ± 0.05	3.4 ± 1
S3B	15-30	0.98 ± 0.02	0.99 ± 0.04	1.9 ± 0.8
S4A	0-15	1.0 ± 0.03	1.0 ± 0.05	2.3 ± 0.6
S4B	15-30	0.96 ± 0.03	1.1 ± 0.04	1.5 ± 0.9
S5A	0-15	0.89 ± 0.02	1.6 ± 0.04	3.0 ± 0.6
<i>Biased samples^d</i>				
B1A	0-15	1.0 ± 0.02	1.6 ± 0.04	2.9 ± 0.5
B1B	15-30	0.98 ± 0.02	1.8 ± 0.04	1.3 ± 0.5

^aLocations of soil samples are shown on Fig. 5

^bIndicated counting error is at the 95% confidence level ($\pm 2\sigma$).

^cSystematic samples are taken at locations irrespective of gamma exposure rates.

^dBiased samples are taken from areas with elevated gamma exposure rates.

INTERNAL DISTRIBUTION

- | | |
|-----------------------|----------------------------------|
| 1. B. A. Berven | 20. R. E. Rodriguez |
| 2. R. F. Carrier | 21. P. S. Rohwer |
| 3. W. D. Cottrell | 22-24. R. E. Swaja |
| 4-9. R. D. Foley | 25. M. S. Uziel |
| 10. R. O. Hultgren | 26. J. K. Williams |
| 11-14. C. A. Johnson | 27. Central Research Library |
| 15. S. V. Kaye | 28-29. Laboratory Records |
| 16. A. P. Malinauskas | 30. Laboratory Records-RC |
| 17. M. E. Murray | 31. ORNL Patent Section |
| 18. P. T. Owen | 32. ORNL Technical Library, Y-12 |
| 19. D. A. Roberts | 33-38. MAD Records Center |

EXTERNAL DISTRIBUTION

39. J. D. Berger, Oak Ridge Associated Universities, E/SH Division, Environmental Survey and Site Assessment Program, P.O. Box 117, Oak Ridge, TN 37831-0117
40. James J. Fiore, Director, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, (EM-42), Trevion II, Washington, DC 20585
- 41-43. G. K. Hovey, Bechtel National, Inc., FUSRAP Department, Oak Ridge Corporate Center, 151 Lafayette Drive, P.O. Box 350, Oak Ridge, TN 37831-0350
44. L. K. Price, Director, Former Sites Restoration Division, Oak Ridge Field Office, U.S. Department of Energy, P.O. Box 2001, Oak Ridge, TN 37831-8723
45. James W. Wagoner II, Director, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, (EM-421), Trevion II, Washington DC 20585
- 46-50. W. Alexander Williams, Designation and Certification Manager, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, (EM-421), Trevion II, Washington DC 20585
51. C. D. Young, Office of Technical Services, Roy F. Weston, Inc., 12800 Middlebrook Road, Suite 207, Germantown, MD 20874
- 52-56. Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831

END

**DATE
FILMED**

10 / 20 / 92

