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RADIOLOGICAL AND RCRA HAZARDOUS WASTE SCOPING SURVEY OF THE DECONTAMINATION FACILITY (BUILDING 7819) TRANSFER LINE LEAK SITE

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ABSTRACT

In February 1987, a radiological and hazardous waste scoping survey was conducted at the site of a transfer line leak between Building 7819 and Pit 1, Oak Ridge National Laboratory (ORNL). The survey was made by the Environmental Assessments group of the Health and Safety Research Division (HASRD) of ORNL for the Maintenance, Surveillance and Corrective Actions (MS&CA) Program. The purposes of the scoping survey were: (1) to identify radioactive contamination and hazardous waste [as defined by the Resource Conservation and Recovery Act (RCRA)] and (2) to determine if the concentrations of these contaminants require corrective action to protect human health and the environment.

Three regions of contamination were found at the survey site. Beta-gamma activity levels on the ground surface in these regions (A, B, and C) ranged to 20, 4, and 4 mrad/h, respectively. Region A (~86 m^2) is the result of residual contamination at the point of the line leak; Region B (~72 m^2) is most likely the result of contaminant migration from Pit 1; and Region C (~10 m^2) is believed to be associated with residual contamination from the line leak. Results of biased soil samples indicate ^{137}Cs as the dominant detectable radionuclide, with a maximum of 43,000 pCi/g and an average of 3100 pCi/g. Four RCRA hazardous waste characteristics [extraction procedure (EP) toxicity, ignitability, corrosivity, and reactivity] were not exhibited from eight soil samples taken at the survey site. Recommendations, including suggested corrective actions, are given.

RADIOLOGICAL AND RCRA HAZARDOUS WASTE SCOPING SURVEY OF THE DECONTAMINATION FACILITY (BUILDING 7819) TRANSFER LINE LEAK SITE

INTRODUCTION

An underground 15-cm (6-in.) vitrified pipeline, extending from the decontamination facility [Building 7819, Oak Ridge National Laboratory (ORNL)] southward beneath Lagoon Road ~93 m (~280 ft) to Pit 1, served to transfer (via gravity feed) decontamination waste solutions from Building 7819 into Pit 1 (a storage basin for liquid waste). Building 7819 is located north of Lagoon Road near the entrance to the Solid Waste Storage Area (SWSA) 4. This facility was used for decontaminating operating equipment (i.e., isotope carriers from laboratories and hot cells[1]) during the mid-1960s through the early 1970s.

First indications of the transfer line leak occurred in 1968-69 when trees began dying in areas where drainage could accumulate along the line. It is believed this toxic effect was because strong acids and/or alkalies were used in the Building 7819 decontamination procedures. In 1983, ~40 ft of the Building 7819 vitrified pipeline to Pit 1 was excavated during the SWSA 4 surface runoff diversion project. Approximately 200 ft^3 of contaminated soil (~5 mrad/h beta-gamma) and pipe sections (~120 mrad/h beta-gamma) were disposed of in trench 398 in SWSA 6. The exposed pipe ends were plugged in situ, as was the outdoor drain north of Building 7819, to prevent further leaking of contaminants. The drainpipe section was removed in order to make room for a drain from the SWSA 4 surface runoff collector located east of the site. Currently, this runoff is routed through the east weir drainage of the pits and trenches area.[2]

Between July and October 1951, Pit 1 received ~466,000 L (~123,000 gal) of concentrated liquid wastes (waste sources unidentified), which were transported in 1892-L (500-gal) tanks fitted on a Dempster Dumpster truck. Transportation of waste to the open pit was discontinued on October 5, 1951, when a leak consisting primarily of ^{106}Ru was discovered. Reportedly, Pit 1 received additional wastes from the Building 7819 transfer line from 1964 through 1970. (A separate septic tank and drain system was installed at Building 7819 in March 1964, but presumably this system was only used for nonradioactive discharges.) Pit 1 was filled with Conasauga shale and capped with asphaltic concrete in 1981.[2]

An August 1986 scoping survey of the exterior of the decontamination facility identified ^{137}Cs and ^{90}Sr as the primary radionuclides in soil samples.[3] It is believed that wastes transferred from this facility to Pit 1 would consist of various decontamination agents,

including soaps, chelating agents, oxalates, nitric acid, alkalies, and caustics, and radioactive wastes associated with decontamination procedures. The decontamination facility, transfer line leak site, and Pit 1 have been assigned Waste Area Group (WAG) number 7.0 [Low-Level Radioactive Waste (LLW) Pits and Trenches Area] as Solid Waste Management Units (SWMUs) 7.1, 7.4d, and 7.5, respectively, by the Remedial Action Program (RAP) of ORNL.[4]

An outdoor radiological and hazardous waste scoping survey of the Building 7819 transfer line leak site was conducted in February 1987 by the Environmental Assessments group of the Health and Safety Research Division (HASRD) of ORNL at the request of the Maintenance, Surveillance and Corrective Actions (MS&CA) Program of ORNL. The purpose of the scoping survey at this site was to determine what radioactive materials and Resource Conservation and Recovery Act (RCRA) hazardous wastes are present and to determine if their concentrations dictate corrective actions to prevent personnel exposure and/or spreading of surface contamination. Specifically, the objectives of the survey were: (1) to determine the nature and extent of radiological contamination and the nature and extent of hazardous waste as defined in RCRA; (2) to illustrate the areal extent of surface radiological contamination in conjunction with the ORNL master grid coordinate system; and (3) to collect and analyze biased surface (0-15 cm) and subsurface (15-<40 cm) soil samples for radionuclides and RCRA hazardous waste.

This report describes the results of the outdoor scoping survey. An overview of outdoor measurements and soil sample results, indexed to figures and tables, is presented in Table 1. Five views of the surveyed site are shown in Figs. 1 through 5, including a southwest view looking toward Pit 1. A scaled drawing of the grid system used in the outdoor survey of the transfer line leak site is shown in Fig. 6.

The results of this survey will be used to determine whether the site is in compliance with applicable U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), State of Tennessee, and ORNL Health Physics environmental and/or health regulations. Remedial action guidelines for surface soil concentrations of several radionuclides have been developed.[5,6] Although these guidelines are not applicable for ORNL facilities, they may be useful as a general reference for contamination cleanup and waste control.

SURVEY METHODS

The radiological and RCRA hazardous waste scoping survey at this site included: (1) gamma exposure rates at outdoor grid locations, 1 m above the ground surface and at the ground surface; (2) range of gamma exposure rates obtained during scan of grid blocks; (3) direct beta-gamma activity measurements on the ground surface; and (4) sampling of soil and analysis of these samples.

For convenience in reporting results, the outdoor area was subdivided into 6.6-m (20-ft) grid block subsections in accordance with the ORNL master grid system as shown on Fig. 6.

A comprehensive description of the survey methods and instrumentation is presented in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program,* Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).[7]

SURVEY RESULTS

BACKGROUND AND REGULATORY LEVELS

Typical radiation and chemical waste levels at ORNL sites vary because of past and present research and development activities, particularly those activities directly involved with radioactive materials and/or chemicals. In February 1987, uncontaminated areas on the Oak Ridge Reservation were investigated for levels of external gamma radiation, and concentrations of selected radionuclides were determined from sampled soil. These data are presented in Table 2 for comparison with the survey results presented in this section. The locations of these measurements and soil sampling sites are shown on Fig. 7.

All 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 samples.

In 1980, the EPA, under Subtitle C of RCRA, established regulatory levels for certain metals and pesticides using the Extraction Procedure Toxicity Characteristic (EPTC) test.[8] If the regulatory levels are exceeded, discarded materials or contaminated soils must be managed as hazardous waste. Table 3 presents the maximum concentration of contaminants for the EPTC.

GAMMA EXPOSURE RATES AND BETA-GAMMA MEASUREMENTS

The Building 7819 transfer line leak site was scanned with a portable gamma scintillation meter, and gamma radiation levels were recorded. Because scintillation meter readings are in counts per minute (cpm), a formula must be used to convert the data to microroentgens* per hour (μR/h). The equation is:

$$y = x/\mathrm{CF}$$

where

y = the exposure rate in μR/h,

x = the scintillometer measurements in counts per minute (cpm),

CF = the conversion factor determined in the field through a direct correlation between a selected number of Pressurized Ionization Chamber (PIC) measurements and scintillometer measurements in cpm/(μR/h).

For this site, CF = 732.

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*The roentgen (R) is a unit that was defined for radiation protection purposes for people exposed to penetrating x rays or gamma radiation. A microroentgen (μR) is one millionth of a roentgen. A milliroentgen (mR) is one thousandth of a roentgen or one thousand microroentgens.

In addition to gamma exposure rate measurements, a portable side-window Geiger-Mueller survey meter (GMSM, 30 mg/cm^2 wall thickness) was used to measure beta-gamma dose rates on the ground surface. Beta-gamma measurements were taken where gamma levels exceeded the upper detection limit of the gamma scintillometer [800,000 cpm (~1000 μR/h)].

Results of grid point/grid block gamma exposure rates and/or beta-gamma measurements are presented in Table 4. Due to radiation emanating from residual hot spot contamination at the site, it was necessary to dig numerous post holes (~30 cm deep) and lower the NaI probe of the portable gamma scintillation survey meter into the holes to more accurately define regions of contamination.

Three regions (A through C) of contamination and their respective areas (m^2) are shown in Fig. 8. Additionally, a 27-μR/h spot (<1 m^2) was found in grid block 42. Elevated gamma exposure rates ranging from 55 to 200 μR/h were found in an offsite area west of the transfer line leak site.

At Region A, the contamination extended along the transfer line and centered ORNL grid coordinates (in feet) North 19,010/East 26,850. Elevated gamma exposure rates near the ground surface scanned from 81 to $\geq$1000 μR/h, whereas direct beta-gamma activity levels on the ground surface ranged to 20 millirad* per hour (mrad/h). The total area of contamination in Region A encompasses ~86 m^2.

Region B, centered at ORNL grid coordinates North 18,920/East 26,310, showed elevated gamma exposure rates ranging from 34 to $\geq$1000 μR/h. Direct beta-gamma measurements on the ground surface ranged to 4 mrad/h at most locations. The total area of contamination in Region B encompasses ~72 m^2.

Region C, found west of the gridded site, showed elevated gamma exposure rates ranging from 130 to $\geq$1000 μR/h. Direct beta-gamma activity levels on the ground surface ranged to 4 mrad/h. The total area of contamination in Region C encompasses ~10 m^2.

SOIL SAMPLING — RADIONUCLIDES

Thirty-three soil samples were taken at the site. These biased samples [denoted as (BR) samples] were taken in regions having elevated gamma exposure rates. Samples were taken at depths of 0 to 15 cm (surface) and 15 to <40 cm (subsurface). The locations of soil sample hole numbers with regions of elevated gamma exposure rates are shown in Fig. 9, and the results of soil sample analysis (gamma-ray spectrometry) are presented in Tables 5-6.

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*The rad is the unit of absorbed dose and is defined as the amount of radiation required to cause absorption of 100 ergs per gram of medium. (The erg is a unit of energy. One erg in the form of heat will raise the temperature of 1 gram of water about 2.4 $\times$ 10^{-8}°C.) A millirad (mrad) is one thousandth of a rad.

The concentrations [picocuries* per gram (pCi/g)] of ^{60}Co, ^{137}Cs, ^{152}Eu, and ^{154}Eu are presented in Table 5. The concentrations of ^{40}K, ^{226}Ra, ^{228}Ra, and ^{232}Th are found in Table 6.

In biased soil samples, the range and mean concentration values [values greater than the minimum detectable activity (MDA)] for each radionuclide are as follows.

Cobalt-60 concentrations in soil ranged from 0.053 to 390 pCi/g and averaged 28 pCi/g. The maximum concentration of ^{60}Co (390 pCi/g) was identified in soil sample BR2A, hole #2, region A.

Cesium-137 concentrations in soil ranged from 0.29 to 43,000 pCi/g and averaged 3100 pCi/g. Concentrations as high as 43,000 pCi of ^{137}Cs per gram of soil were found in soil sample BR2A, hole #2, region A.

Europium-152 concentrations in soil ranged from 0.10 to 1000 pCi/g and averaged 58 pCi/g. The maximum concentration of ^{152}Eu (1000 pCi/g) was identified in soil sample BR2A, hole #2, region A.

Europium-154 concentrations in soil ranged from 0.033 to 1100 pCi/g and averaged 78 pCi/g. Concentrations as high as 1100 pCi of ^{154}Eu per gram of soil were found in soil sample BR2A, hole #2, region A.

Potassium-40 concentrations in soil ranged from 11 to 27 pCi/g and averaged 19 pCi/g. Concentrations as high as 27 pCi of ^{40}K per gram of soil were found in soil sample BR14B, hole #14, region B.

Radium-226 concentrations in soil ranged from 0.81 to 1.3 pCi/g and averaged 1.0 pCi/g. The maximum concentration of ^{226}Ra (1.3 pCi/g) was identified in soil samples BR8B, hole #8, region A, and BR12B, hole #12, region A.

Radium-228 concentrations in soil ranged from 0.97 to 2.3 pCi/g and averaged 1.5 pCi/g. Concentrations as high as 2.3 pCi of ^{228}Ra per gram of soil were found in soil samples BR11B, hole #11, region A.

Thorium-232 concentrations in soil ranged from 1.1 to 8.8 pCi/g and averaged 2.1 pCi/g. The maximum concentration of ^{232}Th (8.8 pCi/g) was identified in soil sample BR2A, hole #2, region A.

Gross alpha and beta activity, and total ^{90}Sr were determined in four biased soil samples. These data are presented in Table 7. Highest concentrations sampled from hole #1 (Region A) are as follows: gross alpha (65 pCi/g), gross beta (4300 pCi/g), and ^{90}Sr (1000 pCi/g).

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*The curie (Ci) is a unit used to define the radioactivity in a substance and equals that quantity of any radioactive isotope undergoing 2.2×10^{12} disintegrations per minute. The picocurie is one million-millionth of a curie, or that amount yielding 2.2 disintegrations per minute.

Background concentration levels of eight radionuclides were determined from soil samples taken from uncontaminated areas on the Oak Ridge Reservation. These data are presented in Table 2 for comparison with survey results.

SOIL SAMPLING — RCRA HAZARDOUS WASTE

The Resource Conservation and Recovery Act, as enacted by Congress in 1976, gave EPA the statutory authority to promulgate specific regulations governing the disposal of solid and hazardous wastes.[9] The first major codification in the *Code of Federal Regulations* was in 1980, and in 1984 substantial amendments were added that provided more detail and specific requirements. Effective October 25, 1986, ORNL was granted a permit by the Tennessee Department of Health and Environment, Division of Solid Waste Management, authorizing the storage of hazardous waste at the Hazardous Waste Storage Facility, Building 7652.[10] Issuance of this permit is in accordance with the Tennessee Hazardous Waste Management Act.

Two mechanisms were established for identifying a solid waste as hazardous: (1) an EPA hazardous waste list and (2) a set of EPA-defined hazardous waste characteristics. A solid waste not listed as a hazardous waste is deemed hazardous if it exhibits one of four characteristics: extraction procedure (EP) toxicity, ignitability, corrosivity, or reactivity.

EP Toxicity

The EP toxicity characteristic was designed to identify wastes that may leach hazardous concentrations of specific toxic constituents (see Table 3). EPA testing protocol requires leaching a sample of solid waste with an acetic acid solution (pH 5.0 $\pm$ 0.2) for 24 h and then testing the extract for contaminants identified in the Safe Drinking Water Act. Waste displays the EP toxicity characteristic if it exhibits concentrations of a toxic constituent 100 times those stated in the National Interim Primary Drinking Water Standards (DWS).

Table 8 gives the results of EP toxicity test for eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) in eight biased soil samples. All contaminant values are well below the maximum concentration for EP toxicity characteristic. Table 9 shows the results of EP toxicity test for four RCRA insecticides and two herbicides [Lindane, Endrin, Toxaphene, Methoxychlor, 2,4-D, and 2,4,5-TP (Silvex)]. All values are well below those given in Table 3 for the maximum concentration of contaminants for characteristic of EP toxicity.

Ignitability

A solid waste displays the characteristic of ignitability if it meets one of four criteria.

1. It is a liquid (other than an aqueous solution containing <24% alcohol by volume) with a flash point <60°C (140°F).
2. It is a nonliquid that under normal conditions can cause fire through friction, absorption of moisture, or spontaneous chemical changes, and it burns so vigorously when ignited that it creates a hazard.

3. It is an ignitable compressed gas [as defined by U.S. Department of Transportation (DOT) regulations in 49 CFR 173.300].
4. It is an oxidizer (as defined by DOT regulations in 49 CFR 173.151).

The ignitability characteristic of eight biased soil samples is shown in Table 10. For all soil samples tested, the flash point was >70°C, which is in compliance with the above stated criteria.

Corrosivity

A solid waste displays the characteristic of corrosivity if it meets one of two criteria.

1. It is aqueous and has a pH of ≤2.0 or ≥12.5.
2. It corrodes steel at a rate of >6.35 mm (0.250 in.) per year at a test temperature of 55°C (130°F).

Table 10 shows the corrosivity characteristic of eight biased soil samples. The pH ranged from 6.20 (BOI14B, hole #14, region B) to 7.90 (BOI15B, hole #15, region B), and the average pH was 6.98. These values indicate that the soil samples do not display the corrosivity characteristic.

Reactivity

The characteristic of reactivity is exhibited if wastes are extremely unstable, to the point of reacting violently or exploding during stages of waste management (e.g., when mixed with water or heated), or if wastes are cyanide- or sulfide-bearing and can generate toxic gases, vapors, or fumes when exposed to pHs between 2 and 12.5.

The eight soil samples listed in Table 10 were tested for the presence of sulfide and cyanide. Until EPA has determined specific limiting concentration levels for reactive cyanide and sulfide in solid wastes, interim guidelines currently requiring EPA action are available.[11] These levels are 250 and 500 mg/kg of waste for total releasable cyanide (HCN) and total releasable sulfide (H_2S), respectively. For all samples tested, cyanide and sulfide levels were below 0.09 and 20 μg/g, respectively. These values indicate that the samples do not display the reactivity characteristic.

SIGNIFICANCE OF FINDINGS

Measurements of gamma exposure levels taken outdoors at the transfer line leak site determined that exposure rates at 1 m above the ground surface at grid points ranged from 10 to ≥1000 μR/h and averaged 32 μR/h. Additionally, gamma exposure rates at the ground surface at grid locations ranged from 11 to ≥1000 μR/h and averaged 29 μR/h. For comparison, background gamma exposure rates (determined from 18 measurements taken from 9 uncontaminated locations on the Oak Ridge Reservation) at 1 m above the ground surface averaged 10 μR/h and ranged from 8 to 13 μR/h; background gamma exposure rates at the ground surface averaged 13 μR/h and ranged from 10 to 17 μR/h.

In Region A, elevated gamma exposure rates (81 to ≥1000 μR/h) and direct beta-gamma dose rates (20 mrad/h), are the result of residual surface contamination originating from the line leak. Region A, as defined in an area of ~86 m^2, most likely represents a surface zone of contamination above a saturated subsurface zone of contaminants at the point of the leak.

Region B surface gamma measurements (34 to ≥1000 μR/h) and beta-gamma activity levels (4 mrad/h), may possibly be the result of contaminant migration from Pit 1. Region B encompasses ~72 m^2 and is located at the base of a topographic slope ~22-m (~66-ft) north of Pit 1.

The source of radiological contamination of Region C is believed to be the result of contaminant migration from the line leak itself or contaminant migration from Pit 1. The surface topography at the survey site suggests a northwest downward grade toward Region C. This ~10 m^2 area, which is located west of the gridded site, showed gamma exposure rates ranging from 130 to ≥1000 μR/h, and beta-gamma activity levels ranging to 4 mrad/h.

Results of analysis of 33 biased soil samples indicate ^{137}Cs as the dominant detectable radionuclide. Cesium-137 concentrations averaged 3100 pCi/g and ranged as high as 43,000 pCi/g in surface soil sample BR2A, hole #2, region A. If surface soil remedial action guidelines* were applicable for this ORNL site, the maximum surface ^{137}Cs concentration (43,000 pCi/g) would exceed (by a factor of 537) the criterion of 80 pCi/g above background.[5] The maximum surface ^{90}Sr concentration (700 pCi/g), found in surface soil sample BR1A, hole #1, region A, would exceed (by a factor of 7) the criterion of 100 pCi/g above background.[5] It should be noted that these guidelines are based on evaluation of pathways of inhalation, ingestion, and external radiation exposure to humans from a 100-m^2 area of contamination. For comparative purposes, the average background concentration of ^{137}Cs, as determined by gamma spectrometry analysis of 12 soil samples taken from 7 uncontaminated locations on the Oak Ridge Reservation, is 0.77 pCi/g dry wt (Table 2).

Europium-152 and ^{154}Eu concentrations ranged as high as 1000 and 1100 pCi/g, respectively, in surface soil sample BR2A, hole #2, region A. These values exceed (by factors of 1.25 and 5.5) average surface soil contamination limits of 800 and 200 pCi/g, respectively. Furthermore, the spot activity limit for ^{154}Eu (480 pCi) is exceeded by a factor of 2.29.[6]

In Regions A and B, some soil samples were found to have high concentrations of various radionuclides. In Region A, soil sample BR2A (hole #2) contained the following radionuclides with their respective concentrations: ^{137}Cs (43,000 pCi/g), ^{154}Eu (1100 pCi/g), ^{152}Eu (1000 pCi/g), and ^{60}Co (390 pCi/g). Cesium-137 concentrations increased with soil depth in samples BR11A (0-15 cm), BR11B (15-30 cm), and BR11C (30-40

*Remedial action guidelines have been derived for specific application to the DOE's Formerly Utilized Site Remedial Action Program (FUSRAP). These guidelines are applicable to FUSRAP sites prior to their release for unrestricted use.

cm), with respective values of 0.29, 1300, and 9300 pCi/g. This suggests residual subsurface contamination near the point of the line leak. In Region B, ^{137}Cs concentrations in soil samples BR14A (hole #14), BR14B (hole #14), and BR15A (hole #15) were 12,000, 110, and 290 pCi/g, respectively.

The results of the Extraction Procedure Toxicity Characteristic test for eight RCRA metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury), four insecticides (Lindane, Endrin, Toxaphene, and Methoxychlor), and two herbicides [2,4-D and 2,4,5-TP (Silvex)] in eight biased soil samples indicate all contaminants were below their respective regulatory levels. In addition, soil samples did not exhibit RCRA hazardous waste characteristics for ignitability, corrosivity, or reactivity.

RECOMMENDATIONS

Analyses of radiological data from this scoping survey indicate a potential environmental and/or health hazard. We recommend that existing radiation control measures, as stated in the *ORNL Health Physics Manual,* be implemented for Regions A, B, and C, depicted in Fig. 10.[12] Currently (9/11/87), an old rope with several attached "contamination zone" signs lies on the ground near Region A. A permanent physical boundary, such as a metal chain attached to metal posts, should extend beyond the perimeters of Regions A, B, and C, and "Radiation Hazard — Keep Out" signs should be attached to the boundary marker. This type of sign is recommended by ORNL Health Physics personnel for use "in areas outside the main confines of the Laboratory and where members of the general public should be warned" (see Sect. 2.3 of Ref. 12).

These recommendations are in accordance with the radiation safety policy of ORNL to conduct all operations in such a manner that personnel exposures to radiation or contamination are maintained at a level as low as is reasonably achievable (ALARA).

We further suggest that areas west of the gridded site should be considered for a more detailed radiation survey. Small, spotty areas of elevated gamma exposure rates ranging from 55 to 200 μR/h were found ~83 m (~250 ft) northwest of Region A.

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ORNL-PHOTO 1389-87

Fig. 1. View looking west at the Building 7819 transfer line leak site from the Chemical Waste Area Access Road (2-12-87).

ORNL-PHOTO 1391-87

Fig. 2. View looking southwest at Pit 1 (2-12-87).

ORNL-PHOTO 1388-87

Fig. 3. View looking southwest at the Building 7819 transfer line leak site (2-12-87). [Note: Pressurized Ionization Chamber (PIC) and rope on ground surface.]

ORNL-PHOTO 1384-87

Fig. 4. View looking south at the Building 7819 transfer line leak site (2-12-87). [Note: Pressurized Ionization Chamber (PIC).]

ORNL-PHOTO 1387-87

Fig. 5. View looking west at the Building 7819 transfer line leak site (2-12-87).

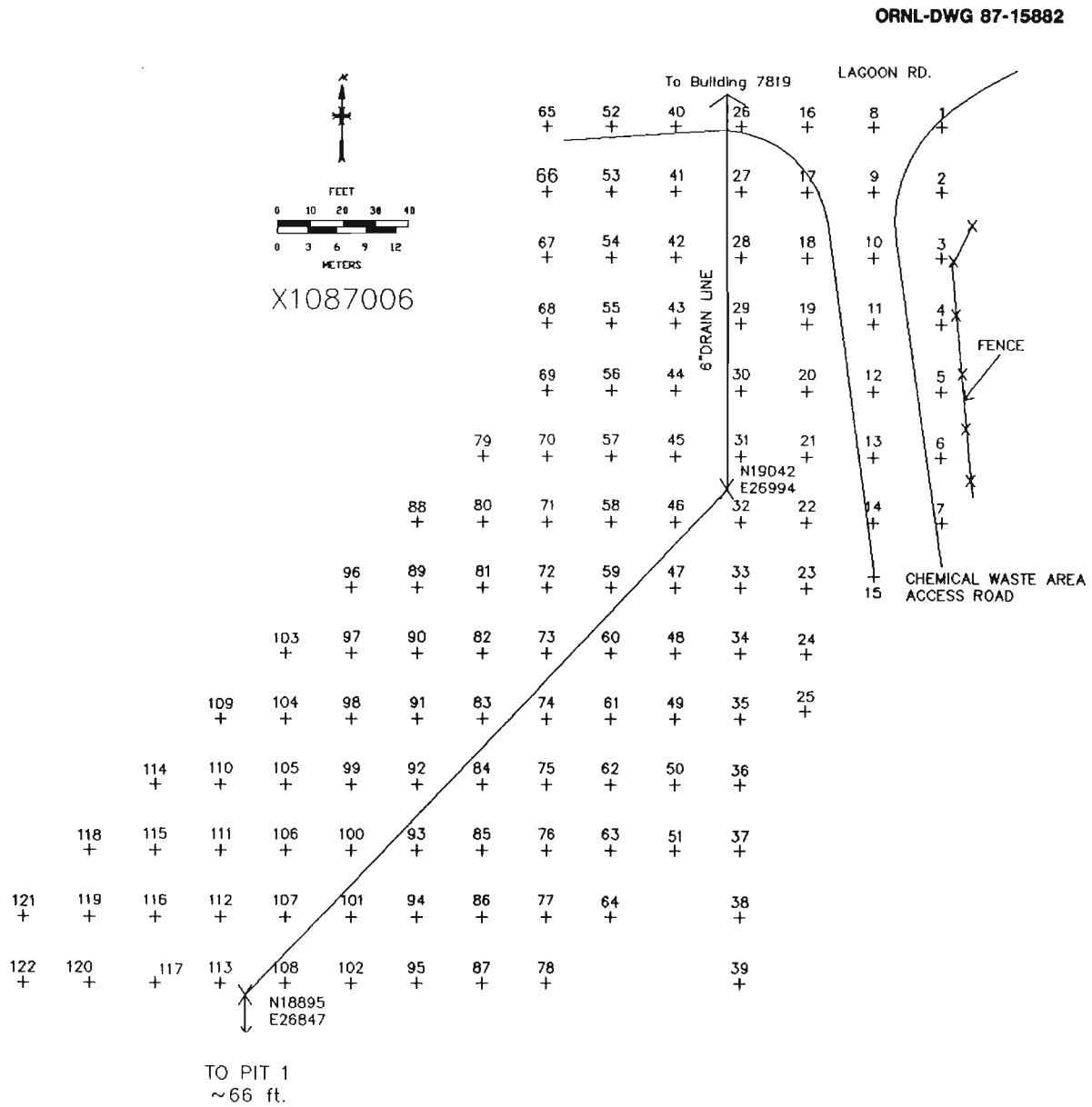


Fig. 6. Scaled drawing of the grid system used in the outdoor survey of the Building 7819 transfer line leak site.

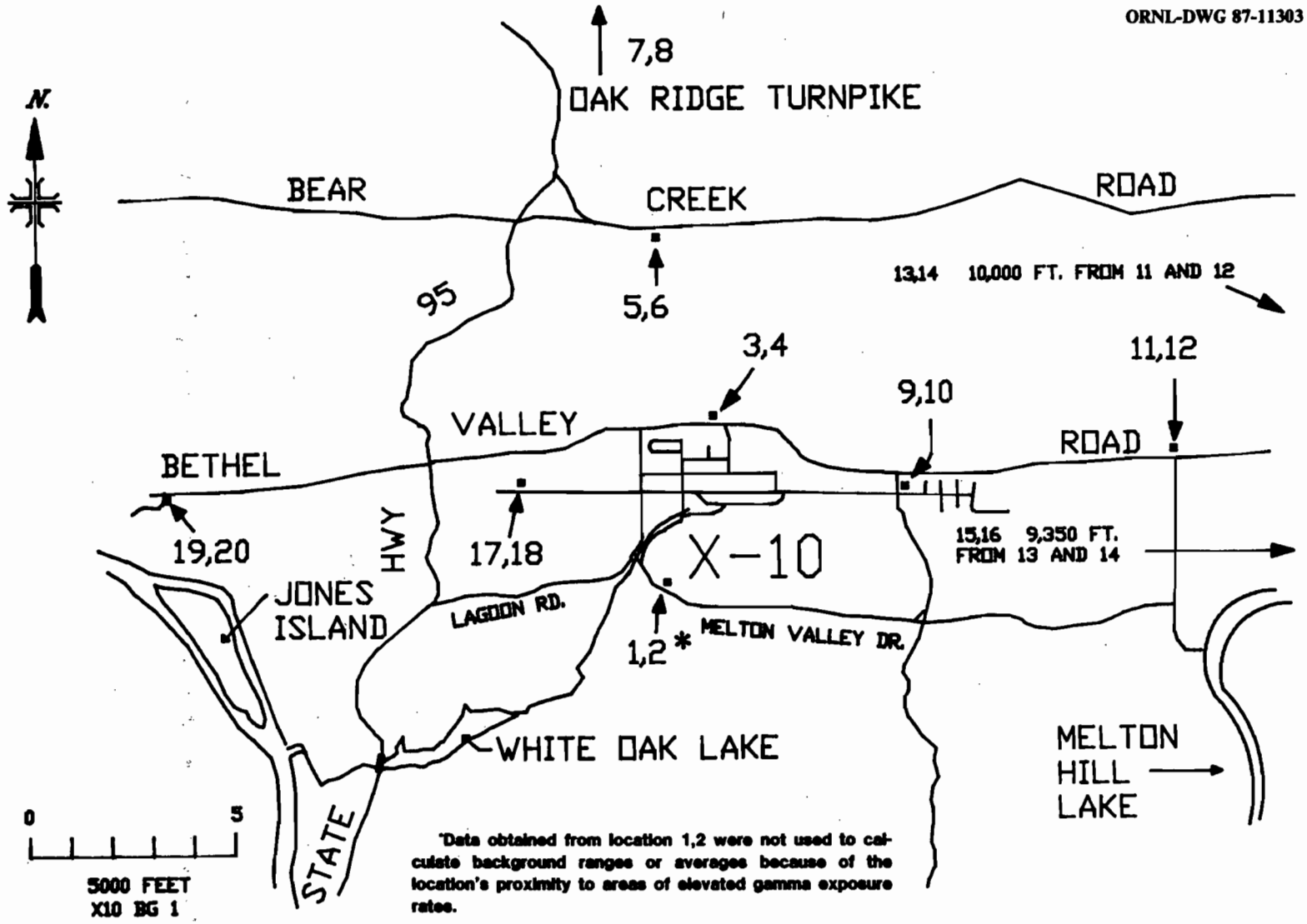
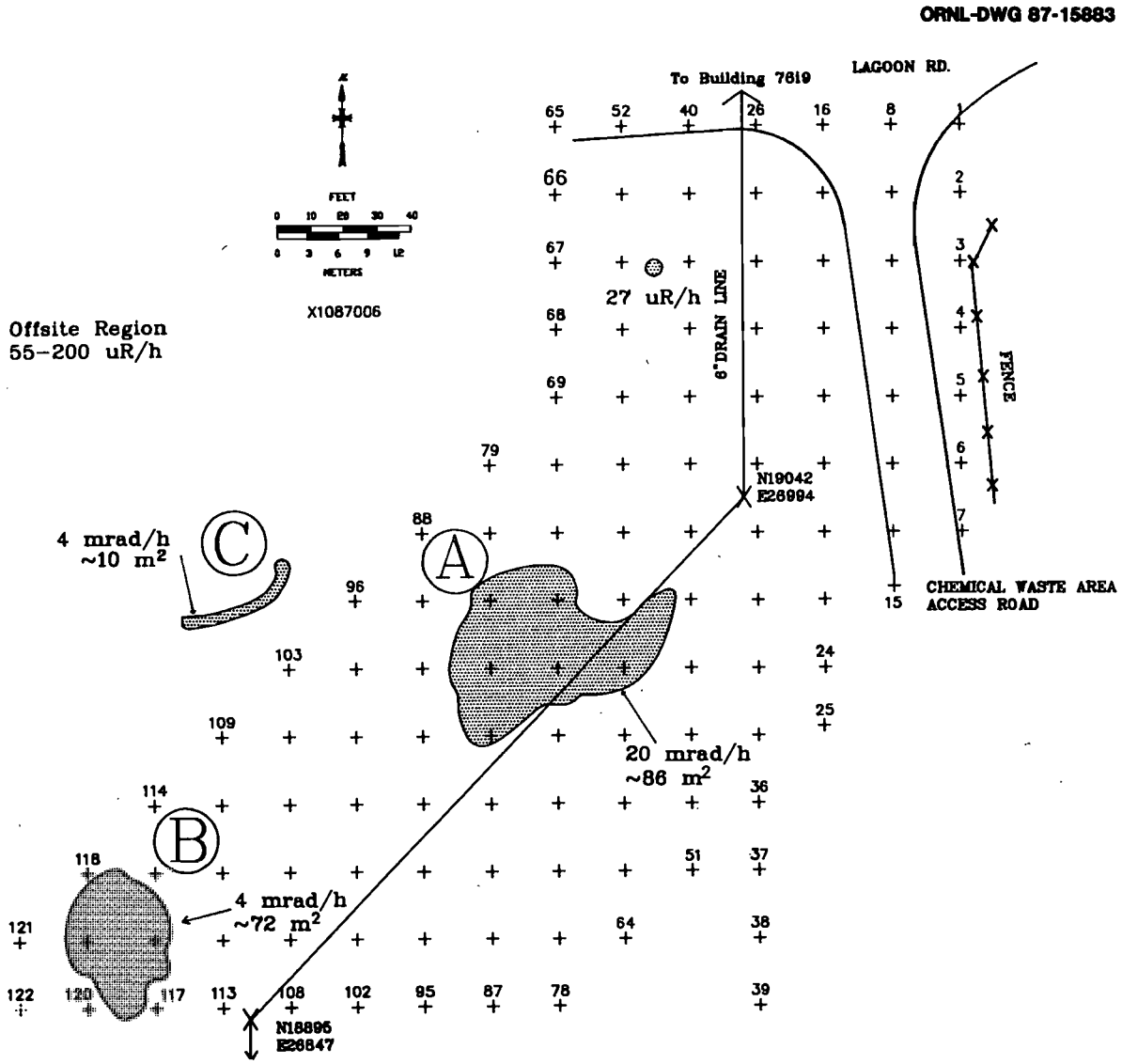
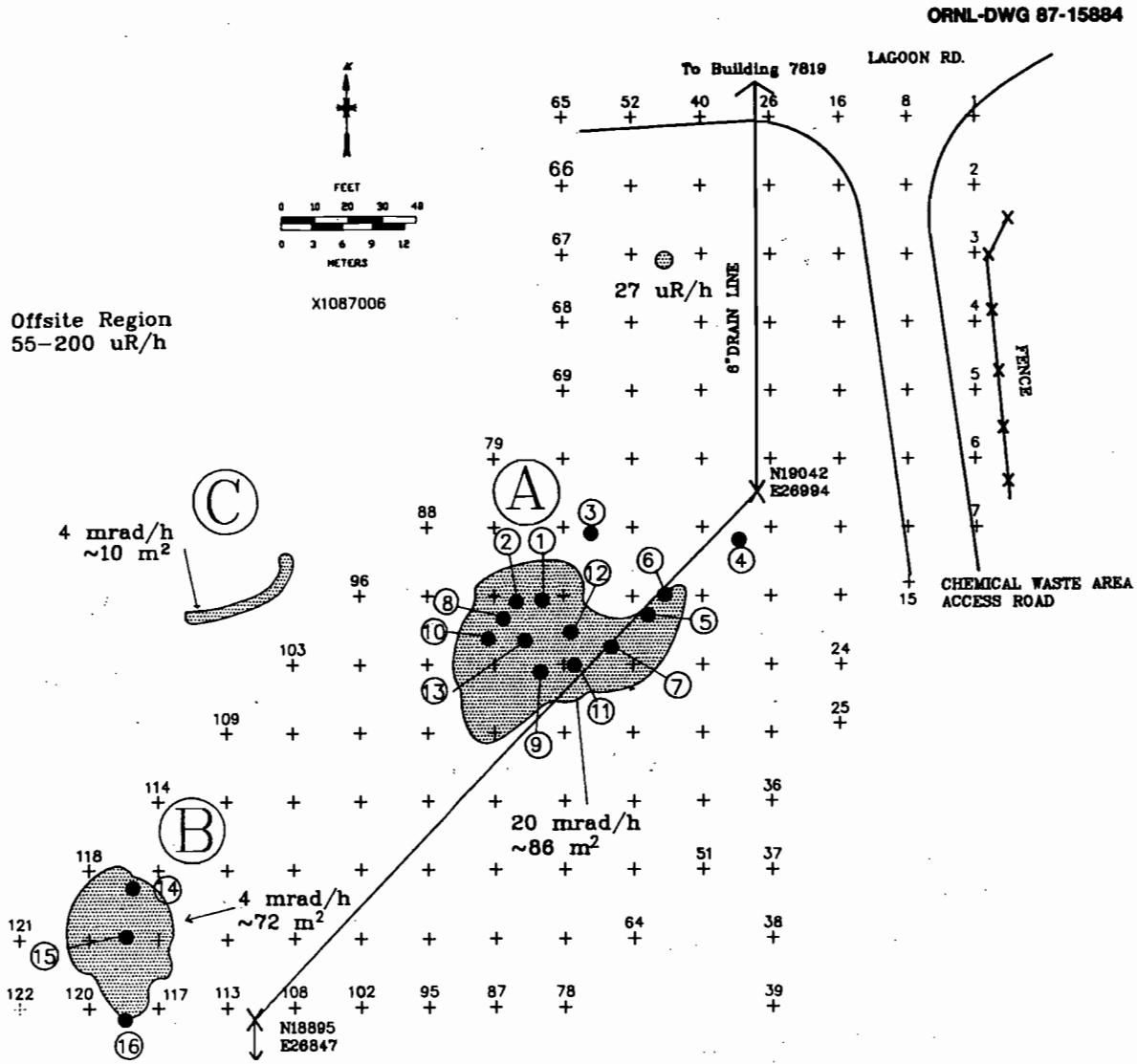


Fig. 7. Locations of gamma exposure rate measurements in uncontaminated areas on the Oak Ridge Reservation.



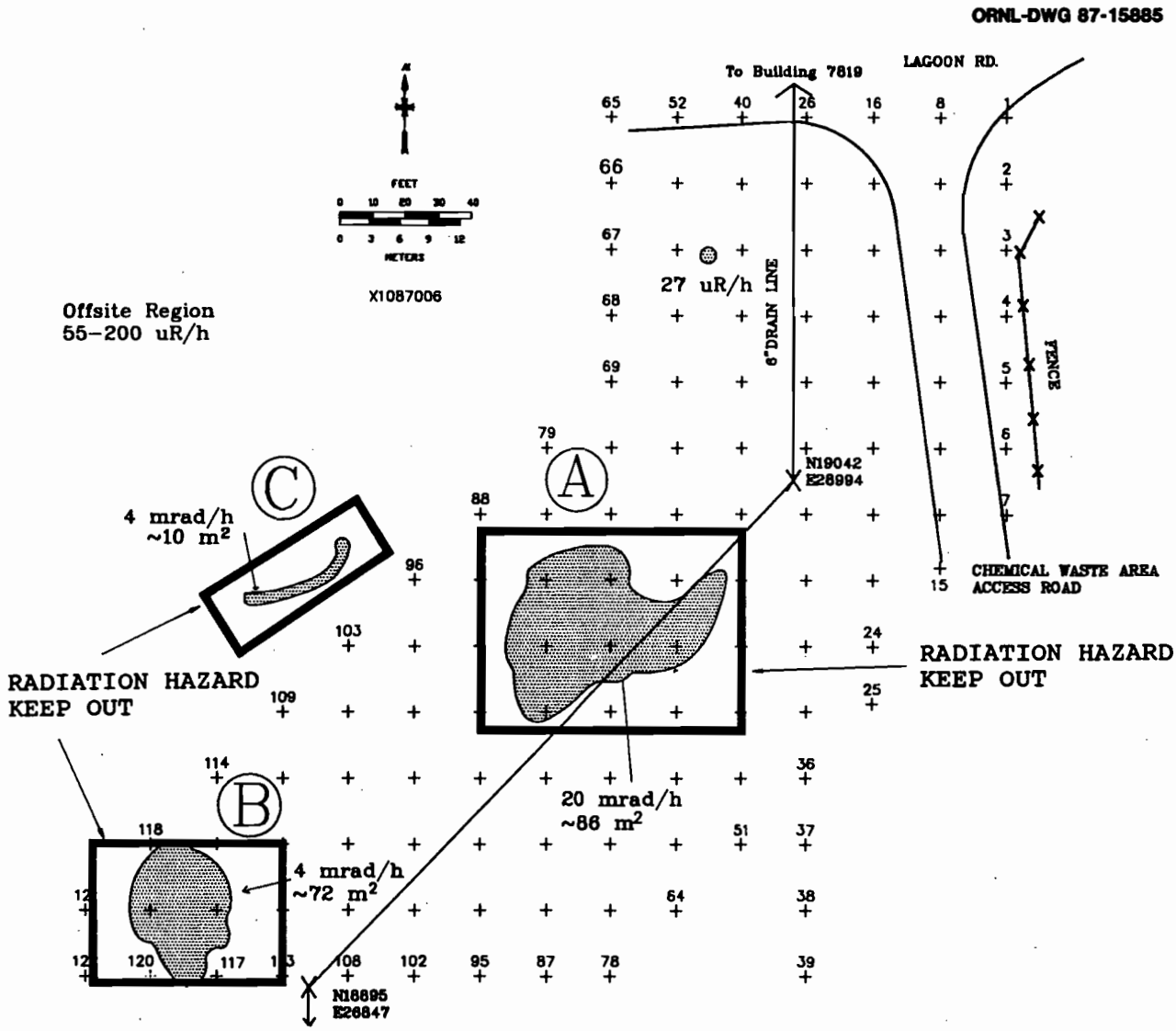
REGION	A	B	C
m^2	~86	~72	~10
uR/h	81–≥1000	34–≥1000	130–≥1000
mrad/h	20	4	4

Fig. 8. Locations of contaminated regions at the Building 7819 transfer line leak site.



REGION	A	B	C
m^2	~86	~72	~10
uR/h	81–≥1000	34–≥1000	130–≥1000
mrad/h	20	4	4

Fig. 9. Locations of soil sample hole numbers with contaminated regions at the Building 7819 transfer line leak site.



REGION	A	B	C
m^2	~86	~72	~10
uR/h	81–≥1000	34–≥1000	130–≥1000
mrad/h	20	4	4

Fig. 10. Locations of contaminated regions with recommended "Radiation Hazard — Keep Out" zones.

Table 1. Summary of outdoor measurements and soil sample results at the Building 7819 transfer line leak site, indexed to figures and tables

Measurement or sample type	Number of measurements or samples	Range[a]	Mean[b]	Figure number and location	Table number and location
Grid point measurements					
Gamma exposure rates at 1 m (μR/h)	122	10->1000	32	Fig. 6, p. 16	Table 4, p. 24
Gamma exposure rates at surface (μR/h)	122	11->1000	29	Fig. 6, p. 16	Table 4, p. 24
RCRA hazardous waste characteristics[c]					
EP toxicity test – 8 metals	8	–	–	Fig. 9, p. 19	Table 8, p. 33
EP toxicity test – 4 insecticides and 2 herbicides	8	–	–	Fig. 9, p. 19	Table 9, p. 34
Ignitability, corrosivity, and reactivity	8	–	–	Fig. 9, p. 19	Table 10, p. 35
Region A (~86 m^2)					
Scan, gamma exposure rates near surface (μR/h)	–	81->1000	–	Fig. 8, p. 18	Table 4, p. 24
Beta-gamma dose rates (mrad/h)	–	20	–	Fig. 8, p. 18	Table 4, p. 24
Concentration of selected radionuclides in soil[c] (pCi/g dry wt)					
^{60}Co	23	0.083-390	38	Fig. 9, p. 19	Table 5, p. 28
^{137}Cs	23	0.29-43,000	4000	Fig. 9, p. 19	Table 5, p. 28
^{152}Eu	23	0.10-1000	69	Fig. 9, p. 19	Table 5, p. 28
^{154}Eu	23	0.033-1100	87	Fig. 9, p. 19	Table 5, p. 28
Region B (~72 m^2)					
Scan, gamma exposure rates near surface (μR/h)	–	34->1000	–	Fig. 8, p. 18	Table 4, p. 24
Beta-gamma dose rates (mrad/h)	–	4	–	Fig. 8, p. 18	Table 4, p. 24
Concentration of selected radionuclides in soil[c] (pCi/g dry wt)					
^{60}Co	6	0.060-4.3	1.9	Fig. 9, p. 19	Table 5, p. 28
^{137}Cs	6	16-12,000	2100	Fig. 9, p. 19	Table 5, p. 28
Region C (~10 m^2)[d]					
Scan, gamma exposure rates near surface (μR/h)	–	130->1000	–	Fig. 8, p. 18	Table 4, p. 24
Beta-gamma dose rates (mrad/h)	–	4	–	Fig. 8, p. 18	Table 4, p. 24

[a]For soil samples, values preceded by "<" denote less than the minimum detectable activity (MDA).
[b]For soil samples, the mean excludes all values preceded by "<", which denotes less than the MDA.
[c]Biased soil samples.
[d]No soil samples were taken.

Table 2. Background radiation levels and concentration of selected radionuclides in soil samples taken on the Oak Ridge Reservation

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at 1 m above ground surface (μR/h)[a]	8-13	10
Gamma exposure rate at ground surface (μR/h)[a]	10-17	13
Concentration of selected radionuclides in soil (pCi/g dry wt)[b]		
^{137}Cs	0.045-2.6	0.77
^{40}K	2.6-19	10
^{226}Ra	0.40-1.3	0.93
^{228}Ra	0.46-1.7	0.88
^{232}Th	0.44-1.8	0.90
^{234}Th	1.0-3.2	1.9
^{235}U	0.025-0.061	0.044
^{238}U	0.53-1.5	1.0

[a]Values were obtained from 18 measurements taken from 9 locations on the Oak Ridge Reservation. (See Fig. 7 for locations.)

[b]These radionuclide concentrations represent values above the minimum detectable activity (MDA). Values for ^{137}Cs, ^{40}K, ^{226}Ra, ^{228}Ra, ^{232}Th, and ^{234}Th were obtained by gamma spectrometry analysis of 12 soil samples taken from 3 locations on the Oak Ridge Reservation. Values for ^{235}U and ^{238}U were obtained by neutron activation analysis of 21 soil samples taken from 6 locations on the Oak Ridge Reservation.

Table 3. Maximum concentration of contaminants for toxicity characteristic by extraction procedure[a]

EPA hazardous waste identification number	Contaminant	Chemical Abstracts Registry number	Maximum concentration (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100
D006	Cadmium	7440-43-9	1.0
D007	Chromium	1333-82-0	5.0
D008	Lead	7439-92-1	5.0
D009	Mercury	7439-97-6	0.2
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D012	Endrin (1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8-dimethano-naphthalene)	72-20-8	0.02
D013	Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer)	58-89-9	0.4
D014	Methoxychlor (1,1,1-Trichloro-2,2-bis [p-methoxyphenyl]ethane)	72-43-5	10
D015	Toxaphene ($C_{10}H_{10}Cl_8$, Technical chlorinated camphene, 67-69 percent chlorine)	8001-35-2	0.5
D016	2,4-D (2,4-Dichlorophenoxyacetic acid)	94-75-7	10
D017	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	93-76-5	1.0

[a]40 CFR 261.24, Ch 1 (7-1-85 Edition) Characteristics of EP toxicity.

Table 4. Results of the radiological measurements outdoors at the Building 7819 transfer line leak site

Grid point	Location[a]		Grid point measurements[b] (μR/h)		Range of gamma exposure rates during scan of grid blocks[c] (μR/h)
	North	East	Gamma exposure rate at 1 m	Gamma exposure rate at the surface	
1	19160	27060	16	14	12–15
2	19140	27060	16	16	12–15
3	19120	27060	18	16	12–15
4	19100	27060	18	18	12–15
5	19080	27060	16	16	12–15
6	19060	27060	15	16	12–15
7	19040	27060	18	18	d
8	19160	27040	16	14	12–15
9	19140	27040	14	14	12–15
10	19120	27040	14	14	12–15
11	19100	27040	14	14	12–15
12	19080	27040	14	14	12–15
13	19060	27040	14	14	12–15
14	19040	27040	14	14	12–15
15	19020	27040	14	14	d
16	19160	27020	14	14	11–14
17	19140	27020	14	12	12–16
18	19120	27020	14	14	11–16
19	19100	27020	14	12	11–16
20	19080	27020	14	14	14–18
21	19060	27020	14	12	12–16
22	19040	27020	16	15	15–20
23	19020	27020	15	14	12–19
24	19000	27020	16	18	16–19
25	18980	27020	14	14	d
26	19160	27000	14	14	12–18
27	19140	27000	15	14	14–18
28	19120	27000	14	14	14–16
29	19100	27000	14	14	12–15
30	19080	27000	14	14	14–15
31	19060	27000	18	16	15–23
32	19040	27000	16	16	16–22
33	19020	27000	18	15	14–20
34	19000	27000	16	16	15–20
35	18980	27000	16	16	15–20
36	18960	27000	15	15	14–16
37	18940	27000	14	14	d
38	18920	27000	14	14	d
39	18900	27000	18	18	d

Table 4 (continued)

Grid point	Location[a] North	Location[a] East	Grid point measurements[b] (μR/h) Gamma exposure rate at 1 m	Grid point measurements[b] (μR/h) Gamma exposure rate at the surface	Range of gamma exposure rates during scan of grid blocks[c] (μR/h)
40	19160	26980	14	11	11–14
41	19140	26980	14	14	12–16
42	19120	26980	15	15	14–27
43	19100	26980	16	15	15–18
44	19080	26980	14	15	14–16
45	19060	26980	14	14	14–25
46	19040	26980	25	22	20–34
47	19020	26980	24	20	20–260
48	19000	26980	19	18	16–27
49	18980	26980	16	16	15–20
50	18960	26980	18	18	14–20
51	18940	26980	16	14	d
52	19160	26960	10	14	10–14
53	19140	26960	14	12	12–16
54	19120	26960	15	15	12–16
55	19100	26960	18	16	15–19
56	19080	26960	23	20	20–26
57	19060	26960	23	20	19–27
58	19040	26960	23	19	27–55
59	19020	26960	57	34	55–≥1000[e]
60	19000	26960	61	27	20–27
61	18980	26960	22	19	16–22
62	18960	26960	16	15	15–18
63	18940	26960	15	18	14–18
64	18920	26960	18	14	d
65	19160	26940	14	12	d
66	19140	26940	15	11	d
67	19120	26940	16	16	d
68	19000	26940	19	18	d
69	19080	26940	22	18	d
70	19060	26940	26	23	23–35
71	19040	26940	41	33	27–64
72	19020	26940	150	41	41–≥1000[e]
73	19000	26940	≥1000[f]	≥1000[f]	41–≥1000[f]
74	18980	26940	30	23	18–20
75	18960	26940	20	18	15–25
76	18940	26940	20	18	16–25
77	18920	26940	18	16	16–19
78	18900	26940	20	20	d
79	19060	26920	26	23	d

Table 4 (continued)

Grid point	Location[a] North	Location[a] East	Grid point measurements[b] (μR/h) Gamma exposure rate at 1 m	Grid point measurements[b] (μR/h) Gamma exposure rate at the surface	Range of gamma exposure rates during scan of grid blocks[c] (μR/h)
80	19040	26920	41	34	25–55
81	19020	26920	78	56	22–79
82	19000	26920	81	44	20–26
83	18980	26920	27	23	16–27
84	18960	26920	19	19	16–20
85	18940	26920	22	19	18–25
86	18920	26920	19	18	15–19
87	18900	26920	20	20	d
88	19040	26900	26	20	d
89	19020	26900	35	30	20–26
90	19000	26900	34	25	20–25
91	18980	26900	20	19	16–20
92	18960	26900	19	18	15–20
93	18940	26900	19	18	16–23
94	18920	26900	18	16	15–20
95	18900	26900	20	20	d
96	19020	26880	27	31	d
97	19000	26880	20	18	18–27
98	18980	26880	20	19	19–20
99	18960	26880	20	19	19–25
100	18940	26880	20	20	18–22
101	18920	26880	19	19	18–20
102	18900	26880	22	22	d
103	19000	26860	37	30	d
104	18980	26860	20	27	18–27
105	18960	26860	26	22	20–27
106	18940	26860	22	20	20–23
107	18920	26860	20	20	20–22
108	18900	26860	22	22	d
109	18980	26840	61	48	d
110	18960	26840	27	19	19–34
111	18940	26840	26	22	20–180
112	18920	26840	26	23	20–200
113	18900	26840	22	18	d
114	18960	26820	34	27	d
115	18940	26820	41	27	27–$\geq$1000[g]
116	18920	26820	120	190	25–340
117	18900	26820	27	23	d
118	18940	26800	31	25	d

Table 4 (continued)

Grid point	Location[a] North	Location[a] East	Grid point measurements[b] (μR/h) Gamma exposure rate at 1 m	Grid point measurements[b] (μR/h) Gamma exposure rate at the surface	Range of gamma exposure rates during scan of grid blocks[c] (μR/h)
119	18920	26800	55	61	25−61
120	18900	26800	31	30	d
121	18920	26780	23	22	d
122	18900	26780	27	31	d

[a]Grid point locations are shown on Fig. 6.

[b]Grid point measurements are discrete measurements at each grid point.

[c]Grid block measurements are obtained by a surface gamma scan of each grid block using the upper right coordinate as the grid block designation.

[d]Offsite.

[e]Gamma levels exceeded the detection limit of the gamma scintillometer (>800 kcpm). Surface beta-gamma dose rates in grid blocks #59 and #72 ranged to 5 mrad/h.

[f]Gamma levels exceeded the detection limit of the gamma scintillometer. Surface beta-gamma dose rates at grid point #73 (1 m and ground surface) and grid block #73 ranged to 3, 5, and 20 mrad/h, respectively.

[g]Gamma levels exceeded the detection limit of the gamma scintillometer. Surface beta-gamma dose rates at grid block #115 ranged to 4 mrad/h.

Table 5. Concentration of ^{60}Co, ^{137}Cs, ^{152}Eu, and ^{154}Eu in biased soil samples from the Building 7819 transfer line leak site[a]

Hole number[b]	Sample ID	Location[b]		Depth (cm)	Radionuclide concentration (pCi/g dry wt)[c,d]			
		North	East		^{60}Co	^{137}Cs	^{152}Eu	^{154}Eu
1	BR1A	19001	26940	0-15	30 ± 1	19000 ± 50	31 ± 5	22 ± 5
1	BR1B	19001	26940	15-30	74 ± 1	7600 ± 30	75 ± 9	76 ± 10
2	BR2A	19007	26937	0-15	390 ± 2	43000 ± 70	1000 ± 90	1100 ± 30
2	BR2B	19007	26937	15-30	70 ± 2	7900 ± 20	130 ± 3	130 ± 8
3	BR3A	19022	26945	0-15	3.8 ± 0.2	460 ± 3	9.2 ± 1	9.3 ± 2
3	BR3B	19022	26945	15-30	0.053 ± 0.004	6.8 ± 0.2	0.14 ± 0.1	0.19 ± 0.2
4	BR4A	19040	26980	0-15	0.11 ± 0.004	25 ± 0.5	0.21 ± 0.3	<0.16
4	BR4B	19040	26980	15-30	<0.084	24 ± 0.4	<0.49	<0.22
5	BR5A	19023	26949	0-15	10 ± 0.6	1000 ± 8	4.9 ± 1	6.7 ± 2
5	BR5B	19023	26949	15-30	0.37 ± 0.04	52 ± 0.9	0.58 ± 0.6	<0.23
6	BR6A	19020	26971	0-15	0.99 ± 0.06	98 ± 0.9	0.63 ± 0.8	1.0 ± 0.4
6	BR6B	19020	26971	15-30	0.52 ± 0.01	21 ± 0.4	<0.60	e
7	BR7A	18995	26945	0-15	0.57 ± 0.003	41 ± 0.6	0.37 ± 0.8	0.58 ± 0.2
7	BR7B	18995	26945	15-30	27 ± 0.09	1100 ± 4	2.8 ± 1	3.9 ± 1
8	BR8A	19015	26918	0-15	0.91 ± 0.03	73 ± 1	1.5 ± 0.5	1.4 ± 0.2
8	BR8B	19015	26918	15-30	0.11 ± 0.02	1.5 ± 0.1	0.10 ± 0.2	e
9	BR9A	19000	26930	0-15	<0.049	2.1 ± 0.1	<0.42	<0.14
9	BR9B	19000	26930	15-30	2.9 ± 0.07	140 ± 2	3.9 ± 0.6	3.5 ± 0.4
10	BR10A	19010	26918	0-15	0.089 ± 0.003	2.2 ± 0.1	0.19 ± 0.4	<0.10
10	BR10B	19010	26918	15-30	<0.032	0.52 ± 0.05	<0.054	<0.10
11	BR11A	19000	26943	0-15	8.8 ± 0.01	0.29 ± 0.2	5.8 ± 0.4	5.4 ± 0.2
11	BR11B	19000	26943	15-30	46 ± 0.5	1300 ± 7	7.2 ± 0.4	6.4 ± 2
11	BR11C	19000	26943	30-40	75 ± 0.4	9300 ± 30	79 ± 8	73 ± 20
12	BR12A	19008	26940	0-15	47 ± 0.3	710 ± 6	42 ± 4	41 ± 4
12	BR12B	19008	26940	15-30	9.4 ± 0.1	16 ± 0.4	1.4 ± 0.6	1.2 ± 0.4
13	BR13A	19015	26925	0-15	0.23 ± 0.05	27 ± 0.3	0.25 ± 0.1	0.45 ± 0.1
13	BR13B	19015	26925	15-30	0.083 ± 0.02	4.3 ± 0.1	0.11 ± 0.2	0.033 ± 0.2
14	BR14A	18932	26812	0-15	0.060 ± 0.4	12000 ± 30	<4.9	<1.2
14	BR14B	18932	26812	15-30	<0.067	110 ± 1	<0.51	<0.21

Table 5 (continued)

Hole number[b]	Sample ID	Location[b] North	Location[b] East	Depth (cm)	Radionuclide concentration (pCi/g dry wt)[c,d] ^{60}Co	^{137}Cs	^{152}Eu	^{154}Eu
15	BR15A	18918	26806	0-15	1.7 ± 0.1	290 ± 2	<0.68	<0.21
15	BR15B	18918	26806	15-30	0.081 ± 0.002	16 ± 0.2	0.41 ± 0.6	<0.098
16	BR16A	18900	26803	0-15	4.3 ± 0.06	41 ± 0.6	<0.78	<0.26
16	BR16B	18900	26803	15-30	3.5 ± 0.05	29 ± 0.4	<0.57	<0.20

[a]Biased samples are taken from areas shown to have elevated gamma exposure rates.
[b]Grid locations and soil sample hole numbers are shown on Figs. 6 and 9, respectively.
[c]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).
[d]Values preceded by "<" denote less than the minimum detectable activity (MDA).
[e]No analysis performed.

Table 6. Concentration of ^{40}K, ^{226}Ra, ^{228}Ra, and ^{232}Th in biased soil samples from the Building 7819 transfer line leak site[a]

Hole number[b]	Sample ID	Location[b]		Depth (cm)	Radionuclide concentration (pCi/g dry wt)[c,d]			
		North	East		^{40}K	^{226}Ra	^{228}Ra	^{232}Th
1	BR1A	19001	26940	0-15	23 ± 10	<16	<9.2	4.7 ± 2
1	BR1B	19001	26940	15-30	12 ± 7	<7.4	<4.8	2.9 ± 1
2	BR2A	19007	26937	0-15	<21	<23	<21	8.8 ± 3
2	BR2B	19007	26937	15-30	14 ± 6	<6.0	<4.1	3.7 ± 1
3	BR3A	19022	26945	0-15	13 ± 3	1.2 ± 0.7	1.4 ± 0.4	1.3 ± 0.3
3	BR3B	19022	26945	15-30	12 ± 1	1.2 ± 0.2	1.4 ± 0.1	1.5 ± 0.2
4	BR4A	19040	26980	0-15	18 ± 2	0.81 ± 0.2	1.1 ± 0.4	1.2 ± 0.3
4	BR4B	19040	26980	15-30	17 ± 2	0.98 ± 0.2	1.3 ± 0.02	1.4 ± 0.2
5	BR5A	19023	26949	0-15	20 ± 5	<2.4	1.4 ± 2	1.5 ± 0.3
5	BR5B	19023	26949	15-30	16 ± 2	1.1 ± 0.2	1.3 ± 0.07	1.3 ± 0.4
6	BR6A	19020	26971	0-15	19 ± 2	0.90 ± 0.2	1.1 ± 0.6	1.3 ± 0.7
6	BR6B	19020	26971	15-30	11 ± 2	1.1 ± 0.1	1.5 ± 0.2	1.5 ± 0.2
7	BR7A	18995	26945	0-15	22 ± 2	0.84 ± 0.2	1.4 ± 0.5	1.5 ± 0.4
7	BR7B	18995	26945	15-30	18 ± 3	<1.3	1.7 ± 1	1.7 ± 0.1
8	BR8A	19015	26918	0-15	18 ± 2	1.1 ± 0.3	1.5 ± 0.3	1.6 ± 0.3
8	BR8B	19015	26918	15-30	12 ± 1	1.3 ± 0.1	1.3 ± 0.3	1.4 ± 0.3
9	BR9A	19000	26930	0-15	24 ± 2	0.93 ± 0.2	1.5 ± 0.2	1.5 ± 0.3
9	BR9B	19000	26930	15-30	25 ± 3	0.96 ± 0.4	1.9 ± 0.5	2.1 ± 0.4
10	BR10A	19010	26918	0-15	25 ± 1	0.88 ± 0.1	1.5 ± 0.07	1.4 ± 0.2
10	BR10B	19010	26918	15-30	26 ± 1	0.96 ± 0.05	1.5 ± 0.08	1.5 ± 0.1
11	BR11A	19000	26943	0-15	21 ± 1	0.97 ± 0.2	1.6 ± 0.1	1.7 ± 0.2
11	BR11B	19000	26943	15-30	14 ± 4	<2.2	2.3 ± 3	3.1 ± 1
11	BR11C	19000	26943	30-40	11 ± 8	<8.1	<5.7	4.3 ± 2
12	BR12A	19008	26940	0-15	19 ± 5	<2.0	<2.7	2.2 ± 0.07
12	BR12B	19008	26940	15-30	13 ± 1	1.3 ± 0.2	1.3 ± 0.5	1.4 ± 0.5
13	BR13A	19015	26925	0-15	19 ± 1	0.91 ± 0.1	0.97 ± 0.4	1.1 ± 0.4
13	BR13B	19015	26925	15-30	22 ± 1	0.83 ± 0.2	1.3 ± 0.2	1.3 ± 0.2
14	BR14A	18932	26812	0-15	22 ± 6	<7.2	<2.8	1.3 ± 0.9
14	BR14B	18932	26812	15-30	27 ± 2	0.84 ± 0.2	1.7 ± 0.4	1.6 ± 0.4

Table 6 (continued)

Hole number[b]	Sample ID	Location[b] North	Location[b] East	Depth (cm)	Radionuclide concentration (pCi/g dry wt)[c,d] ^{40}K	^{226}Ra	^{228}Ra	^{232}Th
15	BR15A	18918	26806	0-15	25 ± 3	0.93 ± 0.4	1.5 ± 0.04	1.7 ± 0.4
15	BR15B	18918	26806	15-30	26 ± 1	0.97 ± 0.2	1.5 ± 0.09	1.6 ± 0.1
16	BR16A	18900	26803	0-15	22 ± 2	1.1 ± 0.3	1.7 ± 0.3	1.5 ± 0.5
16	BR16B	18900	26803	15-30	25 ± 2	0.96 ± 0.1	1.6 ± 0.1	1.6 ± 0.2

[a]Biased samples are taken from areas shown to have elevated gamma exposure rates.
[b]Grid locations and soil sample hole numbers are shown on Figs. 6 and 9, respectively.
[c]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).
[d]Values preceded by "<" denote less than the minimum detectable activity (MDA).
[e]No analysis performed.

Table 7. Gross alpha, gross beta, and total ^{90}Sr in biased soil samples[a] from the Building 7819 transfer line leak site

Hole number[b]	Sample ID	Location[b]		Depth (cm)	Gross alpha (pCi/g dry wt)	Gross beta (pCi/g dry wt)	Total ^{90}Sr (pCi/g dry wt)
		North	East				
1	BR1A	19001	26940	0-15	65 ± 80	3500 ± 300	700 ± 30
1	BR1B	19001	26940	15-30	49 ± 60	4300 ± 300	1000 ± 30
2	BR2A	19007	26937	0-15	<35	1400 ± 200	650 ± 30
2	BR2B	19007	26937	15-30	22 ± 50	620 ± 200	380 ± 30

[a]Biased samples are taken from areas shown to have elevated gamma exposure rates.
[b]Grid locations and soil sample hole numbers are shown on Figs. 6 and 9, respectively.

Table 8. Results of the Extraction Procedure Toxicity Characteristic test for eight RCRA metals in biased soil samples[a] from the Building 7819 transfer line leak site

Hole number[b]	Sample ID	Location[b]		Depth (cm)	Solids (%)	Concentration (mg/L)[c,d]							
		North	East			Arsenic (As)	Barium (Ba)	Cadmium (Cd)	Chromium (Cr)	Lead (Pb)	Mercury (Hg)	Selenium (Se)	Silver (Ag)
9	BOI9A	19000	26930	0-15	81	<0.10	0.091	<0.0050	<0.040	<0.20	0.0010	<0.20	<0.050
9	BOI9B	19000	26930	15-30	81	<0.10	0.071	<0.0050	<0.040	<0.20	0.0004	<0.20	<0.050
11	BOI11A	19000	26943	0-15	81.5	<0.10	0.12	0.015	<0.040	0.21	0.0016	<0.20	<0.050
11	BOI11B	19000	26943	15-30	81.6	<0.10	0.11	<0.0050	<0.040	<0.20	0.0016	<0.20	<0.050
14	BOI14A	18932	26812	0-15	81.9	<0.10	0.11	<0.0050	<0.040	<0.20	0.0012	<0.20	<0.050
14	BOI14B	18932	26812	15-30	82.3	<0.10	0.12	<0.0050	<0.040	<0.20	0.0006	<0.20	<0.050
15	BOI15A	18918	26806	0-15	83.6	<0.10	0.13	<0.0050	<0.040	<0.20	0.0010	<0.20	<0.050
15	BOI15A	18918	26806	15-30	86	<0.10	0.29	<0.0050	<0.040	<0.20	0.0008	<0.20	<0.050

[a]Biased samples are taken from areas shown to have elevated gamma exposure rates.
[b]Grid locations and soil sample locations are shown on Figs. 6 and 9, respectively.
[c]Arsenic, barium, cadmium, chromium, lead, selenium, and silver analyses were performed in accordance with EPA procedure 6010.
[d]The inductive coupled plasma spectrometer (ICP) method was used to measure all metals except mercury. The mercury analysis was performed by the cold vapor atomic absorption (CVAA) method.

Table 9. Results of the Extraction Procedure Toxicity Characteristic test for four RCRA insecticides and two herbicides in biased soil samples from the Building 7819 transfer line leak site

Hole number[a]	Sample ID	Location[a]		Depth (cm)	Detection Limit (mg/L)					
		North	East		Lindane[b] 4P[d]	Endrin[b] 14P[d]	Toxaphene[b] 25P[d]	Methoxychlor[b] 400[d]	2,4-D[c] 401[d]	2,4,5-TP (Silvex)[c] 402[d]
9	BR9A	19000	26930	0-15	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
9	BR9B	19000	26930	15-30	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
11	BR11A	19000	26943	0-15	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
11	BR11B	19000	26943	15-30	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
14	BR14A	18932	26812	0-15	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
14	BR14B	18932	26812	15-30	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
15	BR15A	18918	26806	0-15	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01
15	BR15B	18918	26806	15-30	<0.002	<0.0002	<0.005	<0.008	<0.01	<0.01

[a]Grid locations and soil sample locations are shown on Figs. 6 and 9, respectively.
[b]Electron capture detector.
[c]High performance liquid chromatography.
[d]National Pollution Discharge Elimination System (NPDES) compound number.

Table 10. Ignitability, corrosivity, and reactivity characteristics of biased soil samples[a] from the Building 7819 transfer line leak site

Hole number[b]	Sample ID	Location[b]		Depth (cm)	Solids (%)	Ignitability flash point[c] (°C)	Corrosivity (pH)	Reactivity[d]	
		North	East					Sulfide (μg/g)	Total cyanide[e] (CN) (μg/g)
9	BOI9A	19000	26930	0-15	81	>70	6.94	<10	0.09
9	BOI9B	19000	26930	15-30	81	>70	7.07	<10	0.07
11	BOI11A	19000	26943	0-15	81.5	>70	6.56	20	0.05
11	BOI11B	19000	26943	15-30	81.6	>70	6.78	<10	<0.03
14	BOI14A	18932	26812	0-15	81.9	>70	6.82	20	0.09
14	BOI14B	18932	26812	15-30	82.3	>70	6.20	10	0.05
15	BOI15A	18918	26806	0-15	83.6	>70	7.53	20	0.07
15	BOI15B	18918	26806	15-30	86	>70	7.90	<10	<0.03

[a]Biased samples are taken from areas shown to have elevated gamma exposure rates.
[b]Grid locations and soil sample locations are shown on Figs. 6 and 9, respectively.
[c]EPA procedure 1010.
[d]Wet sample values.
[e]EPA procedure 9010.

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