M-762

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

US Army Corps of Engineers®

M-762

U.S. Army Corps of Engineers
New York District
CENAN-PP-M
26 Federal Plaza
New York, NY 10278-0090

OCT 07 1998

Attn: Mr. Allen Roos, Project Manager

Subject: Job No. 14501, FUSRAP Project
USACE Contract No. DACW45-98-D-0028
Maywood Site - FY97 Vicinity Properties Post-Remedial Action Report (PRAR) - Final

Dear Mr. Roos:

Enclosed for your review are 2 copies of the subject document.

Remedial activities for the Maywood Site Vicinity Properties at 5 Shady Lane, 7 Shady Lane, and 34 Long Valley Road have been completed. These properties have been verified by the Independent Verification Contractor (IVC).

If you have any questions regarding this matter, please call me at (201) 843-7080 ext. 201.

Sincerely,

David L Schlick

D. L. Schlick
Project Manager - FUSRAP

KLS:csc:NJ98L097.DOC

cc: Natalae Tillman, w/a

Enclosure: *Maywood Vicinity Properties PRAR*

M-762

USACE/OR/415

Formerly Utilized Sites Remedial Action Program (FUSRAP)

Post-Remedial Action Report for the Maywood Site Vicinity Properties at 5 Shady Lane, 7 Shady Lane, and 34 Long Valley Road

Lodi, New Jersey

February 1998

US Army Corps of Engineers®

Printed on recycled/recyclable paper.

USACE/OR-415

POST-REMEDIAL ACTION REPORT

FOR THE

MAYWOOD SITE VICINITY PROPERTIES

AT 5 SHADY LANE, 7 SHADY LANE, AND 34 LONG VALLEY ROAD

LODI, NEW JERSEY

FEBRUARY 1998

Prepared for

U.S. Army Corps of Engineers

Under Contract No. DACW45-98-D0028

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

CONTENTS

FIGURES

TABLES

ACRONYMS

BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DAC	derived air concentration
DCG	derived concentration guide
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
IVC	independent verification contractor
MCW	Maywood Chemical Works
MISS	Maywood Interim Storage Site
ORNL	Oak Ridge National Laboratory
PIC	pressurized ionization chamber
PPE	personal protective equipment
SEC	Safety and Ecology Corporation
USACE	U.S. Army Corps of Engineers

UNITS OF MEASURE

cm	centimeter
ft	foot
g	gram
h	hour
in.	inch
km	kilometer
L	liter
m	meter
μR	microroentgen
mi	mile
mrem	millirem
pCi	picocurie
yd	yard
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted during 1997 at three vicinity properties that are part of the Maywood site. The Maywood site is located in Bergen County, New Jersey, approximately 20 km (12 mi) north-northwest of New York City and 21 km (13 mi) northeast of Newark, New Jersey (Figure 1-1). The site consists of the Maywood Interim Storage Site (MISS) and 87 vicinity properties in the boroughs of Maywood and Lodi and the Township of Rochelle Park.

The three properties discussed in this post-remedial action report are located at 5 Shady Lane, 7 Shady Lane, and 34 Long Valley Road. The properties are approximately 3.4 km (2.1 mi) from MISS (Figure 1-2). The remedial action was conducted in July–August 1997.

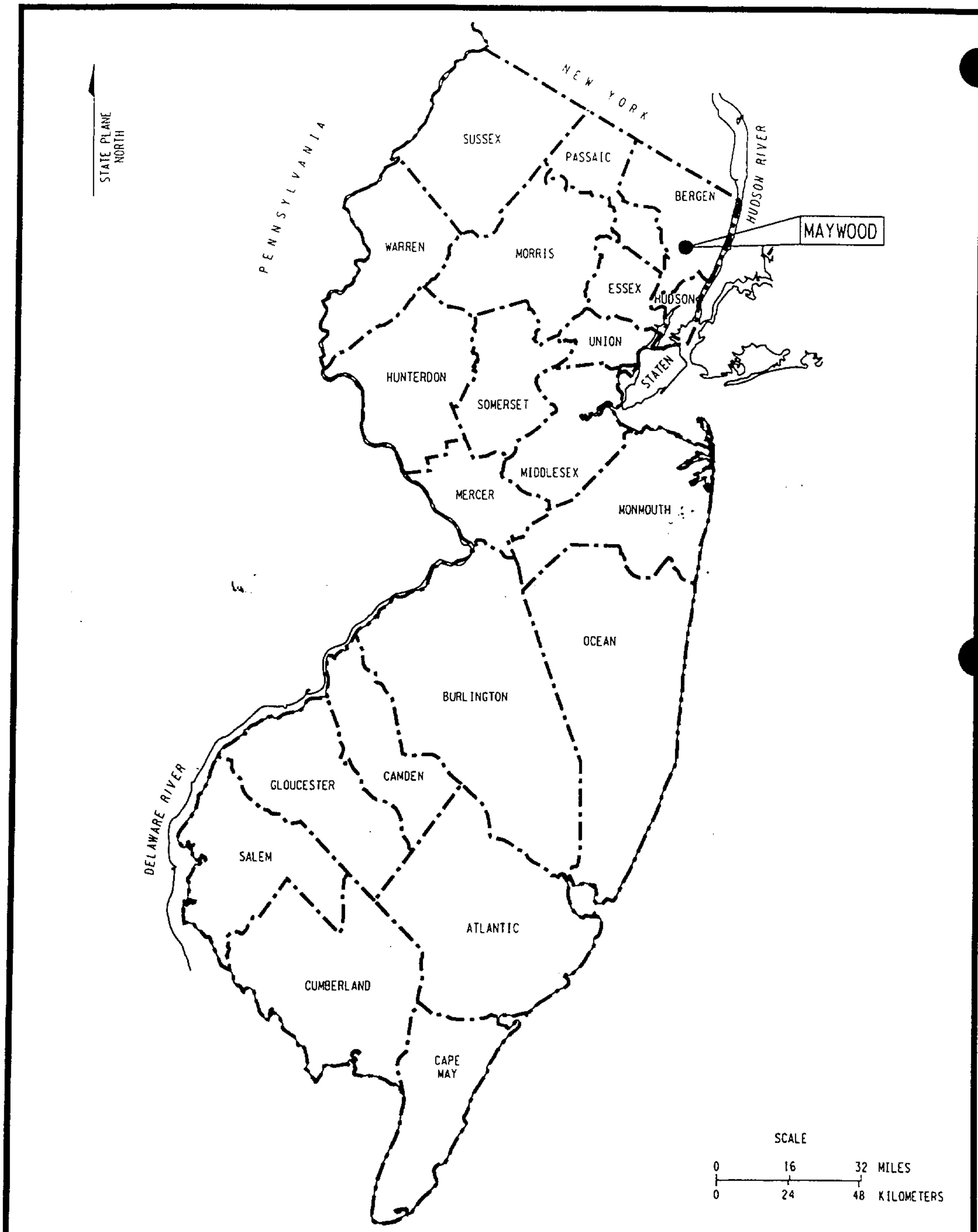
Remediation of these vicinity properties was conducted under the Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized FUSRAP to remedy. The remedial action was conducted as a non-time-critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The objectives of FUSRAP, as they apply to the Maywood site, are

- to remove or otherwise control contamination on sites identified as contaminated above current DOE guidelines, and

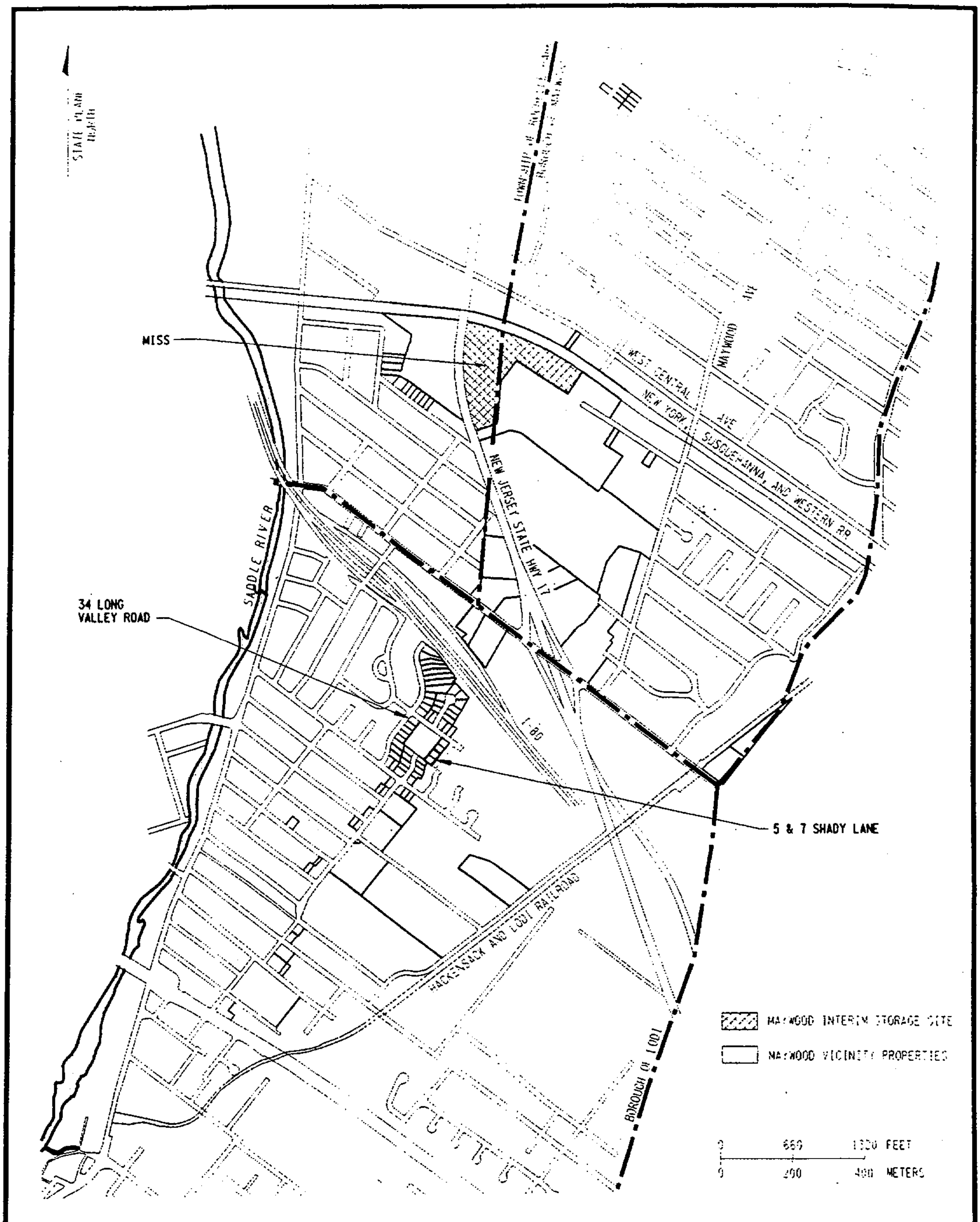
- to achieve and maintain compliance with applicable criteria for the protection of human health and the environment.

FUSRAP was established in 1974 and currently includes 46 sites in 14 states. The Maywood site was assigned to FUSRAP in 1984 after the cleanup was authorized under the Energy and Water Development Appropriations Act.



138 R01F102.DGN

Figure 1-1
Location of Maywood, Bergen County, New Jersey



F:\REPORTS\R077\R77F014.DGN
14 OCT 97

Figure 1-2
Locations of the Properties that Compose the Maywood Site

FUSRAP was administered by the U.S. Department of Energy (DOE) until October 1997, when management of the program was transferred to the U.S. Army Corps of Engineers (USACE). Bechtel National, Inc. (BNI), the project management contractor, assists USACE in the planning, management, and implementation of the cleanup of the Maywood site, including the vicinity properties. Oak Ridge National Laboratory (ORNL) has been assigned by USACE as an independent verification contractor (IVC). The role of an IVC is to provide autonomous assurance that site conditions after remedial action meet the radiological cleanup criteria.

1.2 HISTORY

1.2.1 Prior Remedial Actions

From 1916 to 1959, the former Maywood Chemical Works (MCW) extracted radioactive thorium and rare earths from monazite sand for use in manufacturing industrial products such as mantles for gas lanterns. Slurry containing waste from the thorium processing operations was pumped to earthen diked areas. Nearby properties became contaminated when some process wastes, along with tea and coca leaves from other MCW operations, were removed from the MCW property and used as mulch and fill. Additional waste apparently migrated off the MCW property through natural drainage associated with the former Lodi Brook. In all, 87 commercial, governmental, and residential vicinity properties were radioactively contaminated by these transport mechanisms. Twenty-five residential properties were remediated during 1984–1985; 5 more were remediated during 1995, and 8 were remediated during 1996.

1.2.2 Characterization Before Current Remedial Action

Radiological characterization had not been conducted earlier at these properties because they were not included in FUSRAP. However, during remediation of Lodi Park in 1996, these nearby properties were found to be radioactively contaminated, so in accordance with FUSRAP policy, the cleanup effort was expanded to include a greater extent of contamination than originally anticipated.

Before remediation of these properties began, contaminated areas were identified on the basis of borehole logs and sampling data for radioactive contamination for each property. The post-remedial action details are provided in Section 4.0.

2.0 REMEDIAL ACTION GUIDELINES

Historical data indicate that radioactive contamination at the three vicinity properties consisted primarily of thorium-232 but also included uranium-238 and radium-226 and their associated decay products. Table 2-1 lists the DOE residual contamination guidelines for release of the Maywood Phase I vicinity properties without radiological restrictions. These guidelines were adopted by DOE based on an agreement with the U.S. Environmental Protection Agency (EPA) in 1994 (DOE 1994). Appendix A provides a brief introduction to the nature, sources, and basic units of radiation.

For the remediation of the three vicinity properties, the radiological soil cleanup guideline was 5 pCi/g above background regardless of depth (see Table 2-1). This guideline applied to thorium-232 and radium-226 concentrations in soil and included only concentrations exceeding naturally occurring background radioactivity in soils near the site. The DOE site-specific guideline for total uranium is 100 pCi/g above background regardless of depth. The resulting uranium-238 guideline is 50 pCi/g, based on the assumption that the uranium exists in the naturally occurring abundance of 1:1:0.046 for uranium-234, uranium-238, and uranium-235, respectively (Shleien 1992). The site-specific uranium guideline for Maywood was developed based on the reasonable exposure pathways that could be hypothesized for the site to ensure that the annual radiation dose (excluding radon) received by an individual member of the general public is less than 100 mrem (the unit used to measure radiation dose to man) per year.

These remedial action guidelines are applied in a sum-of-the-ratios calculation for the isotopes uranium-238, radium-226, thorium-230, thorium-232, and radium-228. The calculation is performed by first subtracting the background concentration of each isotope from the reported value for that isotope. The subtraction of background concentrations can cause the values for some isotopes to be reduced to zero, and in some cases this causes the sum of ratios to be zero as well. Next, the uranium-238 concentration is divided by a specific guideline number (50 pCi/g in this case). Then the larger value of radium-226 or thorium-230 is chosen and divided by the appropriate guideline number (5 pCi/g for Maywood). Then the larger value of thorium-232 or radium-228 is also chosen and divided by the appropriate guideline number. Finally, the three calculated values are summed. If the sum of the three calculated values is 1.0 or less, the soil meets the applicable guideline for radioactive contamination at Maywood and is thus considered clean.

Because the cleanup guidelines are based on radioactivity in excess of background levels, it is important to establish the levels of naturally occurring background radioactivity in soils near the site. Background data serve as a frame of reference for evaluating analytical data from the vicinity properties because they represent conditions typical of the areas unaffected by former MCW activities.

Table 2-1
Summary of DOE Guidelines for Residual Radioactive Contamination[a]

Basic Dose Limits

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr. In implementing this limit, DOE applies as-low-as-reasonably-achievable (ALARA) principles to set site-specific guidelines.

Soil Guidelines[b,c,d,e]

Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g when averaged over any 15-cm (6-in.)-thick layer of soil regardless of depth.
Uranium[f]	100 pCi/g total uranium, 50 pCi/g uranium-238.

Radionuclide[g]	Allowable Surface Residual Contamination[g] (dpm/100 cm^2) Average[h,i]	Maximum[h,j]	Removable[h,k]
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-124, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 a	15,000 a	1,000 a
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission except Sr-90 and others noted above)	5,000 b-g	15,000 b-g	1,000 b-g

[a]Department of Energy, 1990, Order 5400.5, "Radiation Protection of the Public and the Environment" (February 8). The soil guideline of 5 pCi/g regardless of depth is from DOE 1994.

[b]Soil guidelines are also used for sediment because there are no sediment guidelines.

[c]These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides must be reduced so that (1) the dose for the mixtures will not exceed the basic dose limit, or (2) the sum of ratios of the soil concentration of each radionuclide to the allowable limit for the radionuclide will not exceed 1 ("unity").

[d]These guidelines represent allowable residual concentration exceeding background levels averaged across any 15-cm (6-in.)-thick layer to any depth and over any contiguous 100-m^2 (1,076-ft^2) surface area, except as noted.

[e]If the average concentration in any surface or below-surface area less than or equal to 25 m^2 (269 ft^2) exceeds the authorized limit or guideline by a factor of $(100/A)^{1/2}$, where A is the area of the elevated region in square meters, limits for "hot spots" will also be applicable. Procedures for calculating these hot spot limits, which depend on the extent of the elevated local concentrations, are given in the supplement. In addition, every reasonable effort shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil.

[f]Guidelines are calculated on a site-specific basis using a DOE manual developed for this use.

[g]Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

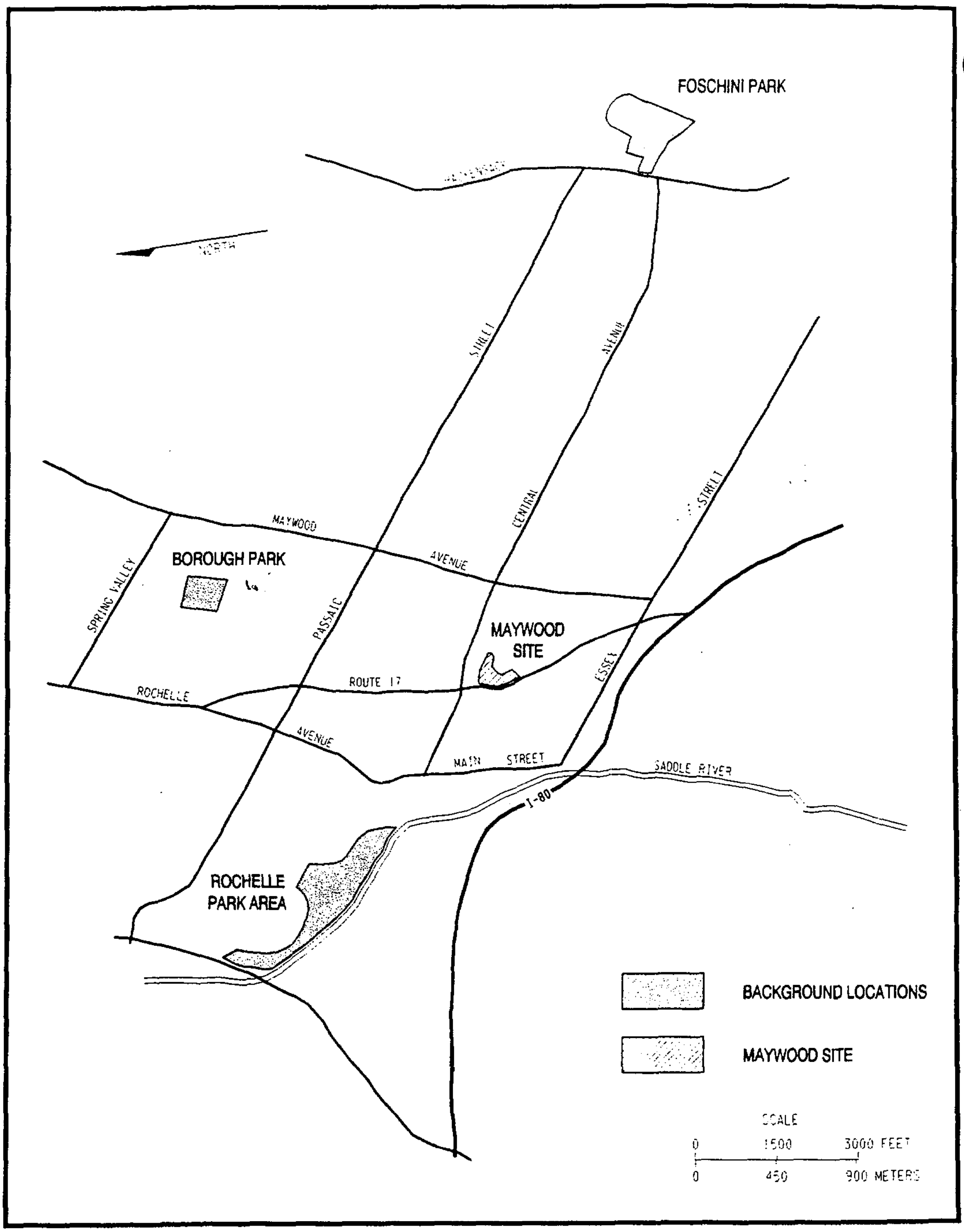
[h]Measurements of average contamination should not be averaged over more than 1 m^2 (10.8 ft). For objects of less surface area, the average must be derived for each such object.

[i]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm (0.4 in.).

[j]The maximum contamination level applies to an area of not more than 100 cm^2 (16 $in.^2$).

[k]The amount of removable radioactive material per 100 cm^2 (16 $in.^2$) of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 (16 $in.^2$) is determined, the activity per unit area should be based on the actual area or the entire surface should be wiped. The number in this column are maximum amounts.

During the remedial investigation, soil samples were obtained from three remote background locations near the vicinity properties. The locations were selected on the basis of their proximity to the site, relative independence from potential influence of the site, and representativeness of area land uses. The background locations are shown in Figure 2-1. Samples from these background areas were analyzed for radium-226, thorium-232, and uranium-238. Background external gamma radiation exposure rates were also measured at these three locations with a pressurized ionization chamber (PIC). The average concentration of thorium-232 in background samples was 1.0 pCi/g, with a range of 0.9 to 1.1 pCi/g. The average background concentration of radium-226 was 0.7 pCi/g, with a range of 0.5 to 0.8 pCi/g. The average background concentration for uranium-238 was 2.9 pCi/g, with a range of 2.4 to 3.5 pCi/g (BNI 1992). The average background external radiation exposure rate was determined to be 9.0 μR/h.



F:\DGN\138\138F281.DGN
15 OCT 97

Figure 2-1
Background Sampling Locations in Relation to the Maywood Interim Storage Site

3.0 REMEDIAL ACTION

3.1 CLEANUP ACTIVITIES

The three vicinity properties were surveyed immediately before remediation began in 1997 to more accurately define the boundaries of radioactive contamination. Walkover surface scans were then conducted during remediation to direct the excavation. And as remediation was completed, soil samples were collected and analyzed to verify that residual radioactive material above the applicable guidelines (Table 2-1) had been removed. Additionally, exposure rate measurements were taken with a PIC to confirm that residual radiation levels were in compliance with applicable guidelines.

The cleanup was performed in exterior locations of the three properties; details are provided in Section 4.0. The primary technique used in the remedial action was excavation of the contaminated materials. A jackhammer was used to break up concrete, asphalt, and debris before removal. Because of the limited working space available, small volumes of soil from the residential properties were removed with picks and shovels, while a backhoe was used to remove larger volumes. After remedial action, areas were restored to the condition agreed upon by the property owners.

After the material was excavated, direct gamma measurements were taken with an Eberline SPA-3 gamma scintillation detector. When survey results indicated that remediation was complete, post-remediation soil samples were collected from the excavated areas in accordance with the "FUSRAP Post-Remedial Action Survey Plan" (BNI 1996). The soil samples were sent to the onsite laboratory at MISS for gamma spectral analysis to ensure that all soils contaminated at levels above applicable criteria had been removed. If the analysis showed that any residual radioactive material exceeding criteria remained, then additional excavation was conducted and additional post-remedial action samples were collected and analyzed. The rationale for the sampling program and the analytical results are presented in Section 4. The use of the Maywood sample preparation and gamma spectroscopy system provided either same-day or 1-day analysis of samples. A substantial cost savings for the project resulted from reduced stand-down time, and the remedial action guidelines were met.

The remedial action was conducted during July–August 1997. During remediation, approximately 125 m^3 (164 yd^3) of radioactively contaminated soil was removed from the three properties (BNI 1997a). Excavated material was transported to MISS, where it was loaded into railcars and shipped to Envirocare of Utah. Table 3-1 lists the volume of soil removed from each vicinity property.

Table 3-1

Volume of Contaminated Soil Removed at Each Vicinity Property

Vicinity Property	Soil Removed, m^3 (yd^3)
5 Shady Lane	18 (24)
7 Shady Lane	69 (90)
34 Long Valley Rd.	38 (50)

After radioactive contamination was removed from these properties (see Section 4.0), soil samples were collected by EPA Region II for chemical analysis. The samples were analyzed for volatile organic compounds, semivolatile organic compounds, pesticides, polychlorinated biphenyls, target analyte list compounds, and cyanides. Results of the chemical analyses did not reveal chemical contamination; most of the compounds were not detected (BNI 1997b). Additionally, some of the compound concentrations were estimated values; the results are not included in this report.

The total cost of the removal action was $1,126,000.

3.2 CONTAMINATION CONTROL DURING REMEDIAL ACTION

During the removal action, engineering and administrative controls (such as dust control, use of hazardous work permits, and installation of a silt fence) and personal protective equipment (PPE) were implemented to protect remediation workers and members of the public from exposure to radiation in excess of applicable guidelines. These measures also controlled the migration of radioactive material to uncontaminated areas next to these vicinity properties.

All personnel working in contaminated areas were required to wear safety glasses, rubber boots, hard hat, and gloves.

Workers exiting controlled areas were subjected to a radioactive contamination survey (frisked) at the control point with a hand-held radiation detection instrument. The frisk was conducted by technicians who have received Radiological Worker II training. This procedure ensured that workers were not contaminated and prevented the potential spread of radioactive material from the work area. A frisk is simply a search for radioactive material that may have been transferred onto the skin or clothing of individuals inside the work area. The hand-held AC-3 alpha probe radiation detection instrument is held approximately 0.5 cm away from the area to be frisked and moved slowly (about 5 cm per second) across the body or clothing. Portions of the worn PPE that were suspected or known to be contaminated were packaged and shipped to Envirocare for disposal.

The primary pathway for exposure of onsite and offsite personnel to radioactive material during removal activities was inhalation and ingestion of radioactively contaminated airborne dust from the excavation. During remedial action, the spread of contamination and personnel exposure were minimized by the following measures:

- A fine water mist was sprayed as needed to control dust during soil removal and transport.

- Trucks hauling contaminated materials were fitted with liners, and the loads were covered with tarps to prevent spillage.

- Silt fences were placed around excavated areas to prevent runoff of potentially contaminated sediment and were maintained until restoration activities were completed.

Area air particulate sampling was also performed adjacent to areas being remediated to ensure that no member of the general public was exposed above DOE guidelines (DOE Order 5400.5). The limits in DOE Order 5400.5 are derived concentration guides (DCGs); a DCG is the concentration of a particular radionuclide that would provide an effective dose equivalent of 100 mrem/yr, DOE's primary dose limit, to an individual continuously inhaling the radionuclide for an entire year. These guidelines were established by the International Commission on Radiation Protection and the National Commission on Radiation Protection and adopted to protect the environment and members of the general public. Eberline RAS-1 high-volume and SKC low-volume samplers were used, and the filters were collected daily and counted after 4 days to allow for radon decay. As an extra precaution, the area monitors were placed well within the site perimeter.

Concentrations of thorium-232 measured by area air particulate monitors ranged from 0.00 to 3.0×10^{-5} pCi/L (BNI 1997c). The average of all perimeter air monitoring results was 6.75×10^{-6} pCi/L. The DCG is 1.0×10^{-5} pCi/L for thorium-232. The measurements for 91 samples were collected over an 8-h period; 22 samples contained levels of thorium-232 exceeding the DCG guidelines, but most results were below the DCG.

4.0 POST-REMEDIAL ACTION MEASUREMENTS

After each portion of the property had been decontaminated, a radiological survey of that area was conducted to confirm that all radioactive contamination exceeding the cleanup criteria (Table 2-1) had been removed. Initial post-remediation surveys were conducted by Safety and Ecology Corporation (SEC) on behalf of BNI. Survey techniques, including walkover gamma scans, external gamma radiation exposure rate measurements, and soil sampling, were conducted as specified in the "FUSRAP Post-Remedial Action Survey Plan" (BNI 1996). ORNL, as the IVC, performed independent verification surveys of the remediated areas using similar or identical survey techniques. The IVC survey data and conclusions will be issued in a separate report by ORNL.

As excavation proceeded, walkover surface scans were conducted with an Eberline SPA-3 gamma scintillation detector to determine whether all soil contaminated in excess of guidelines had been removed from the remediated areas. The walkover survey provided immediate feedback so that additional excavation could be conducted if residual contamination appeared to exceed remedial action guidelines. Soil samples were also collected throughout the excavation and analyzed at the Maywood laboratory; the sample analysis provided an additional check on the surface scans. The area was scanned after each lift of soil was removed to verify that the contamination had been eliminated.

External gamma radiation exposure rates were measured with a PIC at 1 m (3 ft) above the ground surface in each remediated area. Readings taken at this height provide an estimate of the potential exposure from external gamma radiation to the critical body organs. PIC readings are compared with the background exposure rate (9.0 μR/h) determined for the area.

Composite post-remediation soil samples were also taken from the excavated areas and analyzed to determine the radionuclide concentrations in the remaining soil before the excavations were backfilled. Samples were composited to provide samples representative of each 100-m^2 (1,076-ft^2) area remediated as specified in the "FUSRAP Post-Remedial Action Survey Plan" (BNI 1996). Soil sampling was the primary method used to confirm that all radioactive contamination exceeding DOE cleanup guidelines had been removed. Soil samples were analyzed using gamma spectroscopy. The details of soil analysis results presented in Sections 4-1, 4-2, and 4-3 include the background levels of each radioisotope.

As work progressed on the properties remediated in 1997, it was discovered that numerous small rivulets, or "veins," of contamination meandered through all the properties. These rivulets were approximately 0.3 to 0.6 m (1 to 2 ft) deep and contained only slightly elevated levels of contamination. This pattern of contamination deposition is typical of areas that are frequently flooded; Lodi Brook frequently flooded the backyards of 5 and 7 Shady Lane, and 34 Long Valley Road.

Additionally, the assumed areas of contamination were based on very limited borehole logs and sample data consisting primarily of gross radiation readings that are not radionuclide specific. Gross gamma radiation readings ranging from approximately 25,000 counts per minute (cpm) to 35,000 cpm indicate areas where it is difficult to determine (without radionuclide-specific analysis of soil samples) whether the radionuclide concentrations will exceed site-specific criteria. This may result in contributions to the gross readings from naturally occurring radionuclides such as potassium-40. Because of the presence of rivulets and absence of soil sampling data, some of the excavations were larger than had been predicted.

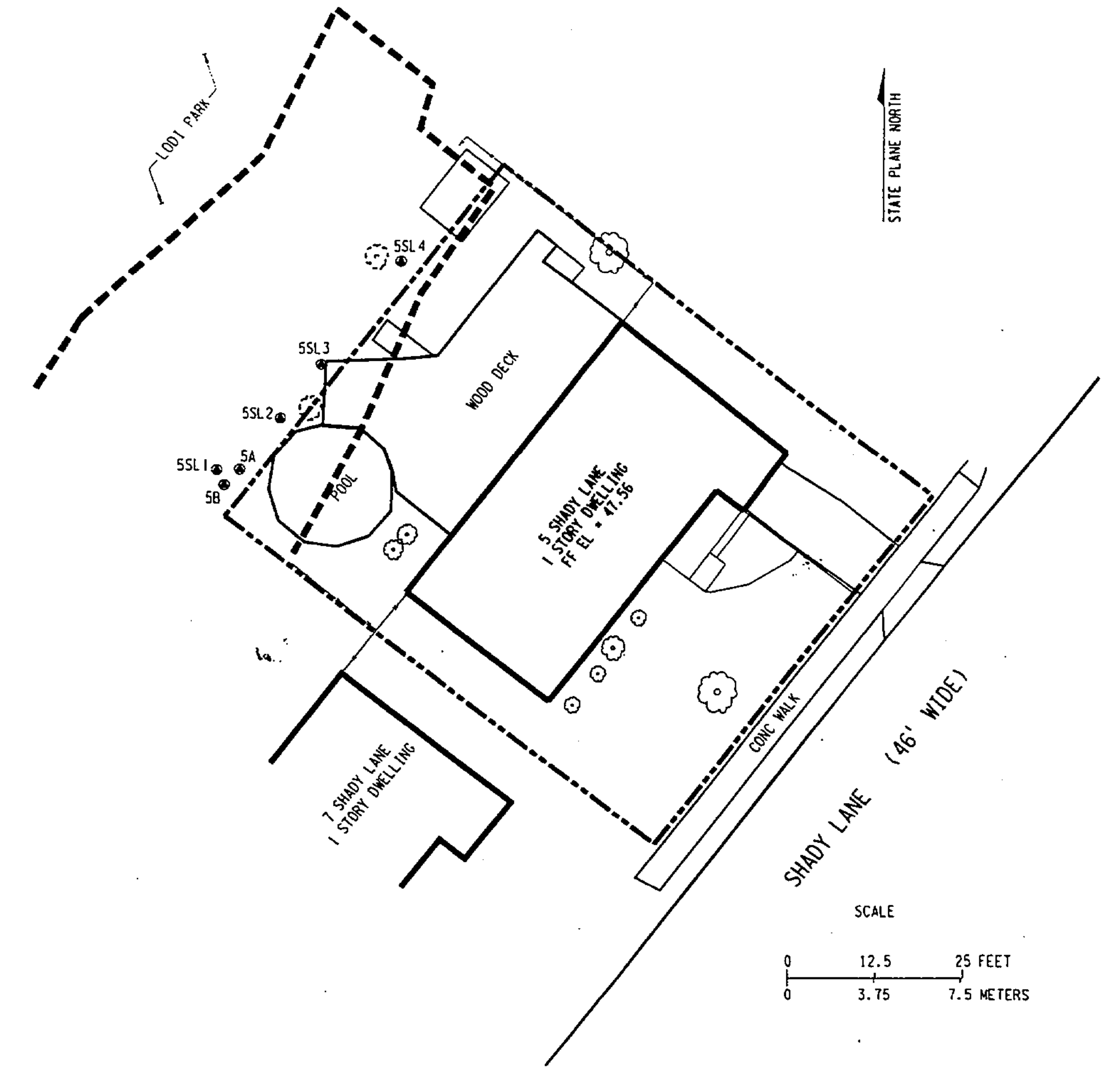
In the tables in this section, use of the "less than" (<) notation with reported survey results indicates that radioactivity was not present at levels that were quantifiable with the instruments and techniques used. Each "less than" value represents the lower limit of the quantitative capacity of the instrument and technique and depends on various factors, including the type of detector used, the counting time, and the background count rate. The actual level of radioactivity is less than the value reported with the "less than" symbol.

4.1 5 SHADY LANE

This site is a one-story dwelling with a wooden deck and pool in the back. Figure 4-1 shows the approximate area of surface and subsurface contamination based on 1996 and 1997 pre-remedial action data. Figure 4-2 shows the actual areas of excavation, locations of post-remedial action soil samples, and post-remedial action radionuclide concentrations. Figure 4-3 shows the location and result of the post-remedial action gamma exposure rate measurement using the PIC.

The contaminated boreholes shown in Figure 4-1 are based on the subsurface gamma-ray radiation readings. The pre-remedial action data were gathered in 1996 and 1997 to evaluate the extent of contamination. The depth of contamination ranged from 1 to 2 m (4 to 7 ft).

Figure 4-2 presents the results of the post-remedial action soil analysis. Only two post-remedial action samples were collected from this property because of the small area of contamination. The figure also shows two areas of excavation: the property boundary of the house (Area B) and Lodi Park (Area C). Excavation was conducted beyond the property boundary because the slope was built along Lodi Park to facilitate excavation close to and around the fence line. Area C indicates excavated residual contaminated soil remaining from the 1996 Lodi Park excavation.



CONTAMINATED BOREHOLES			
BOREHOLES	COORDINATES		DEPTH OF CONTAMINATION
	NORTHING	EASTING	
5A	748957.93	2163688.71	5.0'-7.5'
5B	748955.67	2163686.56	4.5'-6.5'
5SL1	748957.82	2163685.48	6.5'-7.5'
5SL2	748965.46	2163694.55	3.0'-6.5'
5SL3	748973.28	2163700.45	2.5'-6.5'
5SL4	748988.39	2163711.78	2.0'-5.5'

LEGEND:

PROPERTY BOUNDARY

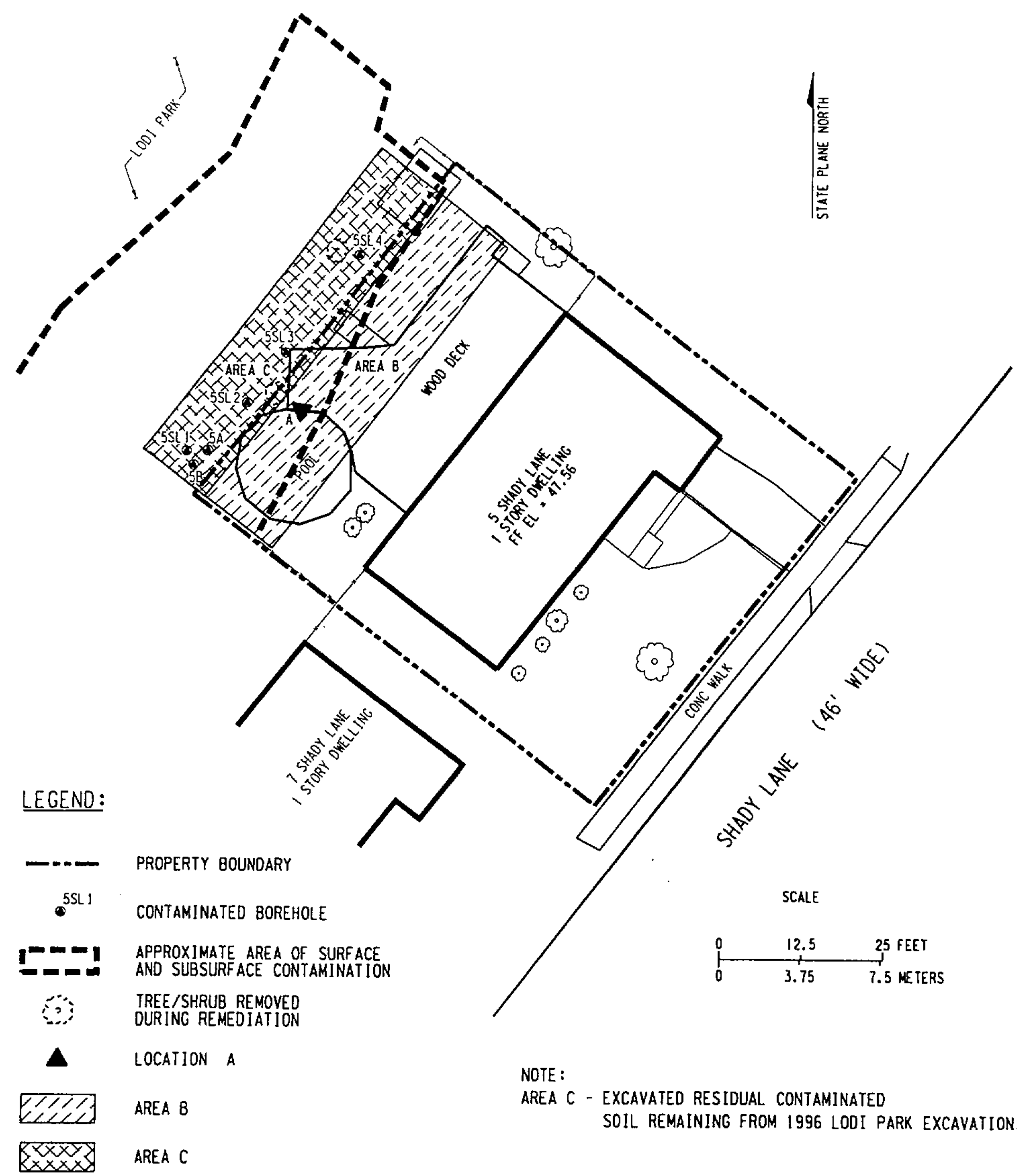
5SL1 CONTAMINATED BOREHOLE

APPROXIMATE AREA OF SURFACE AND SUBSURFACE CONTAMINATION

TREE/SHRUB REMOVED DURING REMEDIATION

F:\DGN\138\138F287.DGN
12 DEC 97

Figure 4-1
Assumed Area of Surface and Subsurface Contamination
5 Shady Lane



AREA/LOCATION	COMPOSITE SAMPLE ID	Th-232 (pCi/g)		Ra-226 (pCi/g)		U-238 (pCi/g)		SUM-OF-RATIOS
		RESULT	ERROR +/-	RESULT	ERROR +/-	RESULT	ERROR +/-	
A	MVP 0070	1.34	0.08	1.71	0.06	<2.83	.	0.269
B	MVP 0071	1.08	0.06	1.57	0.05	<2.97		0.191

F:\DGN\138\138F288.DGN
12 JAN 98

Figure 4-2
Areas of Excavation and Post-Remedial Action Samples
5 Shady Lane

The results of thorium-232 analysis of the two soil samples taken at this property were 1.34 pCi/g and 1.08 pCi/g; the radium-226 results were 1.71 pCi/g and 1.57 pCi/g; the uranium-238 results were <2.83 pCi/g and <2.97 pCi/g; and the sum-of-ratios calculations were 0.269 and 0.191. These results are below the cleanup criteria presented in Table 2-1.

Figure 4-3 lists the external gamma radiation exposure rate, measured at 11.2 µR/h. Because only one PIC reading was taken, the value is comparable to the average background rate of 9.0 µR/h. Any exposure to the public would be essentially indistinguishable from background.

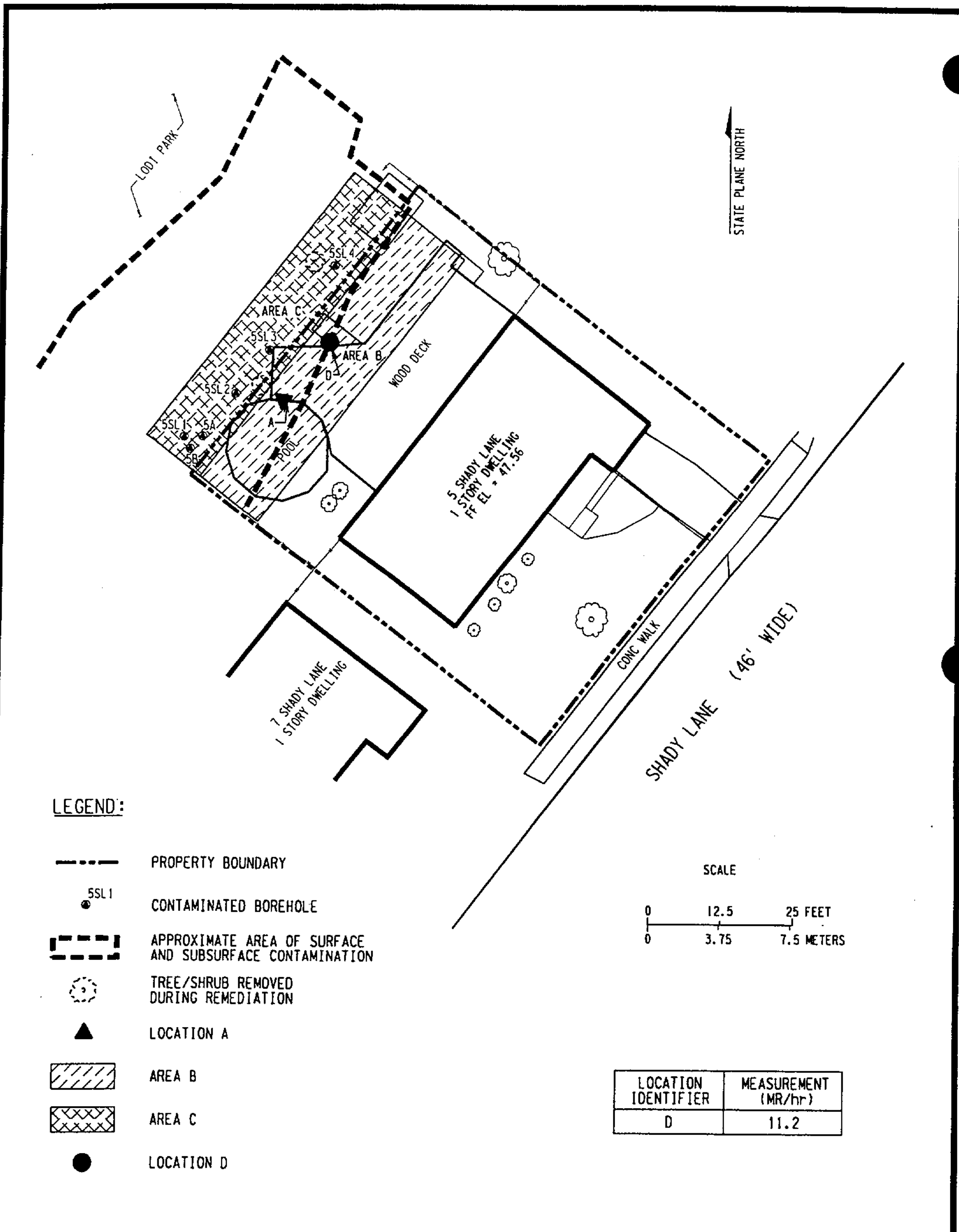
Most of the remediated areas were restored; some items such as the pool, shed, partial deck, partial fence, and lawn were not restored, but the owner was equitably compensated.

4.2 7 SHADY LANE

This site is a one-story dwelling with a wooden deck, concrete pad, brick fireplace, and brick pad at the back of the house. Figure 4-4 shows the approximate area of surface and subsurface contamination based on 1996 and 1997 pre-remedial action data. Figure 4-5 shows the actual areas of excavation, locations of post-remedial action soil sampling, and post-remedial action radionuclide concentrations. Figure 4-6 shows the location and result of the post-remedial action gamma exposure rate measured with the PIC.

The contaminated boreholes shown in Figure 4-4 are based on the subsurface gamma radiation readings. The pre-remedial action data were gathered in 1996 and 1997 to evaluate the extent of contamination. The depth of contamination was estimated at 2 m (7 ft).

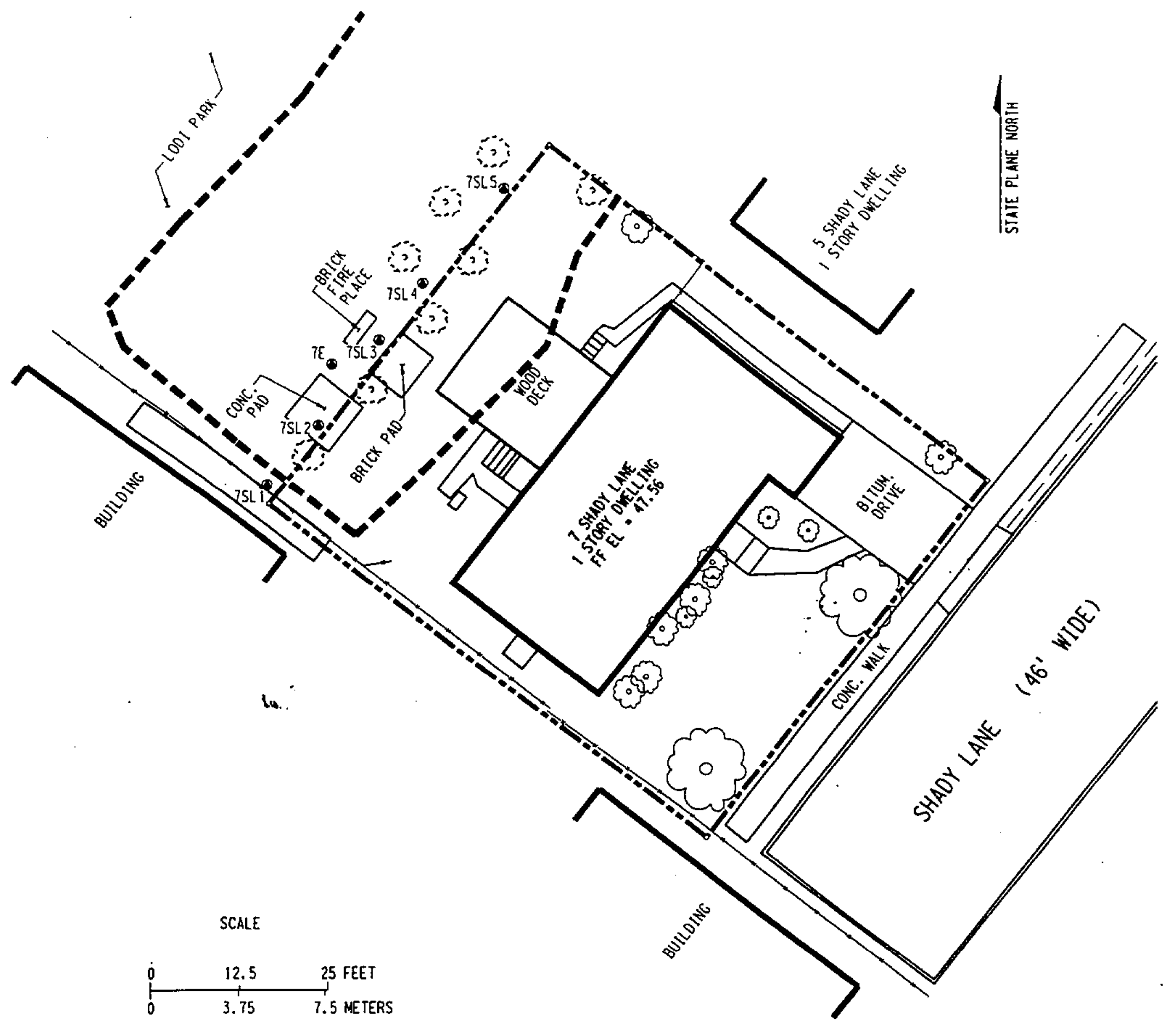
Figure 4-5 presents the results of the post-remedial action soil analysis. Only two post-remedial action samples were collected from this property because of the small area of contamination. The figure also shows two areas of excavation: at the property boundary of the house (Area B) and Lodi Park (Area C). The houses at 5 Shady Lane and 7 Shady Lane are side by side, and excavation at both houses was performed in a similar manner. Excavation on this property was extended beyond the property boundary because the slope was built along Lodi Park to facilitate excavation close to and around the fence line. Area C indicates excavated residual contaminated soil remaining from the 1996 Lodi Park excavation.



LOCATION IDENTIFIER	MEASUREMENT (MR/hr)
D	11.2

F:\DGN\138\138F289.DGN
12 JAN 98

Figure 4-3
PIC Readings
5 Shady Lane



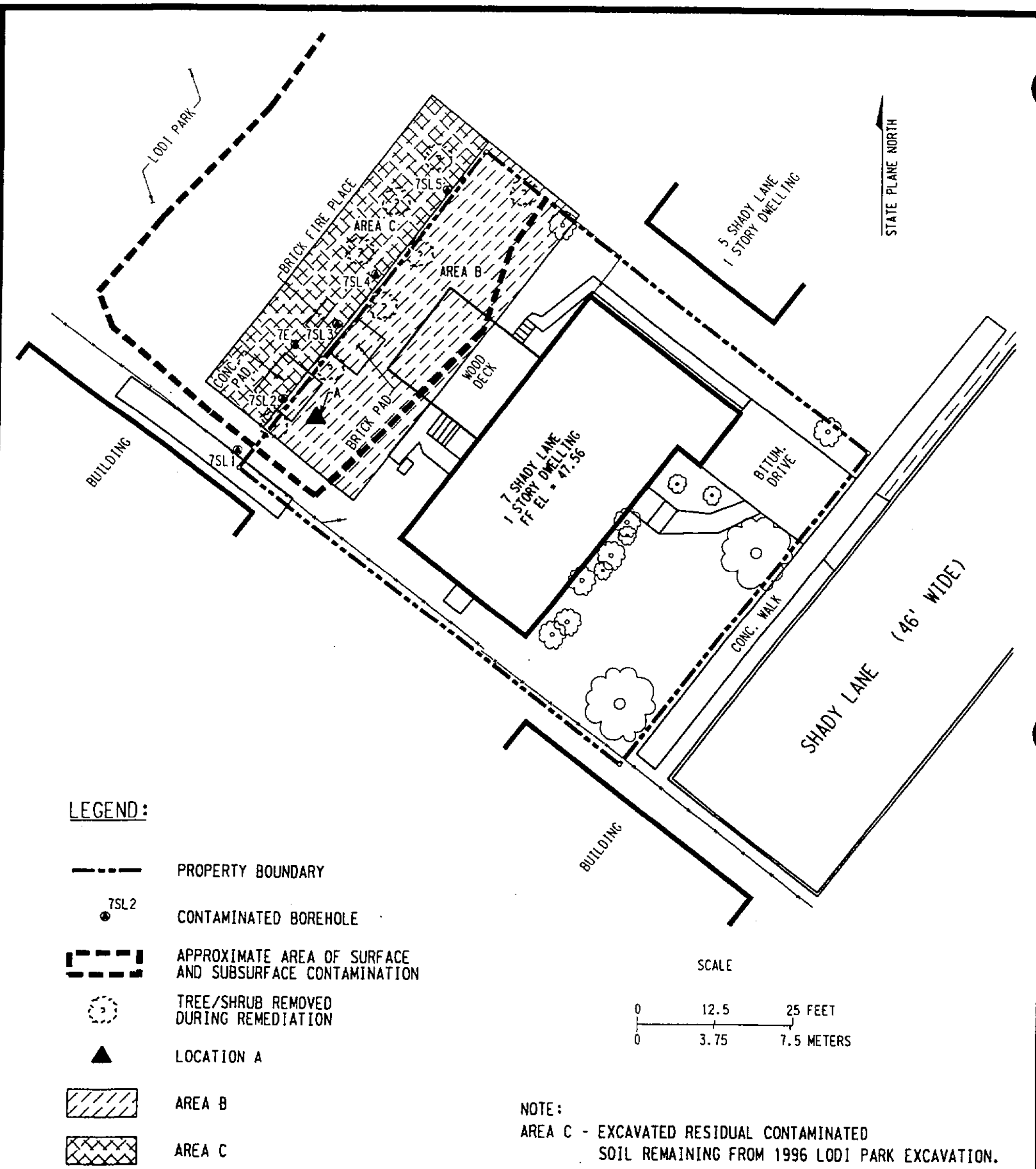
LEGEND:

- PROPERTY BOUNDARY
- 7SL2 CONTAMINATED BOREHOLE
- APPROXIMATE AREA OF SURFACE AND SUBSURFACE CONTAMINATION
- TREE/SHRUB REMOVED DURING REMEDIATION

CONTAMINATED BOREHOLES			
BOREHOLES	COORDINATES		DEPTH OF CONTAMINATION
	NORTHING	EASTING	
7E	748919.79	2163655.78	5.5'-7.0'
7SL1	748902.46	2163646.62	2.0'-7.0'
7SL2	748910.97	2163653.91	2.5'-7.0'
7SL3	748923.18	2163662.60	2.5'-7.0'
7SL4	748931.28	2163668.81	3.0'-7.5'
7SL5	748944.86	2163680.35	5.0'-7.5'

F:\DGN\138\138F290.DGN
12 DEC 97

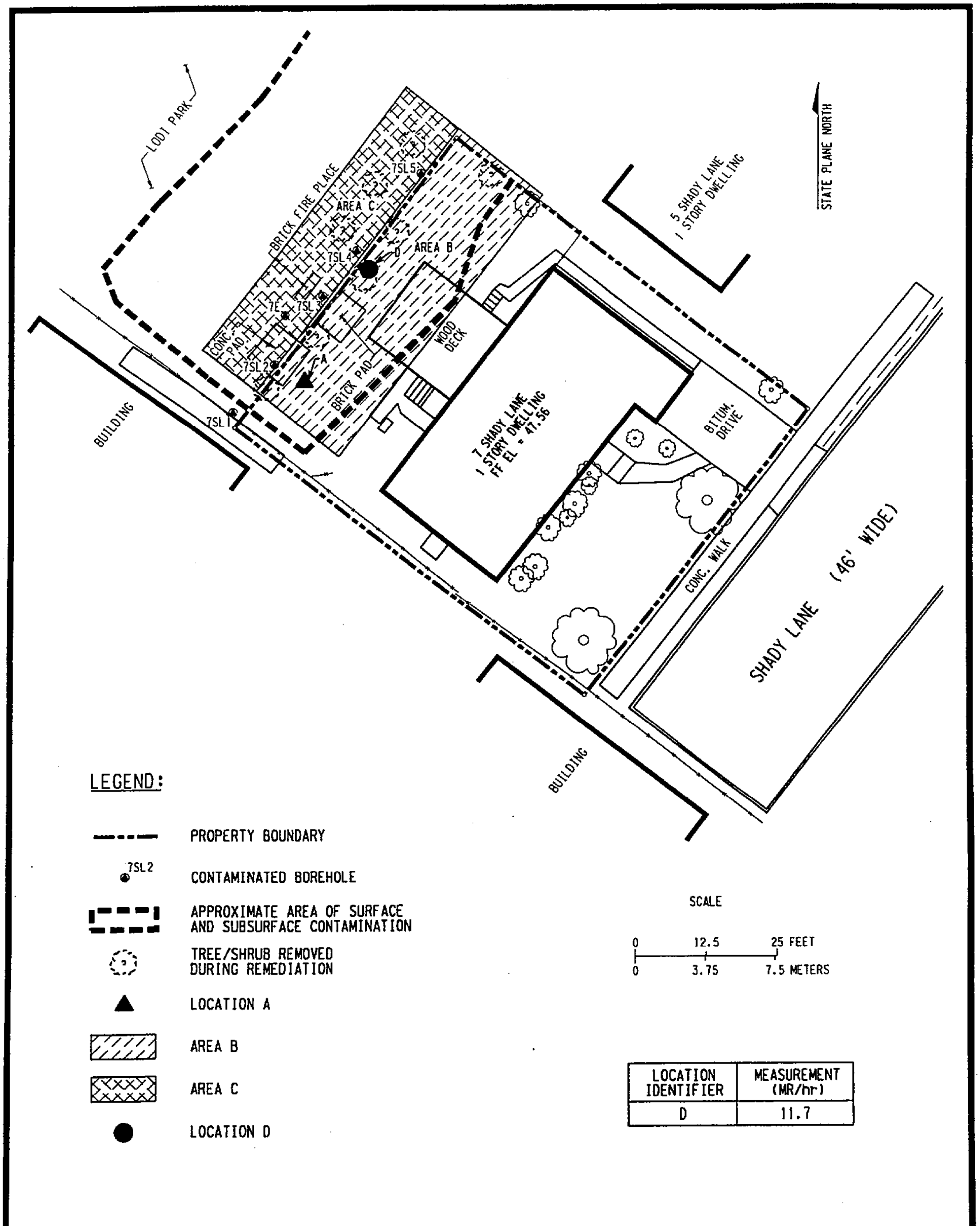
Figure 4-4
Assumed Area of Surface and Subsurface Contamination
7 Shady Lane



AREA/LOCATION	COMPOSITE SAMPLE ID	Th-232 (pCi/g)		Ra-226 (pCi/g)		U-238 (pCi/g)		SUM-OF-RATIOS
		RESULT	ERROR +/-	RESULT	ERROR +/-	RESULT	ERROR +/-	
A	MVP 0073	1.75	0.08	2.12	0.07	<2.93		0.435
B	MVP 0072	1.34	0.07	1.24	0.05	<2.68		0.172

F:\DGN\138\138F291.DGN
12 JAN 98

Figure 4-5
Areas of Excavation and Post-Remedial Action Samples
7 Shady Lane



LOCATION IDENTIFIER	MEASUREMENT (MR/hr)
D	11.7

F:\DGN\138\138F292.DGN
12 JAN 98

Figure 4-6
PIC Readings
7 Shady Lane

The results of thorium-232 analysis of the two soil samples at this property were 1.75 pCi/g and 1.34 pCi/g; the radium-226 results were 2.12 pCi/g and 1.24 pCi/g; the uranium-238 results were <2.93 pCi/g and <2.68 pCi/g; and the sum-of-ratios calculations were 0.435 and 0.172. These results are below the cleanup criteria presented in Table 2-1.

Figure 4-6 lists the external gamma radiation exposure rate, measured at 11.7 μR/h. Because only one PIC reading was taken, this value is comparable to the average background rate of 9.0 μR/h; therefore, any exposure to the public would be essentially indistinguishable from background.

Most of the remediated areas were restored; some items such as shrubs, trees, a partial deck, and the lawn were not restored, but the owner was equitably compensated.

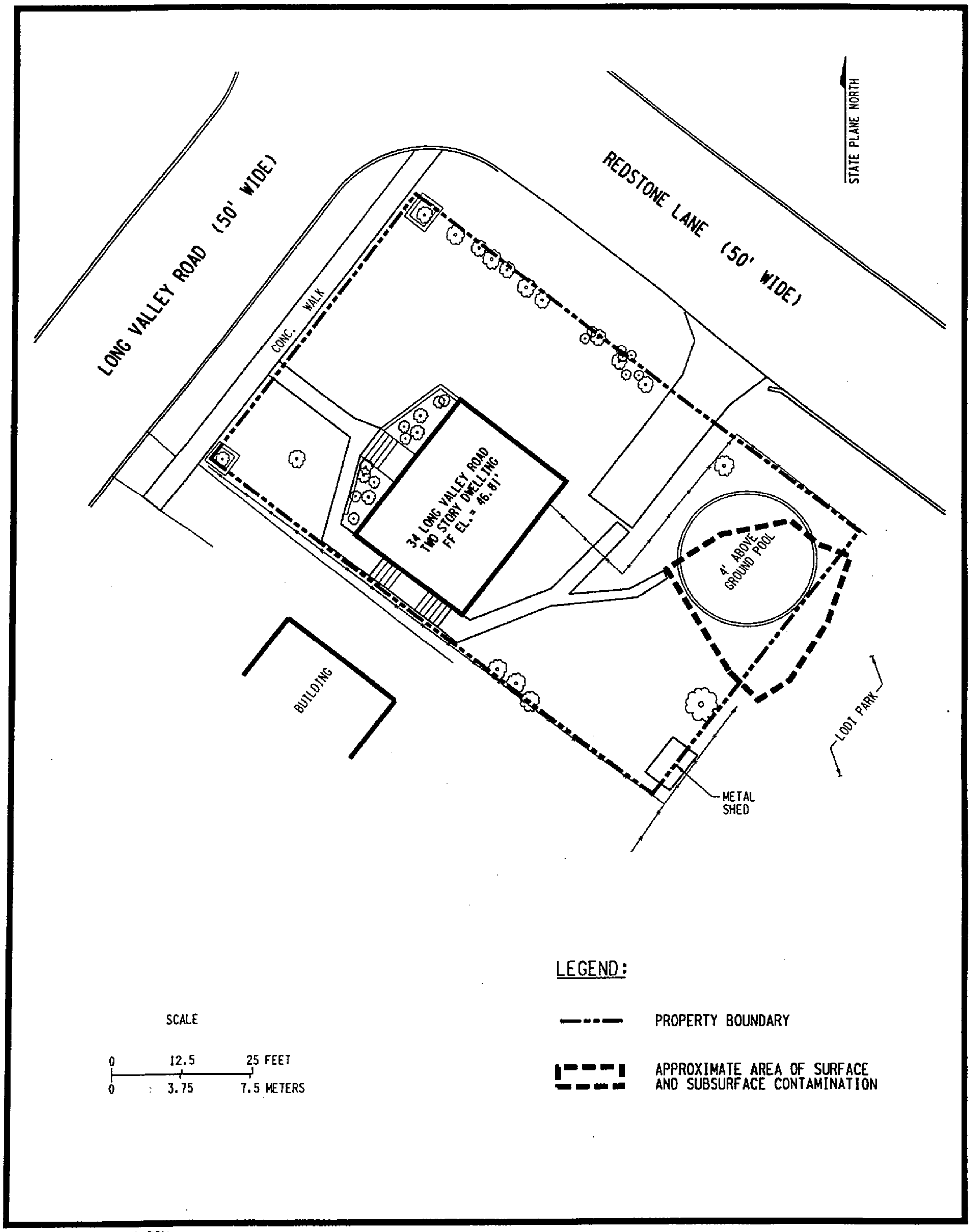
4.3 34 LONG VALLEY ROAD

This site is a two-story dwelling with a pool and trees in back of the house. Figure 4-7 shows the approximate area of surface and subsurface contamination determined from 1997 pre-remedial action data that were gathered to evaluate the extent of contamination. The depth of contamination was estimated at 7 m (4 ft). Figure 4-8 shows the actual areas of excavation, locations of post-remedial action soil samples, and post-remedial action radionuclide concentrations. One post-remedial action gamma exposure rate measurement was obtained with the PIC; Figure 4-9 shows the location and result.

Figure 4-8 presents the results of the post-remedial action soil analysis. Only two post remedial action samples were collected from this property because of the small area of contamination. The figure also shows the area of excavation identified as Area A. The results of thorium-232 analysis of the two soil samples at this property were 0.66 pCi/g and 0.69 pCi/g; the radium-226 results were 0.56 pCi/g and 0.55 pCi/g; the uranium-238 results were <1.75 pCi/g and <1.96 pCi/g; and the sum-of-ratios calculations were -0.119 and -0.111. These results are below the cleanup criteria presented in Table 2-1.

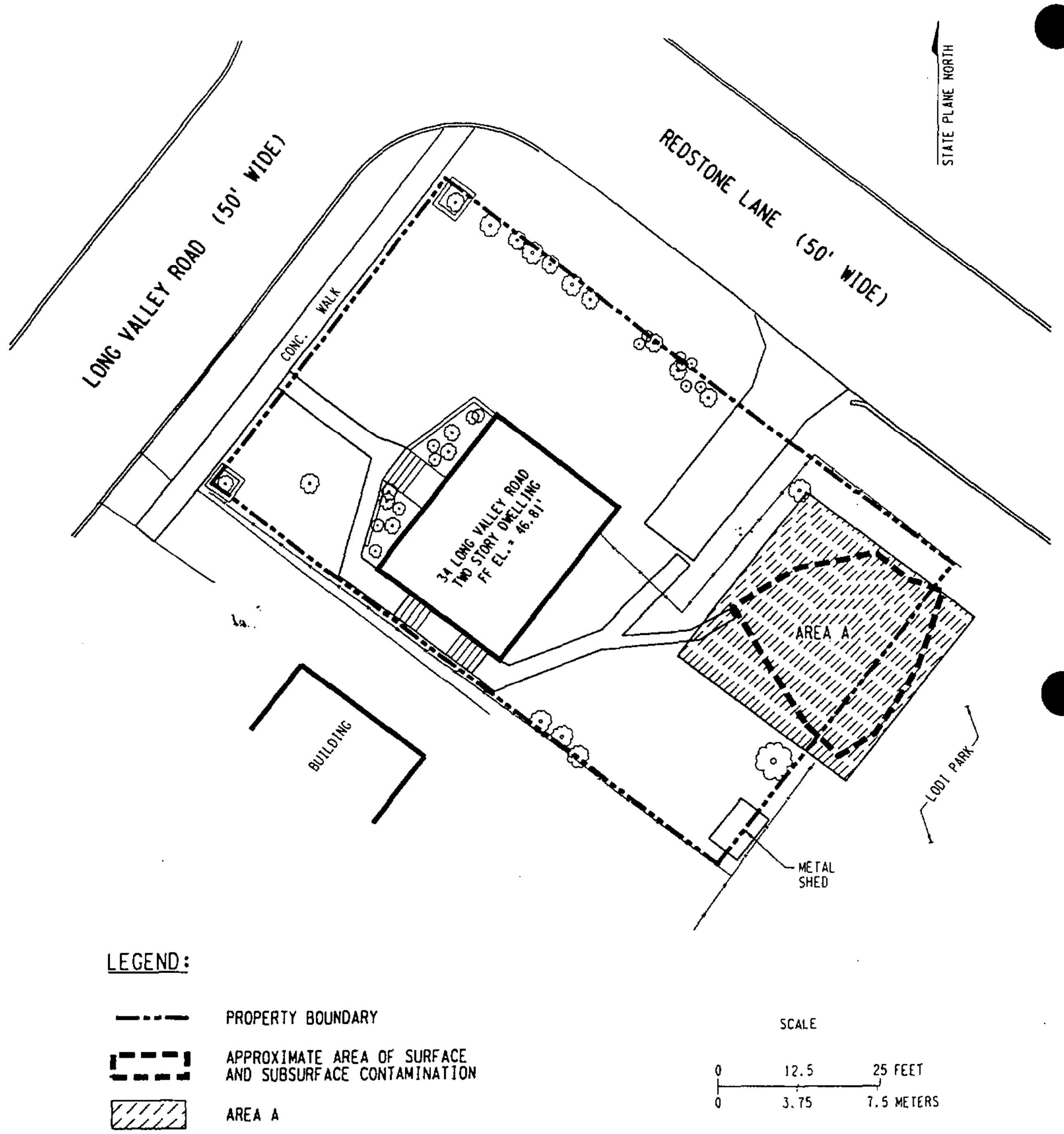
Figure 4-9 lists the external gamma radiation exposure rate, measured at 9.6 μR/h. This value is comparable to the average background rate of 9.0 μR/h; thus, any exposure to the public is essentially equivalent to background.

Most of the remediated areas were restored; the pool was not restored, but the owner was equitably compensated.



F:\DGN\138\138F293.DGN
27 JAN 98

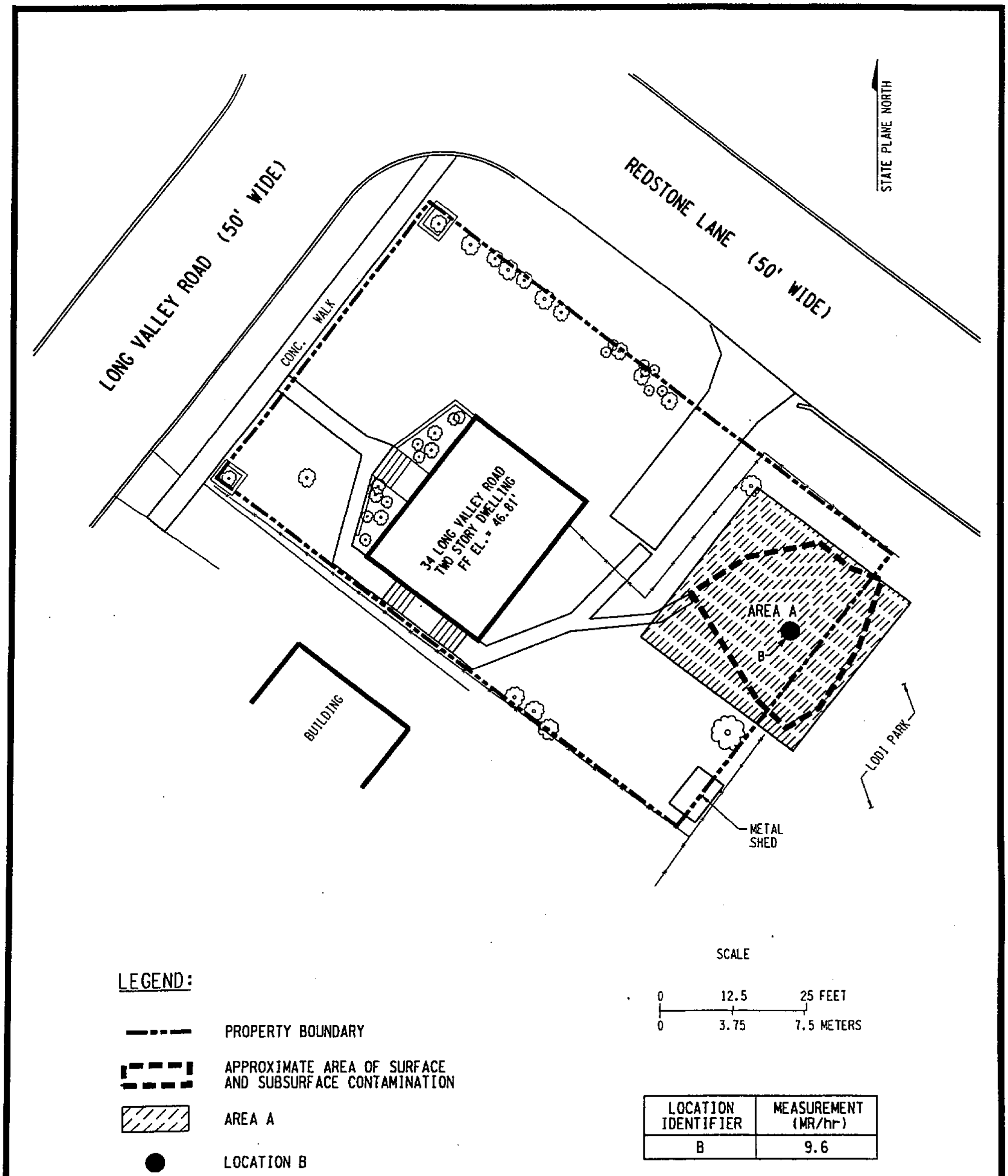
Figure 4-7
Assumed Area of Surface and Subsurface Contamination
34 Long Valley Road



AREA	COMPOSITE SAMPLE ID	Th-232 (pCi/g)		Ra-226 (pCi/g)		U-238 (pCi/g)		SUM-OF-RATIOS
		RESULT	ERROR +/-	RESULT	ERROR +/-	RESULT	ERROR +/-	
A	MVP 0028	0.66	0.04	0.56	0.02	<1.75		-0.119
A	MVP 0029 (DUP)	0.69	0.04	0.55	0.03	<1.96		-0.111

F:\DGN\138\138F294.DGN
12 DEC 97

Figure 4-8
Areas of Excavation and Post-Remedial Action Samples
34 Long Valley Road



LOCATION IDENTIFIER	MEASUREMENT (MR/hr)
B	9.6

F:\DGN\138\138F295.DGN
12 JAN 98

Figure 4-9
PIC Readings
34 Long Valley Road

5.0 POST-REMEDIAL ACTION STATUS

Analytical results of post-remedial action surveys indicate that the levels of radioactivity in the remediated areas are in compliance with applicable DOE cleanup guidelines for radioactive contamination. Chemical contamination was not detected by analysis of soil samples conducted by EPA Region II. The IVC reviewed the post-remedial action surveys and results to determine whether the radiological measurements confirm that these areas comply with the guidelines established for the site.

The IVC is responsible for preparing a plan outlining the procedures used in conducting verification activities. These procedures specify a verification process requiring two methods of review (Types A and B). The IVC conducted both types, in full conformance to the approved verification plan.

Type A verification consists of reviewing the post-remedial action survey results and collecting and analyzing additional samples as required. To perform the Type B verification review, the IVC conducted a site survey that included direct radiological measurements, review of the post-remedial action survey methods and results, sampling, and laboratory analysis of separate soil samples.

After completing the verification study, the IVC will report its findings and recommendations to the USACE New York District office. USACE will review the report to verify that the remedial action was successful. The IVC's published verification report will then become part of the CERCLA Administrative Record file for the Maywood site.

6.0 REFERENCES

Bechtel National, Inc. (BNI), 1992. *Remedial Investigation Report for the Maywood Site, Maywood, New Jersey*, DOE/OR/21949-337, Oak Ridge, Tenn. (December).

BNI, 1996. "FUSRAP Post-Remedial Action Survey Plan," CCN 144856, Oak Ridge, Tenn. (August).

BNI, 1997a. "IOM-1997 Volume Shipped from 5 Shady Lane, 7 Shady Lane, 34 Long Valley Road, and Lodi Park, Maywood VPs," 138-IOA-GET-00059 (November).

BNI, 1997b. "FUSRAP Data Transmittal," ET-SNJ97-042-138 (December).

BNI, 1997c. "FUSRAP Data Transmittal (#SNJ97-023 and #SNJ97-024)" (August).

U.S. Department of Energy (DOE), 1990. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, Washington, D.C. (June).

DOE, 1994. "DOE Acceptance of EPA's Proposed Cleanup Levels," Letter from J. La Grone to W. Muszynski (April 13).

Shleien, B., 1992. *The Health Physics and Radiological Health Handbook*, Revised Edition, Scinta Inc., Silver Spring, Maryland.

APPENDIX A

RADIATION AT A GLANCE

RADIATION AT A GLANCE

Of all activities at FUSRAP sites, those associated with radiation receive the most attention. What exactly is radiation and where does it come from? To answer these questions, it is best to start with a few basics.

All matter is made up of extremely small particles called atoms. Atoms contain even smaller particles called protons, neutrons, and electrons. When an atom has a stable mix of protons and neutrons, it is nonradioactive. However, when atoms have too many of either protons or neutrons, these unstable atoms can break apart, or decay, in an attempt to become stable. As atoms decay, energy is released; this released energy is called radiation.

Sources of Radiation

Radiation originates from natural events that happen all the time, but it can also be made by man. Most of the radiation people are exposed to occurs naturally. It has always been present, and every person who has ever lived has been exposed to radiation. Although modern technology may seem to have greatly increased the exposure rate, this is not necessarily the case. Exposure to man-made radiation varies greatly based on a given individual's lifestyle choices and medical treatments.

Sources of natural or background radiation include internal radiation from food (we all have approximately 500,000 atoms disintegrating in our bodies every minute), cosmic radiation from the sun and from outside the solar system, and terrestrial radiation from rocks, soils, and minerals. People have no control over the amount of natural radiation around them, and the amount of natural radiation stays about the same over time. The natural radiation present in the environment today is not much different than it was hundreds of years ago. In general, over 80 percent of the radiation the average person is exposed to is from natural sources. Man-made radiation accounts for less than 20 percent of the total; most of it is from medical procedures.

Man-made sources of radiation include consumer products, medical procedures, and the nuclear industry. Some consumer products such as smoke detectors and even porcelain dentures contain radioactive elements. Probably the best-known source of man-made radiation is nuclear medicine. For example, to conduct a brain, liver, lung, or bone scan, doctors inject patients with radioactive compounds and then use radiation detectors to make a diagnosis by examining the resulting image of the organ.

Man-made radioactive materials also include cesium-137 and strontium-90, present in the environment as a result of previous nuclear weapons testing. As with background radiation, exposure to other sources of radiation varies greatly depending on individual choices, such as smoking tobacco products (polonium-210) and eating certain foods (bananas contain potassium-40).

Levels of Radiation

The average dose caused by background radiation varies widely. In the United States, the average is about 300 mrem/yr; some people in other parts of the world receive a dose more than four times this amount. For example, in some areas of Brazil, doses to inhabitants can be more than 2,000 mrem/yr from background radiation. These wide variations are the result of several factors, most notably the types and amounts of radionuclides in the soil.

This diversity in background radiation is responsible for the large differences in doses. Because people live in areas with high levels of background radiation without proven harm, it is assumed by most in the scientific community that small variations in environmental radiation levels have an inconsequential effect, if any, on humans.

Measuring Radiation

To determine the possible effects of radiation on the health of people and the environment, these effects must be measured. More precisely, the potential for radiation to cause damage must be ascertained. Measurements of these potential effects are derived from the activity of each isotope and are expressed in terms of the absorbed dose to an individual and the effective dose or potential to cause biological damage.

Activity

When we measure the amount of radiation in the environment, what is actually being measured is the rate of radioactive decay, or radioactivity, of a given element. This radioactivity is expressed in a unit of measure known as a curie (Ci). A curie is a measure of radioactivity, not a set quantity of material. More specifically, one curie equals 37,000,000,000 (3.7×10^{10}) radioactive disintegrations per second. One gram of a radioactive substance may contain the same amount of radioactivity as several tons of another radioactive substance. For example, one gram of tritium (a radioactive form of hydrogen) emits about 10,000 Ci, while one gram of uranium emits about 0.000000333 (333×10^{-9}) Ci. Because the levels of radioactive contamination at most FUSRAP sites are very low, the picocurie is commonly used in reporting contaminant levels. One picocurie is equal to 1×10^{-12} curies. Contaminants in water are reported in picocuries per liter (pCi/L), and contaminants in soil are reported in picocuries per gram (pCi/g).

Absorbed Dose

The total amount of absorbed energy per unit mass as a result of exposure to radiation is expressed in a unit of measure known as a rad. However, in terms of human health, it is the relative effectiveness of the absorbed energy in causing biological damage that is important, not the actual amount of energy absorbed.

Dose Equivalent

The absorbed dose needed to achieve a given level of biological damage is different for different kinds of radiation. To allow for the different biological effectiveness of different kinds of radiation, the concept of dose equivalent is used. The dose equivalent is the product of the absorbed dose and a dimensionless quality factor. The unit of dose equivalent is called the rem (roentgen-equivalent-man). A rem is a fairly large dose; therefore, the most common unit of dose equivalent is the millirem (mrem), or 1/1,000 of a rem. Table A-1 describes some potential health effects over a wide range of radiation doses.

Table A-1

Comparison and Description of Various Dose Levels

Dose	Description
1 mrem	Approximate daily dose from natural background radiation, including that from radon.
2.5 mrem	Cosmic dose to a person on a one-way airplane flight from New York to Los Angeles.
4 mrem	Annual exposure limit set by EPA from manmade radiation in drinking water.
10 mrem	Typical dose from one chest X-ray using modern equipment.
10 mrem	Annual exposure limit, set by EPA, for exposures from airborne emissions (excluding radon) from operations of nuclear fuel cycle facilities, including power plants, uranium mines, and mills.
25 mrem	Annual exposure limit set by EPA from low-level waste-related exposures.
65 mrem	Average yearly dose to people in the United States from man-made sources.
60-80 mrem	Average yearly dose from cosmic radiation to people in the Rocky Mountain states.
83 mrem	Estimate of the largest dose any offsite person could have received from the March 28, 1979, Three Mile Island nuclear accident.
100 mrem	Annual limit of dose from all DOE facilities to a member of the public who is not a radiation worker.
110 mrem	Average occupational dose received by United States commercial radiation workers in 1980.
170 mrem	Average yearly dose to an airline flight crew member from cosmic radiation.
300 mrem	Average yearly dose to people in the United States from all sources of natural background radiation.
900 mrem	Average dose from a lower-intestine diagnostic X-ray series.
1,000–5,000 mrem	EPA's Protective Action Guidelines state that public officials should take emergency action when the dose to a member of the public from a nuclear accident is likely to reach this range.
5,000 mrem	Annual limit for occupational exposure of radiation workers set by the U.S. Nuclear Regulatory Commission and DOE.

8,000 mrem	Average yearly dose to the lungs from smoking 1½ packs of cigarettes per day.
10,000 mrem	The fifth National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation (BEIR V) report estimated that an acute dose at this level would result in a lifetime excess risk of death from cancer, caused by the radiation, of 0.8 percent.
25,000 mrem	EPA's guideline for voluntary maximum dose to emergency workers for non-lifesaving work during an emergency.
75,000 mrem	EPA's guideline for maximum dose to emergency workers volunteering for lifesaving work.
50,000–600,000 mrem	Doses in this range received over a short period will produce radiation sickness in varying degrees. At the lower end of this range, people are expected to recover completely, given proper medical attention. At the top of this range, most people will die within 60 days.